ICIC Express Letters
Part B: Applications
Volume **13**, Number **10**, October **2022**

 ISSN 2185-2766
pp. **1037–1044**

THE EXPANDING ROLE OF METAVERSE PLATFORM IN COLLEGE EDUCATION

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Received February 2022; accepted April 2022

Abstract. *With the widespread of COVID-19 pandemic globally, education environment has been changed from face-to-face to online education with physical distance. The classroom could be moved anywhere from the brick building to ubiquitous place and mobile tools with virtual and augmented reality. The metaverse allows students to fashion a world where they can interact as avatars or digital characters while participating in a host of activities. This paper tries to find the feasibility of applying the metaverse platform in college education in the pandemic environment. A thorough review has been attempted for the state of the art of educational metaverse. Based on the research framework of metaverse platform, two types of implementation have been attempted. The first one is hardware-based extended reality studio for media and broadcasting. The second one is software-based virtual and augmented reality. Using Zepeto, a metaverse classroom is created, and actual activities for teaching and learning have been tried among classroom avatars. By using the metaverse platform in the online education, student's satisfaction has been increased through active interaction and communication via avatars.*
Keywords: Metaverse, Education medium, Pandemic, Extended reality, Mixed reality, Virtual reality, Augmented reality, Avatar

1. **Introduction.** The impact of the COVID-19 pandemic has caused major disruptions and impacts in most areas of our life including the education sector. This disruption led to online education hastily emerging as an important new platform, such as Zoom and Google classroom. Among the significant changes, one of the positive impacts in education is that educators and students can shift from one-way delivery of knowledge to collaborative learning system. By adopting new ICT technology in education platform, education tailored to students' individual levels will not only help them accumulate knowledge but improve their ability to use it.

Recently, online learning techniques and methods have been improved dramatically, but it does not replicate face-to-face or physical interaction that students can experience in the conventional classroom environment. This has compelled educators to find more creative teaching methods to facilitate a more effective and authentic interaction. As a result, more innovative technologies utilizing Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR) to foster more interactive teaching and learning experiences have been emerged.

Facebook has rebranded itself as Meta in an attempt to own the metaverse, a concept for a 3D version of the Internet that a number of companies are working on [1]. In the metaverse, the term 'meta' means beyond and 'verse' refers to the universe. In theory,

DOI: 10.24507/icicelb.13.10.1037

the metaverse will allow users to move in between spaces, allowing them to navigate and explore the learning space while immersing themselves in the subject matter [2].

In recent years, the term has grown beyond Stephenson's 1992 vision of an immersive 3D virtual world, to include aspects of the physical world objects, actors, interfaces, and networks that construct and interact with virtual environments. The metaverse is the convergence of 1) virtually enhanced physical reality and 2) physically persistent virtual space. It is a fusion of both, while allowing users to experience it as either [3].

In this respect, the concept of metaverse is very similar to Digital Twin (DT). DT refers to a digital replica of physical assets, processes and systems that can be used for various purposes. The digital twin concept model contains three main parts: a) physical products in real space, b) virtual products in virtual space, and c) the connections of data and information that ties the virtual and real products together [4].

The DT may enable companies to solve physical issues faster by detecting them sooner, predict outcomes to a much higher degree of accuracy, design and build better products, and, ultimately, better serve their customers. With this type of smart architecture design, companies may realize values and benefits iteratively and faster than ever before [5].

In the pandemic situation where online education was not revitalized, instructors in charge of convergence subjects had difficulty in developing online class materials, and students' satisfaction with the classes was not high.

Main contributions and innovations of this research are utilizing metaverse platform in college education improvement. While the metaverse may be able to bring us virtual reality and experiences beyond what we can imagine, it will also have many uses in creating exact replications of reality. Thus, any change in the physical world is reflected in the digital representation and feedback sent in the other direction.

