Analyses and insights on the potential impact of the metaverse on the education sector

A report by the UOC's eLearning Innovation Center

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The metaverse meets education: the scope of this report

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The rapid development of digital technologies is having a powerful impact on all sectors, and education is no exception. One of the technologies causing the loudest buzz in 2021 was the metaverse, especially after the media hype surrounding its presentation at the **annual Facebook Connect event in October.** There, Facebook shared its present and future plans to move full steam ahead on bringing the metaverse to life. The company is so committed to this idea, in fact, that it officially changed its name to Meta just weeks later.

The buzz did not let up in the weeks that followed, and we have since witnessed business deals that seem to reflect companies' firm belief in this technology. A case in point was Microsoft's purchase of video game company Activision for upwards of €60 billion. This was one of the most significant corporate transactions in the history of the video game industry and has produced the third largest video game company worldwide.

Will the metaverse be another passing fad like so many of its predecessors or will it find solid footing and set off disruption across sectors? **The aim of this report is not to validate this technology at the present time, but rather to explain the concept, explore the road that has led it here, examine why the current landscape is so conducive to its development and, above all, analyse its potential impact on the world of education.**

Regarding the possible **effects of the metaverse on the education sector,** the report sets out **4 overarching areas of impact and 14 lines of reflection and action, providing use cases and highlighting key challenges.**

Concept

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Metaverse is a portmanteau of "meta", meaning "beyond", and "universe". According to Wikipedia, it is a loose term used to "describe an immersive, multi-sensory experience mediated by various immersive internet technologies".

Before exploring where it came from, where it is now and where it might be going in the future (in terms of social and economic developments and impacts), we need to hone in on three key details that will help lay the foundations for the analysis presented in this report: **the name, definition and essential features.**

2.1. Name

In the academic world and on the internet in general, there are two main currents of opinion regarding the right way to refer to the metaverse.

- **Metaverse**: the first current uses the term "metaverse". Proponents argue that the term dates back to the 1992 novel *Snow Crash* (as we will see later on) and that it has since been used commonly to refer to the development of virtual worlds.
- **Virtual reality:** opposing voices say that it should be called "virtual reality". They claim that using the concept "metaverse" only strengthens the term that Facebook is using – practically as its own proper noun – to refer to the technological development it is making in this field. They also believe that using "metaverse" implies likening the name of the concept or technology to Facebook's own development.

This report will **mainly use the term "metaverse".** This is because, although it may seem like Facebook wants to appropriate the concept, it was created before this company ever existed. However, it may use "virtual reality" in some instances as a synonym.

2.2. Definition

As often happens, the term "metaverse" lacks a universally accepted definition, with differences arising depending on the angle taken to define it. **As a result, there are definitions that focus on the underlying technology, others that highlight the social or relational value, and yet others that emphasize the experience of metaverse users.**

For the purposes of this report, we will use the following definition:

"A virtual environment in which humans interact socially and economically as avatars, using physical devices (e.g., headsets or sensors); this environment acts as a kind of metaphor for the real world, but without physical limitations."

Let's take a more detailed look at some of the concepts in this definition:

- **Virtual environment:** the metaverse makes sense when **interactions take place virtually** rather than in a physical environment.
- **Human interaction**: a basic feature of the metaverse is that **interactions occur between human beings,** in a both social and economic sense. However, the not-so-distant future is likely to see interactions where one of the parties is no longer a human being, as has happened on social media. Humans may instead be replaced by bots (as is the case, for instance, with some customer services).
- **Avatars:** as a virtual world seeking to emulate the real world, people need a **graphic representation of themselves** in this environment. This is called an avatar.
- **Metaphor for the real world:** the metaverse is not intended to be a fantasy world (as opposed to the virtual worlds created in video games such as *Fortnite* and on platforms such as Roblox), but rather a **replica of the real world in a digital environment.**
- **Physically limitless**: the aim is to **dissociate physical reality from digital reality.** This means that, once inside the metaverse, any user should be able to move around and access any space or content, no matter the physical distance that would exist in the real world.

2.3. Essential features

There is strong consensus regarding the metaverse's essential features. Lacking these, any self-proclaimed metaverse solution or product would be rejected. According to **Edward Castronova,** professor of economics and telecommunications at Indiana University, these three features are:

- **Interactivity**: the user is able to interact with the metaverse and communicate with other users. This also implies that their actions and behaviours can influence objects or other users. If there is no interaction, there is no metaverse.
- **Corporeity or presence:** the virtual environment is subject to certain laws of physics. This implies faithfully reproducing the experiences that users have in physical environments in relation to objects and other users.
- **Persistence**: even if no user is connected to the metaverse, the system continues to work non-stop. Users' positions must also be saved when they log out, so that they reload at the same point when they reconnect.

