Chapter 14

How Metaverse—Virtual Reality—Can Facilitate the Emergency Remote Teaching

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A. Social Contagion toward Technology Adoption Behaviour

21st-century technological advances have entered various aspects of life, including education. Technology changes the field of education, including objectives, contexts, processes, teaching, and policy (Burbules et al., 2020). In addition, viral contagion, such as the COVID-19 pandemic, has also created a social contagion regarding technology adoption behavior toward digital technologies across all sectors (George et al., 2020). The rapid technological advance during the pandemic is due to the requirement for all education stakeholders to utilize technology to keep the learning process going. For example, laboratory activities that are important for science courses (Blocken, 2015; Tobin, 1990) and the significance in teaching and learning phys-

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ics (Hanif et al., 2009) must be carried out through various alternative limited activities, such as the use of virtual laboratories, traditional online course materials, synchronous and asynchronous discussions, and the reliance on question banks for online exams (Brown & Krzic, 2021).

Because of the pandemic, online learning has become the most popular option. Pandemic has significantly impacted education; fully online classes held in almost all schools and universities have become a new requirement (Dwivedi et al., 2020). Online learning also has been widely promoted to replace traditional face-to-face learning during the COVID-19 pandemic (Dong et al., 2020). However, the sudden adaptation of the whole online learning procedure also appears as a big challenge, particularly in some developing countries facing policy paralysis. This phenomenon occurs due to the lack of capacity, technical infrastructure, academic competency, and resource availability to manage educational planning, management, and organization during the pandemic (Mishra et al., 2020).

Many researchers have shared their teaching solutions during COVID-19, for example, using emergency online learning at a higher educational level (Aguilera-hermida, 2020), utilizing gamification in the remote laboratories during food engineering courses (Debacq et al., 2020), and creating problem-solving videos for the chemical engineering exam (Ripoll et al., 2021). Some researchers also suggest accelerating the learning process and improving after a pandemic because the crisis due to COVID-19 on education will leave a permanent mark (Daniel, 2020). Consequently, regarding the new academic year [after the pandemic], the university's management must implement efficient measures to tackle these negative issues as much as possible and improve learning performance (Radu et al., 2020).

Face-to-face learning remains the primary class modality, but online and blended learning environments are mostly recognized as effective as face-to-face in increasing students' knowledge (Rivera, 2016). It has been proven that there is no significant difference between distance education and face-to-face education. Because it

was regarded to have the same objectives, a new term emerged to combine the two: blended learning (Klentien & Wannasawade, 2016). By combining virtual and face-to-face learning methods, it is hoped that it can enrich students' knowledge so that they can learn not only to deal with a COVID-19 pandemic crisis but also to face the future emergency remote teaching environments.

Metaverse is a new term coined by the founders of Facebook to refer to the next level of social interaction in virtual space. Many technologists agree that the metaverse is the next level of augmented reality (AR) and virtual reality (VR) technologies. Many studies prove their strengths in facilitating the cognitive capacity of humans to experience learning (Daniela & Lytras, 2019) and enhance digital-age literacy, creative thinking, communication, collaboration, and problem-solving ability, which constitute the so-called twenty-first-century skills that are necessary to transform information rather than merely receive it (Papanastasiou et al., 2019), especially those that involve abstract concepts (Edwards et al., 2019).

This chapter discusses the possibilities of learning using metaverse, focusing on metaverse as virtual reality. With the metaverse development, it is necessary to further study the metaverse potential in facilitating remote learning needed in various emergencies. It is not impossible; pandemics, epidemics, and possible problems that encourage educators to implement remote learning will happen again. COVID-19 is predicted not to be the last disease to take advantage of current global conditions; thus, such preparation is needed, including enhancing the integration and effectiveness of the emergency management systems through education (Iserson, 2020). Therefore, preparing and knowing the potential media to improve the learning process during an emergency must be studied.

