

# Metaverse

Subjects: Computer Science, Artificial Intelligence

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The Metaverse is the post-reality universe, a perpetual and persistent multiuser environment merging physical reality with digital virtuality. It is based on the convergence of technologies that enable multisensory interactions with virtual environments, digital objects and people such as virtual reality (VR) and augmented reality (AR). Hence, the Metaverse is an interconnected web of social, networked immersive environments in persistent multiuser platforms. It enables seamless embodied user communication in real-time and dynamic interactions with digital artifacts. Its first iteration was a web of virtual worlds where avatars were able to teleport among them. The contemporary iteration of the Metaverse features social, immersive VR platforms compatible with massive multiplayer online video games, open game worlds and AR collaborative spaces.

Keywords: metaverse ; mixed reality ; virtual reality ; augmented reality ; extended reality ; virtual worlds ; multiuser virtual environments

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Computer Science innovations play a major role in everyday life as they change and enrich human interaction, communication and social transactions. From the standpoint of end users, three major technological innovation waves have been recorded centered around the introduction of personal computers, the Internet and mobile devices, respectively. Currently, the fourth wave of computing innovation is unfolding around spatial, immersive technologies <sup>[1]</sup>. This wave is expected to form the next ubiquitous computing paradigm that has the potential to transform (online) education, business, remote work and entertainment. This new paradigm is the Metaverse. The word Metaverse is a closed compound word with two components: Meta (Greek prefix meaning post, after or beyond) and universe. In other words, the Metaverse is a post-reality universe, a perpetual and persistent multiuser environment merging physical reality with digital virtuality. The term Metaverse was invented and first appeared in Neal Stevenson's science fiction novel *Snow Crash* published in 1992. It represented a parallel virtual reality universe created from computer graphics, which users from around the world can access and connect through goggles and earphones. A modern literary reincarnation of the Metaverse is the *OASIS*, illustrated in the 2011 science fiction novel *Ready Player One* authored by Ernest Cline. *OASIS* is a massively multiuser online VR game that evolved into the predominant online destination for work, education and entertainment. It is an open game world, a constellation of virtual planets.

The Metaverse is based on immersive technologies that enable multisensory interactions with virtual environments, digital objects and people. Extended Reality or Cross Reality (XR) is an umbrella term that includes a series of fundamental immersive technologies; electronic, digital environments where data are represented and projected. XR includes Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR). In all the above-mentioned XR facets, humans observe and interact in a fully or partially synthetic digital environment constructed by technology.

To understand the potential, it is useful to study the history of virtual media and the aforementioned technologies. VR usually brings to mind futuristic science fiction images and sophisticated hardware. However, it is essential to realize that VR is associated with procedures in the human brain that do not require any equipment. Humans can experience an alternate reality through imagination as a thought, fantasy or mind-wandering. In fact, virtual-world building is an essential part of the human experience from the primordial, distant first days of the human species.

Early VR technologies initially offered single-user experiences since networking computing was in its infancy. Computer networks allowed the ascension of collective, social non-immersive VR spaces named virtual worlds. A virtual world is a persistent, computer-generated networked environment where users meet and communicate with each other just they would in a shared space. Social, collective VR spaces enable the wider application of blended active learner-centered instructional design strategies such as problem-, project and game-based learning. Online learning in social VR allows the wider deployment of game-based learning methods. These motivation amplification methods include playful design, gamification and serious games that can be applied in the micro-, meso- or macro-level of an online course

The second iteration of the Metaverse is under construction where social, immersive VR platforms will be compatible with massive multiplayer online video games, open game worlds and AR collaborative spaces. According to this vision, users

can meet, socialize and interact without restrictions in an embodied form as 3D holograms or avatars in physical or virtual spaces. Currently, this is possible with several limitations within the same platform. Cross-platform and cross-technology meetings and interactions, where some users are in VR and others in AR environments, are the next frontier. Common principles of the Metaverse include software interconnection and user teleportation between worlds. This necessitates the interoperability of avatar personalization and the portability of accessories, props and inventory based on common standards.

Education is one crucial field for society and economy where core implementation methods remain unchanged and orbiting around content transmission, classrooms and textbooks despite numerous technological innovations [2]. Regarding online distance education, Metaverse has the potential to remedy the fundamental limitations of web-based 2D e-learning tools. Online learning is becoming increasingly mainstream especially in higher and adult, continuous education. The COVID-19 pandemic accelerated this trend by disrupting attendance-based activities in all levels of education. 2D asynchronous and synchronous e-learning platforms have the following limitations that impact education negatively:

- Low self-perception: Users experience a very limited perception of the self in 2D environments. They are represented as disembodied entities through a photo or a live webcam head shot feed with no personalization options.
- No presence: Web conferencing sessions are perceived as video calls to join rather than virtual collective meeting places. Participants in long meetings tend to lean out and be distracted.
- Inactivity: 2D platforms offer limited ways of interaction among participants. Unless instructors initiate a learning activity, students are confined to passive participation with few opportunities to act.
- Crude emotional expression: Users have very limited options to express their feelings through smileys and emojis.

All these limitations can be addressed with 3D, immersive spatial environments. Currently, there is an intense race to construct the infrastructure, protocols and standards that will govern the Metaverse. Large corporations are striving to construct their closed, proprietary hardware and software ecosystems so as to attract users and become the de facto Metaverse destination. Different systemic approaches and diverging strategies collide around concepts such as openness and privacy. Related risks can be classified into four categories related to (i) physical well-being, health and safety, (ii) psychology, (iii) morality and ethics and (iv) data privacy. The outcome of this race will determine the level of users' privacy rights as well as whether the Metaverse will be inclusive to students and school pupils. Both issues have important implications for education as they will determine if the Metaverse can become mainstream in e-learning. The aim of this article is to raise awareness about the origin and the affordances of the Metaverse, so as to formulate a unified vision for meta-education, Metaverse-powered online distance education.

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