2.4. Academic approaches

Although the concept has come up often in the academic literature, there are few specific academic papers on the architecture around which the metaverse should be built.

Once defined, there is a clear need to understand – conceptually and not technologically – what makes up the metaverse. Some authors, such as **Jon Radoff**, have described what its architecture should look like **based on its value chain**. Radoff breaks down the metaverse into seven layers:

- Infrastructure
- Human interface
- Decentralization
- Spatial computing
- Creator economy
- Discovery
- Experience

Other authors have kept it simpler, describing the metaverse's architecture in three layers:

- Infrastructure
- Interaction
- Ecosystem

The concept is still under construction and continues to evolve. More articles and research are expected to come out in the near future attempting to detail how the metaverse's architecture should be conceptually built.

Origin and evolution

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There have been three key points in the metaverse's evolution, starting with its first appearance in 1992.

Point 1: Origin

Reference to the metaverse was first made in the 1992 novel *Snow Crash*. The author used this term to describe a fictitious world resulting from the convergence of the physical and virtual worlds.

In the words of the author, Neal Stephenson: "My idea came about when I found that some existing words, such as "virtual reality", were simply too clumsy to use."

In the novel, the metaverse is a virtual world in which users are represented by avatars that they design themselves. Users connect via individual terminals in the real world, wearing goggles that project a virtual reality image. Surprisingly, the author predicted many of the features that define the metaverse today, as we will see in greater detail later on.

Point 2: Reality

The metaverse hit a second key milestone in its evolution in 2003, when software company Linden Lab presented ***Second Life***, a virtual community accessed via the internet.

There were four aspects that made this launch so relevant:

- **Avatars**: in order to join the community, users had to create an avatar (a graphic representation of themselves). This is how they interacted in the online environment.
- **The *Second Life* economy:** to allow users to engage in activities within the community (e.g., creating items, exchanging products or accessing services), an open marketplace was created. It was based on a local currency belonging to the community, called the **Linden dollar**, which could be purchased with US dollars (the exchange rate was set at $248 per Linden).

- **Spin-off business:** a business model was developed around *Second Life* to help residents create buildings and items for use in the virtual environment. These buildings and items could be created (through coding) or purchased ready-made, which is why the marketplace was set up.
- **Commercial appeal:** according to unofficial statistics, the community grew to over 20 million users by around 2009. Many commercial brands wanted to capitalize on this popularity, prompting them to purchase land within the virtual world, put up buildings and conduct business there (e.g., selling products to clothe the avatars). **The brands that set up shop in *Second Life* came from the banking sector (Wells Fargo), the automotive industry (Nissan, General Motors, PSA Peugeot), the consumer and retail sectors (Coca-Cola, Adidas, Reebok) and technology (Dell, Intel and Sony).**

After an initial period of considerable growth, use of *Second Life* began to fall from 2009 onwards. Although it is still up and running today, very few users remain.

To gain some insight into what caused this downturn, Professor **Fernando Checa García** looked into what differences between this virtual community and social media might have attracted users towards the latter. His findings could be useful now and down the line when developing the metaverse.

	Second Life	**Social media**
Complexity of first-time use	High	Very low
Hardware and software	Demanding requirements	Access via any connected device
Connectivity requirements	High bandwidth demand	Just an internet connection
Economic impact	Environment that required the use of a virtual token (Linden dollar) to access products and services on the platform	Free access to most features
Primary purpose	Exploring the unknown	Building relationships and connections

Point 3: Popularization

The metaverse's popularity took off on 29 October 2021, when Facebook founder and CEO Marc Zuckerberg presented it as the next step in the company's evolution, announcing an investment of over $10 billion to develop technology and content to bring it to life. The presentation was a full-on declaration of intent, with Zuckerberg calling the metaverse "the next generation of the internet and the next chapter of us as a company". To emphasize this vision and commitment, Facebook changed its name to Meta just days after the presentation.

This sparked headlines, business deals and a burning interest in understanding and predicting the real impact of this technology and its use, in terms of both our personal and social engagement with social media and, more than anything, the effects on business across all sectors.

Background and state of the art

So, we know what the metaverse is and the road it has taken to get here, but what is it about now that makes people think the metaverse is about to leap forward in its evolution and become so potentially disruptive across sectors? Describing the present time and context in relation to the metaverse, its background and how the technology has been introduced into the educational sector will help us to understand its foreseeable medium-term and long-term impact on various fields, especially education.