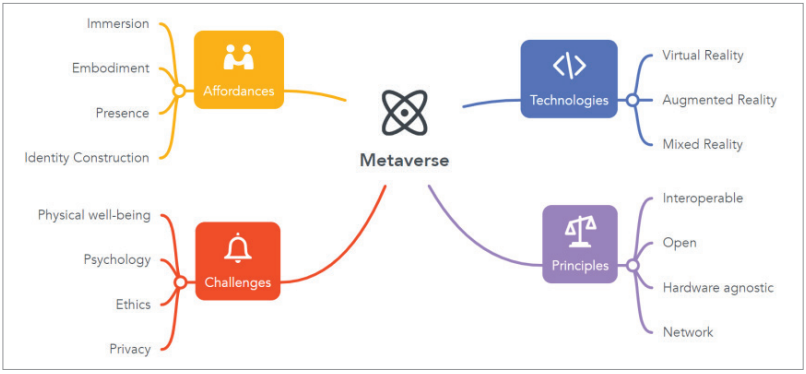
B. Metaverse to Facilitate Emergency Remote Teaching

Technology is vital in communicating efficient learning (Toquero, 2020). In addition, innovative virtual learning methods provide

positive experiences for students to support the implementation of the teaching and learning process during the COVID-19 pandemic.

1. Metaverse

A metaverse is a 3D virtual part that combines the real world into a virtual world with an avatar as a representative display so that it looks real and users can interact with each other (Lee, 2021). Metaverse is not new; the term metaverse was introduced in 1992 in Neal Stevenson's science fiction novel Snow Crash (Mystakidis, 2022). Metaverse has four main dimensions, as shown in Figure 14.1 below.



Source: Mystakidis (2022)

Figure 14.1 The Main Dimension of Metaverse

The technology in the metaverse includes virtual reality (VR), Augmented Reality (AR), and Mix Reality (MR), which have been widely developed into learning devices. The distance learning model adopted into the metaverse enables a good learning experience (Mystakidis, 2022); online learning in the metaverse will reach both formal and non-formal learning.

Classroom learning that interacts between educators and students can be carried out simultaneously in a virtual space. Online learning can be done through conference platforms that refer to web 2.0, such

as WebEx, Zoo, Microsoft Team, Meet, and Skype (Mystakidis, 2022). More advanced, the next generation of web 3.0 (i.e., metaverse) offers more real interaction (Zahabi & Abdul Razak, 2020) so that learning can be delivered effectively.

2. Virtual Reality

Along with its development, virtual reality will be suitable to become the leading in the development of learning in the pandemic era, which enables the learning process done despite limited circumstances and geographical distance (Owusu-Fordjour et al., 2020; Silva et al., 2020). Virtual reality is a breakthrough that can carry out online activities remotely (Toquero, 2020).

In Education, virtual reality can reach students' experience in an actual virtual world (Serin, 2020). With virtual reality in education, online learning amid a pandemic can be done with a more authentic approach. In addition, VR plays an essential role in teaching methods, thus providing an excellent and exciting approach to getting information (Alfarsi et al., 2020).

3. Emergency Remote Teaching

The pandemic negatively impacts students' learning process because many are not used to learning effectively, so they are required to carry out learning in such an emergency (Silva et al., 2020). The pandemic has forced many restrictions on human interaction and the learning process, interfering with students' ability to understand their lessons (Erduran, 2020).

Many technologies are used on the internet, and each has different features, methods, and protocols, but the easiest to use is the web (Jacksi & Abass, 2019). Amid limited access to classes, a video conferencing platform of limited web 2.0 along with the development of web technology continues to experience growth. Hence, it is easier for the users to access it. The third version of the web or web 3.0 is executable for users to interact with dynamic applications (Jacksi

& Abass, 2019) thus, allows users to interact directly despite a long distance.

C. Implementing Metaverse in Learning Process

In learning a virtual reality, teachers need to design instructional that provide students to learn "with virtual reality, not from virtual reality" and merge constructivism with educational technology. Constructivism is founded on the idea that learning is an active exploration process from multiple perspectives, resulting in knowledge being constructed from a personal interpretation of the experience (Jonassen et al., 1998). VR has long been known through very complex tools and is used only for research purposes developed in 1993 using prototype VR devices of large sizes and not compatible to solve many misconceptions that physics students often occur (Loftin et al., 1993). Then, VR became widely known since the commercial Cardboard Generation was on the market[1].