The purpose of this research is to propose metaverse platform used in college education in this corona pandemic environment. For this purpose, the state of the art for the metaverse platform for education is surveyed in Section 2. Section 3 proposes the methods for this research. Section 4 presents the application of metaverse platform in real education environment. Conclusions and further research directions are discussed in final section.

2. **Literature Review.** Exploring the educational applicability of metaverse-based platform is proposed in Jeon and Jung [6]. The metaverse-based platform was approached from the perspective of the online education ecosystem, which means that not only online teaching and learning activities but also holistic educational activities such as learning, communication, and empathy are performed within the metaverse.

In order to overcome the limitations of existing online shopping, combining live commerce with metaverse using digital twin technology is proposed by Jeong et al. [7]. It is an innovative business model of a new electronic commerce platform.

Virtual worlds are defined as various concepts as the following [8].

- Shared space: Many users can participate at once.
- GUI: Virtual worlds depict space visually, ranging in style from 2D "cartoon" imagery to more immersive 3D environments.
- Immediacy: Interaction can take place in real time.
- Creativity and interaction: Virtual worlds allow users to alter, develop, build, or submit customized content.

According to the problem domain, the appropriate concept for the virtual world can be adopted for the problem-solving.

The effectiveness of online education during COVID-19 pandemic is proposed by Butnaru et al. [9]. It analyzes students' perceptions regarding the effectiveness of online education in a period when this type of education is the only available option.

Jean investigated the present condition of distance learning in domestic universities for effective distance learning in the coming era of metaverse by emphasizing the interaction and communication between instructors and learners through an analysis of distance learning of a convergence subject [10].

Upon reviewing previous research papers, a metaverse platform applied for college education is highly required considering present's severe pandemic situation.

3. **Methods.** In order to enhance the effects of education, many types of approaches have been tried in the area of pedagogy and education engineering. Introduced by Dale in his textbook on audio-visual methods in teaching [11], the Cone of Experience is a visual device meant to summarize Dale's classification system for the varied types of mediated learning experiences (Figure 1). Dale theorized that learners retain more information by what they 'do' as opposed to what is 'heard', 'read' or 'observed'. The bottom of the Cone represented "purposeful experience that is seen, handled, tasted, touched, felt, and smelled".

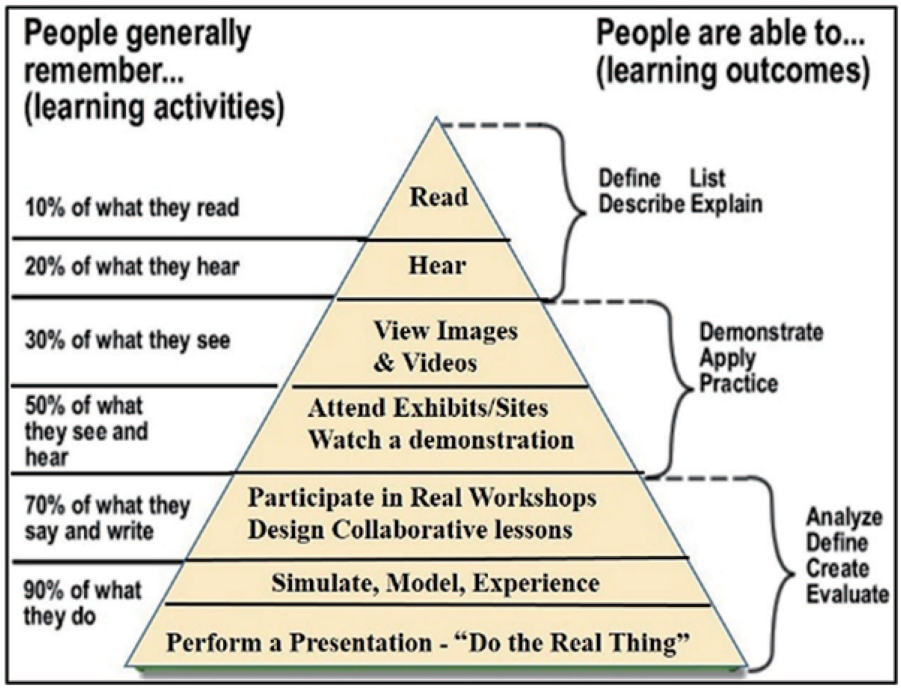

FIGURE 1. Cone of learning example from Wikipedia (Dale [11])

Following Dale's theory, utilizing metaverse framework in the online class under pandemic environment seems reasonable.