4.1. Video games: the forerunners

The video game industry is the metaverse's main precursor. In recent years, this industry has evolved into large platforms where players go online to access games and interact with other players with whom to share the experience. This evolution has given rise to platforms and games to which millions of players connect at the same time. Online gaming has laid the groundwork for the metaverse in three ways:

- **Normalizing the use of avatars:** it is common practice in many of these online games for players to create an avatar that represents them and acts as a digital liaison for interaction with other players. These avatars also become part of the players" identity within the game, hence the desire to personalize them. This has led to a type of business that puts articles of clothing and accessories for these avatars up for purchase.
- **Creating tighter bonds:** despite the growth of social media and communication platforms (such as WhatsApp), it is on these gaming platforms where bonding and engagement are truly increasing. Just to give an example, users aged 15 to 25 show a higher level of engagement on the online gaming platform Roblox than in networks such as Facebook or Instagram. Likewise, the average number of messages sent by each user per day on this platform exceeds the number of messages sent by the same group via WhatsApp (see Figure 1).

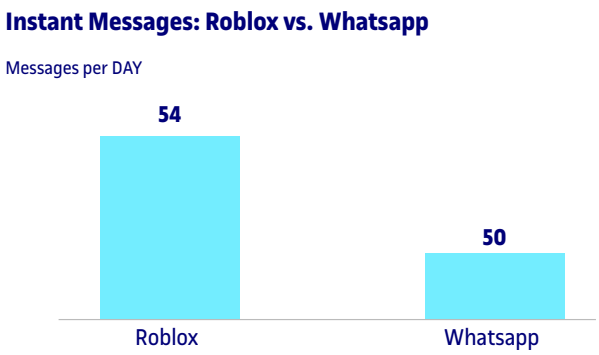


Figure 1: Roblox vs. WhatsApp

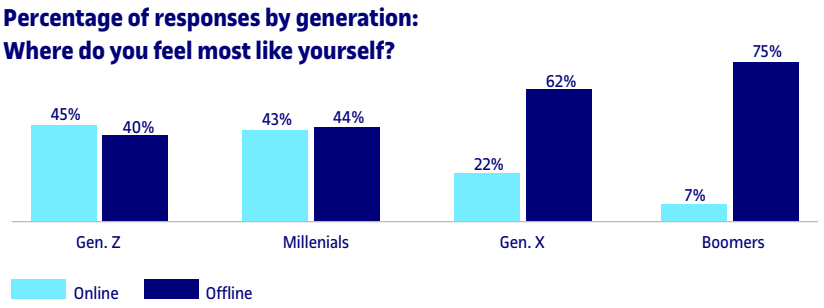
- **Playing host to adjacent activities:** these platforms have begun to host activities that go beyond online gaming, garnering interest from both players and brands, which see an opportunity to reach these audiences. One example is the virtual concert tour that Travis Scott went on in April 2020 via his avatar in *Fortnite* (owned by multinational video game development company Epic Games). The rapper put on a total of 5 live concerts that drew over 27 million concurrent viewers on the platform.

4.2. The future of the metaverse: market value and uptake

Many technologies have been seen as potentially disruptive or possessing massive potential for growth, only to fall into oblivion sometime later. The common denominator in these cases is the lack of a real market need or even the availability of another technology that covers this need in a less complex way. We have already seen, for example, the argument that *Second Life's* growth was stunted because users were more comfortable in the social networking environment.

Given the significant percentage of people expressing the need to engage in online activities (and their comfortability in doing so), there is likely a willingness to embrace the metaverse. Figure 2 shows the results of a study carried out by *The New Consumer* at the end of 2021, which found that 45% of Gen Zers feel most like themselves in online environments.

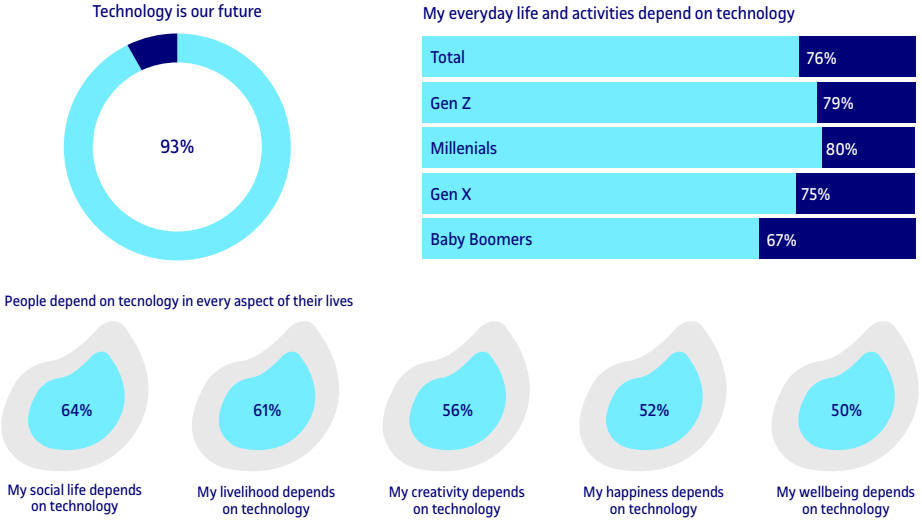
More Gen.Z consumers say they feel most like themselves "online" than "offline"



Data: Consumer Trends Survey powered by toluna*

Figure 2: Gen Z's perception of life online

Figure 3 also sheds light on people's dependence on technology in various aspects of life. In the study conducted by Wunderman Thompson Intelligence, 76% of those surveyed said that their everyday life and activities depend on technology.