1. Blended Learning and Virtual Reality

Learning with a blended learning method positively impacts students' way of thinking (Klentien & Wannasawade, 2016). Every strength of student learning activities obtained through face-to-face learning directly or virtually will cover the shortcomings of any types of learning that have been done previously (Gumilar et al., 2019; Klentien & Wannasawade, 2016). Blended learning has an essential role in the development process of students so that collaborators between virtual and face-to-face learning can provide additional knowledge to students. Blended classes or blended learning methods have advantages in learning experiences (Gumilar et al., 2019). The combined learning method can also positively respond to students' learning process, which is recognized as a good and effective method (Harahap et al., 2019; Sullivan et al., 2017).

[1] Supporting data of this study are available at https://doi.org/10.17605/osf.io/5tm87, and further data can be accessed on request from corresponding author Nur Ichsan Sumardani at ichsan.sumardani@gmail.com

Moreover, the latest technology utilization makes a breakthrough in learning methods (Allcoat et al., 2021; Klentien & Wannasawade, 2016; Zilka et al., 2019) so that learning can be delivered optimally both in face-to-face and virtual learning. Along with the development of virtual learning experiencing growth and direct face-to-face learning, which seem stagnant, educators must provide fundamental understanding to students in both ways. The virtual environment allows students to enhance the exploratory learning process (Zilka et al., 2019). Therefore, it must be ensured that this method aligns with the pedagogical implementation through the alignment of blended classes (Rivera, 2016).

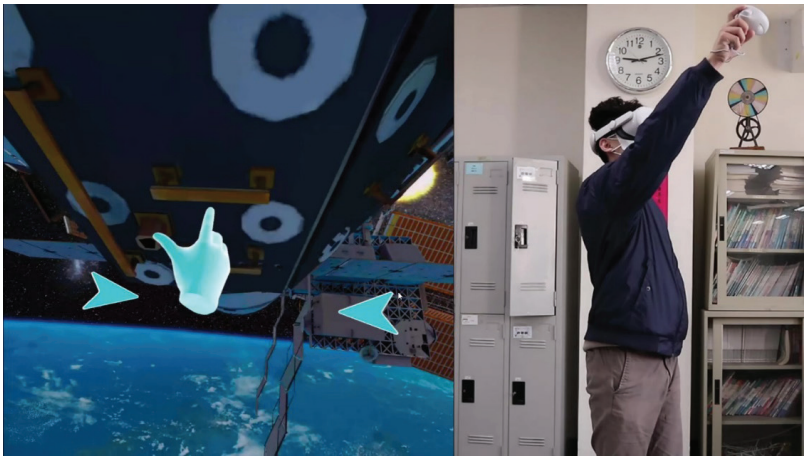
Blended learning is an educational strategy that has grown and improved exponentially during the COVID-19 pandemic (Papadimitropoulos et al., 2021). Virtual representations can be used in cases where academic lessons must be replaced with online learning due to limitations (Calderón et al., 2021). Blended learning encourages students to study the material before class to ensure understanding and active participation in the learning process (Kuroki & Mori, 2021). Some universities use online experiments and do some online learning platforms (Andrews et al., 2020; Clark et al., 2021). However, some negative aspects were reported: lack of adequate infrastructure for some students, less effective teacher-student communication and interaction, the impossibility of performing practical applications, lack of socialization, lack of learning motivation, less objective examination (e.g., the possibility of cheating), the possibility of physical and mental health degradation (e.g., too much time spent in front of screens, installation of a sedentary lifestyle) (Radu et al., 2020). The parents also generally have negative beliefs about the values and benefits of online learning (Dong et al., 2020).

Departing problems from online and blended learning during the pandemic (Dong et al., 2020; Radu et al., 2020), VR can be used as a solution to the problems of physical activities (Cao et al., 2021) and socialization (Aysina & Nesterova, 2019) (Figure 14.2). However, nowadays, educators do not widely use virtual reality as the primary modality of blended or online learning.

Source: VRChat (2019)

Figure 14.2 Meeting with other people [teachers] in the virtual world using VRChat

With distance learning being carried out during the pandemic, many VR developers have developed applications to support remote interaction, for example, Horizon Workrooms by Facebook, VRChat, and Multiverse by Future Tech Labs.



Source: Magnopus (2019)

Figure 14.3 Virtual laboratory with the hazardous situation in the virtual world using Mission ISS

Virtual reality can both facilitate distance learning and provide an authentic experience during a pandemic; for example, in the space station (Figure 14.3), these materials can be transferred using virtual and physical learning to avoid danger in hazardous situations (Jelonek & Herrmann, 2019) without omitting the theories so that learning can be interrelated and complementary.