In order to implement MR or eXtended Reality (XR), immersive media can be adopted that blends computer generated content with the physical environment, creating a sense of immersion and stimulating the human senses through interactive multimedia. For instance, VR aims to occlude the physical environment. In contrast, AR may involve overlaying content upon the physical world [12]. Digital twin is a digital replica of physical object. Figure 2 shows the virtuality continuum with various modes on a scale including AR, VR and DT.

In the metaverse roadmap, metaverse combines four categories: AR, mirror world, lifelogging (the act of recording one's daily life with a portable camera or digital device), and virtual world [3]. To construct a metaverse model, four quadrants are proposed according to the spectrum of technologies and applications. In the technology spectrum, augmentation and simulation are proposed, and internal and external views are proposed for the application area. This is shown in Figure 3.

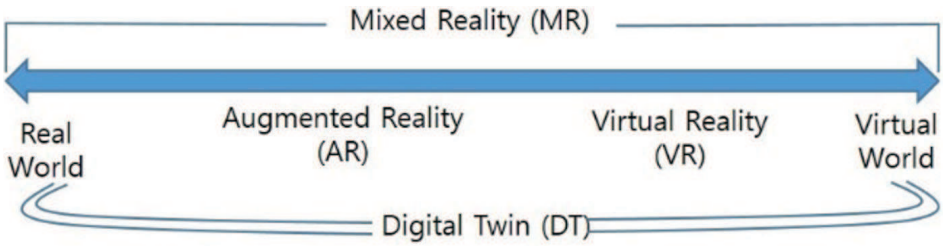

FIGURE 2. Continuum of mixed reality

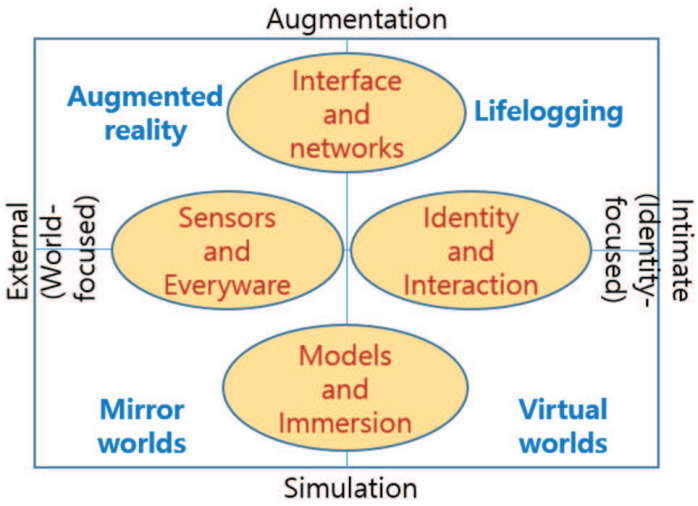

FIGURE 3. Metaverse framework scenario [3]

'Augmentation' refers to technologies that add new capabilities to existing real systems. 'Simulation' means technologies that provide simulated worlds as the locus for interaction. 'Intimate technology' is focused inwardly, on the identity and actions of the individual or object; in the Metaverse context, either through the use of an avatar/digital profile or through direct appearance as an actor in the system. 'External technology' means technologies that provide information about and control of the world around the user.

Since 2003, people have been gathering to do all of the above in the online world of Second Life by Linden Lab. In Second Life, there are no goals or objectives. Instead, users create a digital avatar to represent them and are then free to explore the world, meet other users, create their own digital content and even trade goods and services in the in-world currency, the Linden Dollar [13].