3,011 participants across the United States, United Kingdom and China, fielding from July 9 - July 27 2021. Survey by Wunderman Thompson Data.

Figure 3: People's dependence on technology

The above figures provide some insight into the current level of attachment that people have to technology, and hint at the future impact that it will have on our lives.

For a better look at the future impact of the metaverse, we can turn to some of the predictions about the economic effects that it (and everything related to it) will have in the coming years. According to **Bloomberg, the metaverse revenue opportunity could reach $800 billion by 2024**. This is mostly based on the expected growth of online gaming and the hosting of leisure and entertainment events in the metaverse. Importantly, it has not yet considered the impact that Facebook's investment in this technology might have.

4.3. A sector in transformation: EdTech

The fusion of education and technology has given us EdTech, which aims to invalidate the equation that says that more students equals worse quality. Introducing technology in the education sector should translate into improved quality and reduced costs.

Technology is taking hold in the education sector, as illustrated by the fact that **investments have tripled in the last two years** (coinciding with the COVID-19 pandemic), reaching $20 billion in 2021, according to data from Brighteye Venture's *European Edtech Funding Report.*

Figure 4: Trend in investments in EdTech start-ups

To better understand the state of technology in education now, we should take a quick look back at how it has made its way into this sector over the years.

Background and state of the art

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Stage 1: Technology as a tool

Over the last 30 years of the 20th century, technology entered the world of education and became a way to enhance traditional educational models. As in many other sectors (such as banking, for example), this first stage was about looking for ways to boost efficiency, namely by creating technological tools that provided better solutions for student data management, information repositories and the delivery of online courses. These tools often saved educational institutions money and other resources but added little value in terms of improving the educational process for students.

This led to companies developing in various areas:

- **School management:** K12 and Google Classroom
- **Online course management:** 2U and Kaplan
- **Educational publishing:** Wiley and Pearson
- **Content management:** Blackboard and Instructure

Stage 2: Technology as a teaching-learning environment

Moving into the 21st century, **the focus of technology in the education sector turned to developing new educational experiences.** Start-ups in the EdTech environment set out to redesign education and disrupt traditional models.

This has had an impact on three areas:

- **Primary and secondary school education: companies providing technology-based extracurricular activities have started to become real learning alternatives.** Examples of this in the United States include Edgi, which brings together students to explore common interests, and Ender, which drives educational competitions in *Minecraft*. In Spain, there is Galileo, which creates alternative educational groups.
- **University education: technology is being used to transform not only the educational environment (i.e., moving it online) but also the educational process itself**. This has led to proposals such as Minerva in the US and Kibo School, which offers a bachelor's degree that is accessible to young people all over Africa. Governments are also stepping up and investing in disruptive companies, such as Multiverse in the United Kingdom and OpenClassrooms in France.

- **Executive training:** companies are emerging to provide solutions to professionals' desire and/or need to receive training outside the corporate environment. This has given rise, for example, to Collective, a Mexico-based venture that teaches skills for working in start-ups, and Master Me Up, which promotes new work methods.

This brief overview provides enough insight to say that the education sector is indeed transforming, and that technology is playing (and will continue to play) a decisive role in this process. **The challenge is for existing educational institutions to harness this trend as well.**

4.4. Normalizing the use of technologies for remote work

The success of new technologies relies on various factors. One of them, which is key, is the willingness of potential users to take them up. As seen earlier, one of the reasons why experiences such as *Second Life* were unsuccessful was that most internet users were not particularly interested in them. However, the landscape has since changed. One new feature that stands out is the prevalence of remote work.

As a result of the COVID-19 pandemic, **it has become commonplace for people to work from somewhere other than the office.** This has meant introducing new tools (tools for videoconferencing, digital environments for document sharing, messaging apps, etc.), identifying new ways of working and accepting the fact that some work can be done from anywhere.

Rather than go into the effects or the future of remote work, suffice it to say that most professionals and students have embraced a new way of carrying out their activities. This makes it unlikely for the use of metaverse technologies, which have yet to demonstrate their usefulness and capabilities, to take anyone by surprise. Indeed, their potential users possess much better digital skills than before the pandemic broke out.

