

Education lands in the Metaverse: Opportunities and Risks

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A metaverse is defined as "A maximally scalable and interoperable network of real-time rendered 3D virtual worlds that can be experienced synchronously and persistently by an effectively unlimited number of users with an individual sense of presence within them, and that ensure continuity of data regarding identity, history, objects, communications and payments." So, the metaverse is based on virtual worlds understood as any simulated, computer-generated environment in which users can act through various interaction devices such as a simple keyboard, camera, or viewers. The creation and interaction of virtual worlds are very useful in numerous fields. Examples of applications come from urban planning, business management, healthcare, and education, to name a few.

In education, the metaverse presents a versatile and challenging platform that can transform teachers' and students' learning processes. Virtual worlds enable novel educational experiences where theoretical notions meet real-world case studies and applications. The metaverse can generally scale secondary and university education and open several opportunities. Among them are:

- Create immersive learning experiences. In the metaverse, students can immerse themselves in three-dimensional virtual environments and interact with simulated objects, people, and places. These immersive learning experiences offer an engaging way to explore complex topics and acquire practical skills in a hands-on way. For example, students can participate in science lab simulations, explore historical monuments, travel into space to study astronomy and experience surgical interventions.
- Enabling collaboration and social learning. The metaverse fosters collaboration between students and teachers from around the world. Through customized avatars, students can interact and work together synchronously or asynchronously. This global connection broadens students' perspectives, promotes social learning, and develops cross-cultural collaboration skills.
- Promoting accessibility and inclusion. The metaverse can overcome geographic and socioeconomic barriers. Students who would otherwise have difficulty accessing traditional education can participate in classes and activities in the metaverse, eliminating limitations related to distance and mobility. In addition, people with disabilities can benefit from adaptations and customizations in the metaverse to enable them to participate in educational activities actively.
- Personalizing learning. Teachers can create learning environments tailored to students' needs in the metaverse. Through digital tools and resources, personalized learning can be offered, tailoring the learning path, activities and resources to each student's abilities, interests and learning pace.
- Exploring new frontiers of learning. The metaverse paves the way for exploring new frontiers of learning, such as virtual and augmented reality. Students can interact with virtual content and contexts that offer immersive and engaging experiences. This fosters learning based on exploration and experimentation, encouraging creativity and innovation.
- Developing 21st-century skills. In the metaverse, students can develop and hone 21st-century skills, such as collaboration, communication, problem-solving, critical thinking, and digital citizenship. Students learn to adapt to new digital environments and work effectively with emerging technologies through interactive projects and activities.

Despite the countless benefits, it is necessary to resolve some risks that could involve students and faculty.

First, to date, the metaverse is not a scalable technology. Not all students can fully access the technological resources needed to participate in virtual worlds. The socioeconomic divide may widen digital exclusion, as students from low-income families may need more devices or a stable Internet connection. This could create inequality in access to the metaverse's educational opportunities, putting some students at a disadvantage compared to their peers. So, technology should not exacerbate digital exclusion and the socioeconomic divide.

Second, the overuse of the metaverse (and new technologies) could lead to technology addiction, with students spending more and more time immersed in virtual environments at the expense of real-life social interactions. This could lead to social isolation and decreased face-to-face communication and interaction skills. In addition, the metaverse could provide a virtual environment in which students can hide behind avatars and experience an altered identity, which could negatively affect the development of their personality and the authenticity of human relationships.

In conclusion, the metaverse represents an unexplored territory full of educational potential. The opportunities it offers, such as immersive learning, global collaboration, enhanced accessibility, personalization of learning, exploration of new frontiers, and development of 21st-century skills, are fascinating and promising. However, it is also important to address the associated risks, such as digital exclusion and technological dependence, to ensure that ethical principles guide the metaverse and that it fits students' needs (Figure 1). A balanced approach, based on sound pedagogical design, educator training, and risk awareness, will enable the full potential of the metaverse as a tool to enhance the educational experience, preparing students for an increasingly digital and globalized future.

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