Metaverse-based platform is adopted for creating easy game and small business creators. Four major metaverse platforms which are popular of global usage are summarized in Table 1. It is surprising that almost half of teenagers in US are playing with the Roblox.

Upon surveying relevant resources, the research framework is proposed as Figure 4. Recent corona pandemic and global learning paradigm motivated remote and e-learning decades ago. Based on the 'Cove of learning' theory, learner's active participation is highly recommended for memory recall and satisfaction. This stimulates huge interests of metaverse in education, society and IT business, etc. Within metaverse, we will focus on XR, AR and VR. With the component perspective, hardware and software are major parts. Hardware equipment is very expensive to implement. As software costs less or free, students can build metaverse project using software platform. Thus, in the implementation stage, hardware system is constructed for broadcasting studio, and software use case with AR and VR is created as a class project.

TABLE 1. Four major metaverse platforms

Platform	Contents	Users (Players)	
Roblox	Create your virtual world and play game and make money	202 mil (2021)	
Fortnite	Free-to-play Battle Royale game with numerous game modes for every type of game player	80 mil (2020)	
Minecraft	3D sandbox video games (Lego block) Release 2011	131 mil (2020)	
Zepeto	Social media app that lets you create a 3D digital character (called a Zepeto)	200 mil (2021)	

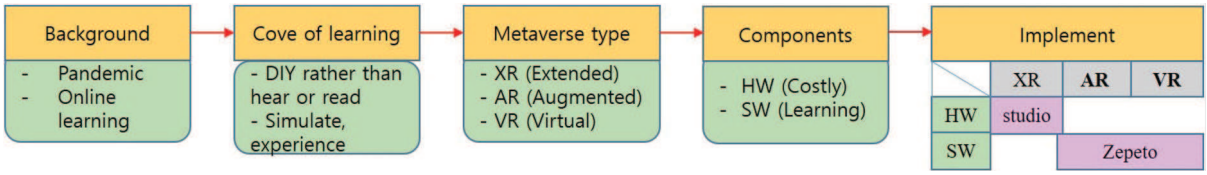

FIGURE 4. Research framework

4. **Implementation.** Metaverse applications are tried to implement in two directions. The first one is XR part for implementing broadcasting studio. The second one is metaverse based classroom creation using Zepeto platform.

4.1. **XR use case for broadcasting class.** XR is a culmination of the spectrum of immersive realities including VR, AR, and MR as shown in Figure 2. XR becomes an extension of the physical environment for students through using human-machine interactions. The distinctions between the real and virtual world are blurred beyond recognition.

XR applications allow researchers to experiment with design concepts and design solutions in mixed-reality environments. XR applications in engineering, game, media and broadcasting are limited mainly due to primitive AR and VR technologies.

A brief XR system architecture for broadcasting studio is composed of XR controller, LED system, networking, and real stage. The XR controller connects 3D simulation, VR and AR function in the real studio. VR and AR image are transferred into LED system, which are fed back to real studio with virtual reality in the physical stage. This concept is shown in Figure 5.