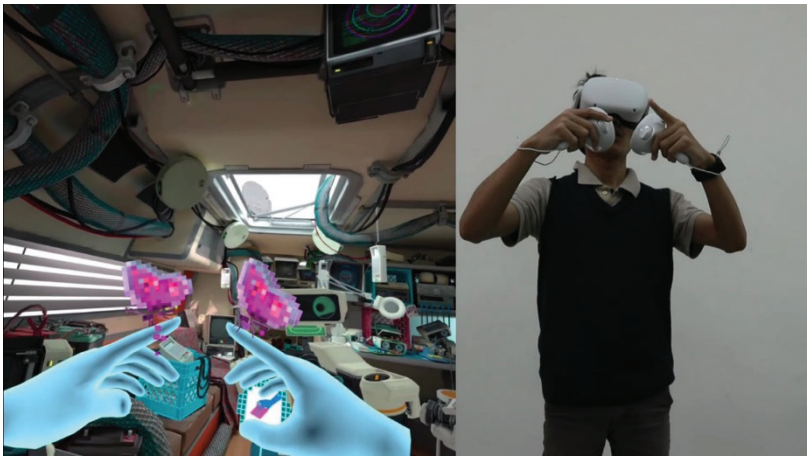
2. Virtual Reality in the Classroom

a. Normal classroom

The media facilitates knowledge transfer through communication between teachers and students during the learning process. According to mind and brain studies, the key findings from neuroscience and cognitive science are expanding knowledge of the mechanisms of human learning (National Research Council, 2000).

Many studies prove that learning through VR as visualization media can improve learning and student engagement (Allcoat & Mühlenen, 2018), create learning interactions (Wang et al., 2019), increase self-efficacy (Makransky et al., 2020), and concretize concepts (authenticity) (Yang & Goh, 2022). According to the cone of experience

(Dale, 1969), active learning, for example, performing an experiment and simulating a model of phenomena, can be remembered 90% of the material, in contrast to 10% if only reading a textbook. In this case, VR can simulate a model of the phenomena; for example, in one of the simulations, students can simulate how they experience in the space station or keep in touch with the environment (Figure 14.4).



Source: Fun Bits Interactive (2019)

Figure 14.4 Keep in touch with the environment

If face-to-face learning runs typically, VR can be used as a visualization medium to access dangerous experiments and experiments that cannot be done in the real world, such as laboratories in outer space, nuclear labs, investigating uranium, or exploring countries around the world. However, if students cannot use VR, for example, because of the high cost, VR also provides a casting feature to facilitate this problem so students can collectively see what someone is seeing in the virtual world. Although in the ideal learning process, it will be better to use one device for one person.

b. Emergency Classroom

Similar to today's hybrid learning approach, using VR in an emergency classroom enables teachers to meet students face-to-face and provide lessons to students who cannot attend class via live video conference simultaneously. Metaverse can be used similar to those hybrid learning approaches; for example, when Artur Sychov in TEDx Talks uses a VR suit to bring himself to exist in 2 worlds: the real space to meet face-to-face with the audience and the virtual space to meet with people in the metaverse, which is known as cross reality (TEDx Talks, 2021). Metaverse, in other words, is the next generation of live video conferences with the display of the physical body – not only showing people's faces but also existing the whole body in the virtual world – that other people can shake their hands (Figure 14.5).

Source: Oculus (2020)

Figure 14.5 Shake other people's hands in the virtual world

Although the collaboration between cross reality through virtual and physical worlds in the classroom has never been implemented, it is hoped that this method can be applied in emergency classes in the future. Notably, technological developments require teachers to

innovate, especially in strategies using appropriate and technology-based learning methods.

D. Recommendation and Implication

With the metaverse development, the possibilities of learning using metaverse technology are getting significant. Educators need to find all alternative learning process that has the potential to facilitate remote learning in case of emergencies. Learning from the history of the COVID-19 situation, educators need to be well-equipped in case of a disruption during the learning process. Thus, they can still manage to continue the activity.

With all the drawbacks of online learning, virtual reality –metaverse– has the potential to bridge distance learning experiences that are more beneficial. The definition of virtual reality and metaverse will significantly develop along with the development of the technology. Finally, educators are expected to use this technology in the classroom when face-to-face learning is allowed and during emergency learning.

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