The world of education

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In light of the above, it is clear that the world of education cannot and will not remain unaffected by the metaverse's emerging impact.

There are several approaches for analysing the potential (disruptive) impact of the metaverse on education. This report sets out **4 overarching areas of impact and 14 lines of reflection**. For each of these lines, it presents the following:

- The situation at present
- Current applications (if any)
- Future outlook
- Challenges and possible courses of action

Area 1: Impact on learning models and processes	1. Making the transition from face-to-face to online to immersive content and environments
	2. Improving the quality of learning: personalization and matching the student's pace
	3. Leveraging the new, proven possibilities of virtual worlds
	4. From lecture methods to gamification
	5. Reaching a greater number of students
Area 2: Matching educational supply and demand	6. The gap between educational supply and the demand for talent
	7. The access challenge: digital and generational divides
Area 3: Redesigning environments (infrastructure) and the roles of those involved in the educational process	8. Redesigning educational environments
	9. Transforming the role of student and teacher
	10. Understanding the new ways of capturing attention
	11. Tackling assessment and monitoring challenges
Area 4: An ecosystem-based model	12. New partners in education
	13. Setting standards
	14. Interoperability, blockchain and non-fungible tokens

5.1. Impact on learning models and processes

a) Making the transition from face-to-face to online to immersive content and environments

Education was becoming more digital even before the impact of the COVID-19 pandemic on educational environments.

- **Producing digital media and content:** the transition began when traditional educational environments turned to digital tools to manage and monitor their programmes. Environments such as Moodle and other platforms allowed students and teachers to log into a digital environment where they could store documents, access digital content, track programmes, and so on.
- **Using digital infrastructure:** traditional classrooms later brought in digital media such as computers, tablets, smartboards and mobile phones, which transformed classroom-based educational experiences by creating a hybrid model in terms of infrastructure.
- **Creating digital educational environments:** experiences such as those offered by the Universitat Oberta de Catalunya have taken the entire educational environment online, from the classroom itself to the content, learning processes and student monitoring.

These initiatives, some of which are more established than others, have coexisted with an educational approach set on face-to-face teaching and learning. The latter, however, radically changed following the COVID-19 outbreak and the widespread move towards hybrid educational processes and environments in which videoconferencing platforms have become a common tool.

The potential advent of the metaverse would trigger a much more disruptive next step in this transition, **as it is not about evolving or transforming content, processes and environments by adding a digital layer, but about changing the paradigm completely.** It would mean leaping from face-to-face, hybrid or online education to a fully immersive educational experience, which would set off a paradigm shift in terms of content, environments and learning processes.

There are already some examples of this possible next step, such as the Optima Classical Academy in Naples, Florida. The school is designing a curriculum for third- to eighth graders in which **classes will no longer be delivered via platforms such as Zoom, but rather in a metaverse environment** which students will access through virtual reality headsets. Below are the most important features:

- **The immersive environment (classroom):** each student plugs into the environment using a virtual reality headset, whether from the physical classroom, from home or from anywhere else. The teacher also accesses the environment this way. Everyone involved must create and use an avatar.
- **The system will complement traditional classroom learning:** the immersive process is not meant to take up 100% of the students' time, but rather part of it. The initial idea is for them to plug in for 30 to 45 minutes at a time for a total of 3 hours a day, 4 days a week.
- The immersive environment does not always have to be a classroom. It can take students anywhere, **from the depths of the ocean to the ruins of Pompeii.**
- **It is designed to provide well-rounded education.** As such, the curriculum will include subjects such as maths, art, languages, music, science and US history.

Challenges to making the content and environment transition

- **Identify,** even with a high degree of uncertainty, **the possibilities that the metaverse can open up for education.**
- Given that the metaverse is still developing, **create a model for monitoring changes and assessing its potential for use,** i.e., instead of reacting to changes, take a proactive approach (for example, by setting up a radar system aimed at spotting new developments in this area).
- **Plan possible actions,** accepting that some of them will involve core changes (transforming people's way of thinking, enhancing physical infrastructure, such as buildings and classrooms, with technological infrastructure, etc.).
- Understand that this paradigm shift i**s not about bringing what is done in the physical world to the digital environment** (one of the main criticisms of the videoconferencing model used during the pandemic), but instead about creating an entirely new environment.

b) Improving the quality of learning: personalization and matching the student's pace

When it comes to any learning process or pathway, one of the challenges is being able to **personalize it for every student, taking into account factors such as their prior knowledge and skills, how fast they learn, their interests, and even the reasons why they need to engage in the learning process in the first place.**

The developments we are beginning to see in the metaverse foreshadow decisive progress in this respect from several angles:

- **Learners will be able to explore** the immersive environments on their own or with other users, moving through them at their own learning pace.
- Since the infrastructure and its use are digital, they can be automatically **converted into data,** which can be used for a range of purposes, including to understand and anticipate the next steps in each student's learning process.
- Included in the metaverse equation are **artificial intelligence-based algorithms,** which aggregate data on metaverse users (students), making it possible to **predict and personalize the next steps in their learning processes.**
- This data-driven process will make it easier to **quickly and systematically assess** students' performance, so as to continuously adjust the process or even change it completely.