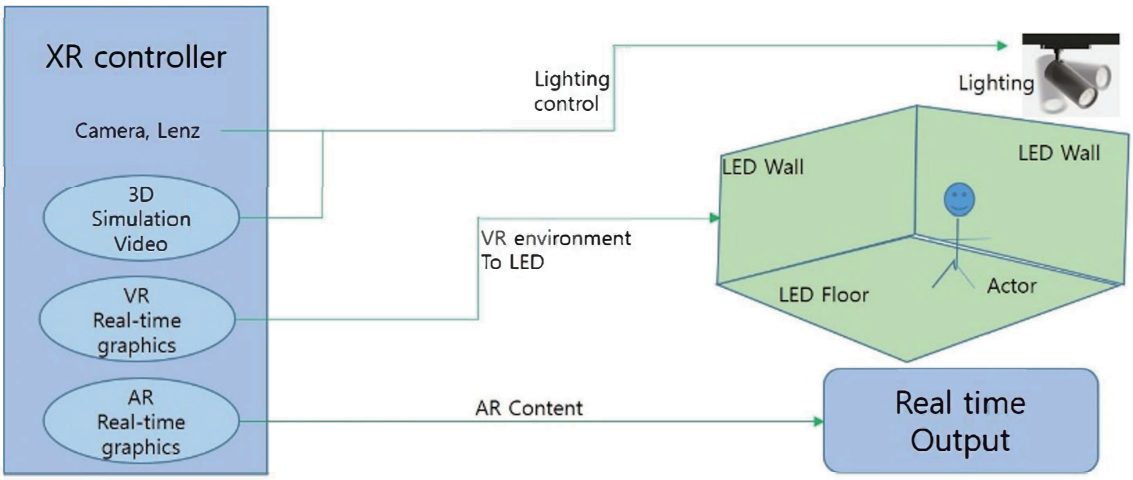

FIGURE 5. XR concept architecture for live broadcasting

XR studio configuration XR studio demonstration for broadcasting

FIGURE 6. XR studio configuration and demonstration

Figure 6 (left) shows XR studio configuration and, right figure shows real studio implementation with virtual reality. For laboratory hour in related subject, student can implement XR video production as a class project.

4.2. **Metaverse use case for e-learning.** For the implementation of metaverse for class teaching, software project creating VR and AR has been assigned to the students. As a class project, university building is constructed using metaverse platform, Zepeto. Inside the building, many components and activities are added in order to enhance user experience.

In the project, student constructed university buildings and PR room shown in Figure 7. After the project is finished, it is available in the cloud, and all students can enter to the cyber university with their avatars. In the PR room, all information about Industrial Engineering is provided not only visual but also verbal explanation by student avatar to incoming visitor. Also, in the reception room, virtual refreshments can be provided for the visiting avatar.

For the class, virtual classroom is created in the metaverse platform shown in Figure 8. Using Zepeto platform, all students have participated in the Zepeto project.

In the online teaching environment such as Zoom or Google classroom, the instructor has difficulty in recognizing student's real activity, nor interact with student with intimacy as face-to-face teaching. However, in the metraverse classroom environment, all students create their own avatar, and during class hour, each avatar sits on his/her seat. Instructor can interact with the student's avatar for talking, discussion and interaction. In the metaverse environment, it is proved that students can be very attentive when their avatars interact with teacher's avatar in classroom.

University building

PR room (Industrial Engineering Program)

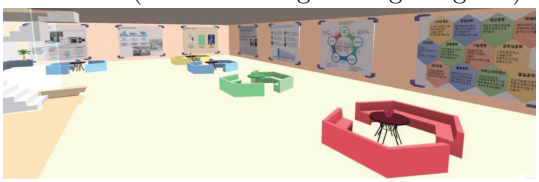

FIGURE 7. University building and PR room using metaverse platform, Zepeto

A big lecture hall and instructor (Avatar)

Classroom design with Avatars

FIGURE 8. Classrooms created in the metaverse platform, Zepeto

Compared to face-to-face class, online class under pandemic lacks in student attention, participation, active Q&A, and immersion, etc. If we adopt the metaverse platform in online education, the weakness of online education can be supplemented in some level.

5. **Conclusions.** The use of metaverse platform in college education may enhance active participation in the class, immersion, promotion of student interaction, higher customization, increased creativity, high motivation and engagement. Also, it can extend traditional learning by offering experiences that would otherwise be very difficult. In this paper, metaverse role has been reviewed in many respects. For the implementation, XR studio for broadcasting and classroom with avatar have been constructed and tested. The former is hardware dependent with high cost and the latter is software oriented.

The following could be suggested for a further research. In this paper, we have presented a simple use case of XR studio and classroom creation. According to the framework in this paper, more intensive and practical platform of metaverse needs to be developed which can be used in e-learning purposes.

Acknowledgment. This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (No. 2020R1I1A306844111).

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