Challenges to improving the quality of learning

- Possess the **necessary technology to convert the process into data** that can be analysed to draw conclusions about how the process should continue.
- Building on the previous challenge, **possess the necessary skills and technologies to continuously produce new content and resources for these personalized educational pathways.**
- **Transform the role of student and teacher** (to be explored later in this report) and work out how to manage the changes that this will entail.

c) Leveraging the new, proven possibilities of virtual worlds

As we have seen, gaming platforms are among the metaverse's most immediate forerunners. As such, it could be very interesting to explore not only their dynamics but also their codes of conduct, so as to import any that could have an impact on the educational environment.

One standout case is **Roblox**, an online gaming platform with over **200 million monthly active users,** according to the latest official statistics for 2021. The most compelling figure, however, is that two thirds of these users are school-age children. For the sake of comparison, this is more than the combined total of all schoolchildren in the US, Canada and the UK in the 2021/2022 school year.

This platform, which allows users to create their own games and make them available for the rest of the community to play, has tuned in to its educational potential. This, for example, has led it to **design a curriculum on safe internet use for students under the age of 18.**

However, the qualitative leap takes place when **teachers themselves begin to use the platform in their own curricula.** That is, once the platform has helped to delimit any potential risks for students, for example by limiting the possibility of strangers contacting them through the platform. Emulating the platform's game creation and sharing dynamic, teachers take preset templates and personalize the topics and levels (as if it were a game) and create interactive tutorials for their students about the subjects in their curricula. From there, students play these levels to enhance the learning process.

There are a few knock-on effects:

- Content creators on Roblox earn money for their creations based on how well they do among other users on the platform. **By learning how to use the platform and produce content, students can become content creators themselves** and generate a revenue stream for their future.
- Digital skills (e.g., coding) prime students for a successful career in the future.

Challenges to leveraging the new, proven possibilities of virtual worlds

- **Identify existing platforms and analyse them** as research tools to be applied later in the educational environment (benchmarking).
- **Make sure that those designing and carrying out educational programmes and curricula immerse themselves in these platforms;** gaining first-hand experience is a crucial first step towards leveraging their capabilities.
- **Ensure that teaching staff develop proficiency in the use of these platforms.**

d) From lecture methods to gamification

This report is not revealing any sort of well-kept secret when it recalls the value of gamification as an educational tool. However, it is worth noting again just how important this type of practice is right now.

- **It embraces games** as fun activities that spark learning, making educational environments resemble recreational environments and, as a result, enhancing students' receptiveness to learning.
- **It hones skills such as teamwork, collaboration, strategic thinking, spatial awareness and imagination.**
- It enables key lessons on issues such as losing and failing in a controlled setting.

By harnessing the features of the metaverse we can take gamified education to the next level. The use of immersive technologies adds a realness factor that affords students more intense experiences and, in addition, allows teachers to take part in the process as facilitators or even as participants themselves (as we will see later on).

Challenges to gamifying education

- **Spot any potential risks that platforms such as those for gaming pose** for students' cognitive development, as discussed by Stanford University in regard to games such as *Fortnite*.
- Use these methodologies to **work on specific skills** that are extremely difficult to develop in lecture-heavy environments.
- **Co-create these environments with learners.**

e) Reaching a greater number of students

One of the clear advantages of moving education online is the possibility of reaching more students and removing the distance between students, teachers and educational institutions. This advantage only shines brighter when we think about the potential impact of the metaverse on education.

If we take as a reference, for example, **the underlying theories of exponential growth in business environments, the size of the potential market is one of the first key characteristics.** Indeed, the bigger the potential market, the greater the possibility for a business to grow in it. This growth can come in three ways: **expanding within the existing market, creating a new market from an existing one or creating adjacent markets.**

At the intersection of education and the metaverse, this growth can also take three avenues:

- **Expanding within the existing market**: educational institutions that build the metaverse into their educational models may expand and grow within current markets thanks to the attractiveness of the technology, its features and the updated educational processes.
- **Creating a new market:** a second possible route is that of reaching new population and/or geographic markets.
- **Creating adjacent markets:** the third growth strategy involves creating adjacent markets. Educational institutions can follow in the footsteps of companies such as Apple, where the manufacture of computers led to adjacent businesses around the underlying technologies and with the aim of meeting various needs among the same target market.

Challenges to reaching a greater number of students

- **Dissociate the business goals of educational institutions from the technologies they use in their programmes and courses.**
- **Leverage user-centred methodologies to imagine possible needs that could be met using metaverse technology,** even those outside the normal scope of education.

5.2. Matching educational supply and demand to create human capital and transfer it to the productive system

a) The gap between educational supply and the demand for talent

Some people believe that there is a widening gap between what the education system is offering and what the market actually needs in terms of the skills and knowledge required to carry out productive activities. **The consequence of this potential mismatch between supply and demand would be a loss of productivity and competitiveness.** If companies cannot bring in the talent they need, they make up for this deficit by hiring less qualified professionals and bringing them up to scratch themselves or recruiting people who skip formal education altogether and are trained directly by companies instead, often in their own training centres. Whatever the case, t**his can lead to a decline in productivity which can weaken competitiveness if other countries do manage to narrow this gap.**

We have recently witnessed the first large company respond to a skills shortage among its employees by setting up a programme within its own corporate university, in this case to provide training to over 50,000 employees. The company in question is **Bank of America**, whose corporate university, called The Academy, rolled out a **training programme featuring virtual reality technology and a metaverse** in 2021. Through this programme, more than 50,000 employees across 4,000 branches will be able to virtually simulate face-to-face interactions with clients (in a practice environment). There are currently 20 simulations allowing employees to work on skills to improve client relations, manage conflicts and become more empathetic listeners.

This first example highlights the need to move past educational programmes that fail to meet company challenges (e.g., using scripted videos or group dynamics with simulators), as well as the will to explore training environments, like the one described above, that are not yet part of higher education and must therefore be designed specifically by companies to meet a need.

Challenges to narrowing the gap between supply and demand

- **Identify what is in demand in the business sector.**
- **Quickly provide solutions.**
- **Create collaborative environments** between the worlds of business and education to even out the imbalance between supply and demand.

b) The access challenge: digital and generational divides

Bringing the metaverse to life will clearly require high investments in technological infrastructure (creation of content, platforms, etc.). Users, too, will have to invest in high-performance computing and graphics hardware, a device for entering the metaverse (for now, an AR headset), and high-speed bandwidth, to name a few things. This raises various concerns in the scope of education:

- **The economic and digital divide:** as pointed out by some authors[1], the fact that some people do not have access to certain technologies or cannot afford them creates an imbalance in educational attainment and learning processes. Any educational institution considering evolving its learning resources and methods towards the metaverse will have to take this into account if it does not want to make access and use more exclusive to some.

[1] In their book *The Race between Education and Technology* (2010, The Belknap Press), Claudia Goldin and Lawrence F. Katz provide an evolutionary analysis of the US education system. They show that there is a wage gap between those groups that have access to a certain level of education and those that do not, and that this gap is growing over time.

- **The generational divide:** the use and availability of digital technologies are evolving and becoming an increasingly normal part of everyday life. Against this backdrop, the need and motivation to use certain technologies may mean that age is no longer a key factor determining their uptake. This was laid bare throughout 2020 and 2021. During the strongest waves of COVID-19, people who knew little about technology and rarely used it were forced to rely on it for transactional (access to e-commerce), work (videoconferencing and remote working platforms) and even social purposes (access to online healthcare services or contact with family members). However, the development of the metaverse entails a new paradigm shift not only in the type of infrastructure required (more powerful computers, VR headsets and high-speed internet access), but also, and most importantly, in our understanding of what an immersive reality and virtual world would imply. This poses a challenge for any institution offering education to learners of a certain age who, until now, have been unconcerned with accessing and using technology.

Challenges relating to access and the digital and generational divides

- Ensure that accessing education in the metaverse is affordable to as many people as possible.
- Accept that technology can slow down deployment and that its cost will have to go down while system performance goes up.
- Take action to prevent an age divide by making the metaverse more normal and appealing to groups who are currently the furthest removed from technology.

5.3. Redesigning environments (infrastructure) and the roles of those involved in education

a) Redesigning educational environments

The first step towards introducing the metaverse in education has necessarily involved replicating physical infrastructure in a digital environment. In 2021, for example, the **Chinese University of Hong Kong (CUHKSZ)** created its first metaverse prototype. Leveraging Unity technology, it recreated its physical infrastructure in the metaverse. The digital facilities allow students to carry out the same actions they would on campus, as pictured in Figure 5.

Figure 5: Screenshot of the CUHKSZ in its metaverse environment

The **Communication University of China** has followed a similar pattern. On 26 December 2021, it inaugurated its metaverse campus during a hybrid graduation ceremony that took place at a real-life venue and in the metaverse. In this case, development was carried out on the Xi Rang platform, owned by tech company Baidu.

Both examples show that for the moment redesigning educational environments means **replicating** or creating digital graphic representations of physical structures. However, there is clear potential to create new environments for learning that go beyond the traditional classroom or the recreation of educational buildings.

In the first images made public by Facebook (Meta) at the presentation of its vision for the metaverse, representations of the solar system and the city of Rome in 50 BC were seen as examples of environments in which to develop immersive learning pathways.

Challenges to redesigning environments

- As in many points above, but especially here, **possess enough technology to develop graphic environments.**
- Consider **moving beyond the digital recreation of present-day physical environments**, imagining immersive learning environments that fit the subject matter or training content (such as the solar system or bygone cities and civilizations).

b) Transforming the role of student and teacher

Face-to-face educational models, as well as the hybrid models that evolved from them as a result of the COVID-19 pandemic, **have clearly set roles for teachers and students in the classroom. Teachers play an active role as knowledge transmitters while students assume a passive role as knowledge receivers.**

Some pedagogical movements have attempted to transform these roles by devising models and environments in which students take on a more participatory role and teachers facilitate the learning process rather than purely transmitting knowledge.

This trend is most likely to spill over into the metaverse, leading to foreseeably transformed roles:

- **Role of the student:** the first tests using virtual worlds, gaming platforms or even metaverses as educational environments seem to lay out a path that students must actively take as leaders of their learning process. **They no longer simply receive content, but rather play a leading role.**
    - For example, some Spanish universities began using *Second Life* as an educational tool in 2007. In these cases, students take on an active role not only because they have to create their avatar and define other user settings, but also because they have to lead the process themselves by completing specific actions.
    - In other examples, such as the educational initiatives hosted on Roblox (as seen earlier), students perform the same active role.

- **Role of the teacher:** in an environment such as the metaverse, teachers will definitively take on the role of facilitator. With turnkey educational materials and settings available (and often not created by the teachers using them), teachers will instead support, guide and facilitate students through their learning process, likely playing a more passive role than before. The role of teacher will effectively be transformed. Plus, since teaching will take place in environments that offer more knowledge than teachers can realistically hope to possess, their added value will derive from their ability to understand and master the process and environment and to facilitate students' learning. This transformation will not occur overnight, requiring planning and learning on the part of teachers.

Challenges to transforming the role of student and teacher

- **Prepare teachers for this new role,** setting out a process of change that helps them transition from knowledge transmitters to learning facilitators.
- Provide support in student-led learning processes.

c) Understanding the new ways of capturing attention

In 2003, Stanford University set up the Virtual Human Interaction Lab, a research centre focused on understanding the psychological and behavioural effects of augmented reality. In 2021, the centre rolled out the first course developed entirely in a metaverse environment, called Virtual People[2]. Students engage in the course through a VR headset and an avatar.

One of the main lines of research stemming from this experience focuses on how to capture participants' attention in an environment that is so different from what they are used to. It raises questions about what triggers participants' attention in the learning process. Two areas stand out in this case.

[2] This "experiment" leveraged the platform offered by ENGAGE, a company specialized in creating virtual environments for the metaverse.

- **Access to otherwise impossible, overly expensive or dangerous content:** an environment such as the metaverse opens the door to content considered dangerous or extremely difficult to access in a classroom. The creator of this course at Stanford University, Professor Jeremy Bailenson, cites experiences that would otherwise be too dangerous, such as an underwater ocean voyage, or expensive, such as travelling to the world's major cities. Because students are able to immerse themselves in this type of content, their attention is guaranteed. This fulfils one of the metaverse's essential features, which is none other than allowing participants to perceive their virtual surroundings as reality.
- **Social learning:** one of the course's activities involves groups of students putting on performances using their avatars. Here, students play a central role and engage in group work, with the added bonus of being able to take full advantage of the platform's immersive capabilities.

As highlighted earlier in this report, one of the best knock-on benefits of metaverse-based experiences is data availability. At Stanford University, these data can be used to improve and personalize the course. So far, the instructors and students taking part in the course have shared over 3,000 hours in VR environments.

Challenges to capturing attention in new ways

- **Identify participants' expectations,** in order to anticipate anchor points that will keep their attention from drifting away.
- **Continuously examine use patterns,** prioritizing empirical measurements to pinpoint areas that capture participants' attention the most.

d) Tackling assessment and monitoring challenges

The specific traits of the metaverse will have a direct impact on assessment and monitoring. Factors such as personalization, the unique pathways followed by students and the undeniably individual nature of the process can transform commonly accepted models.

Firstly, this will involve **redefining assessment criteria** to encompass more than just knowledge acquisition. Factors that have been included in some educational processes in recent years come into play here, including digital skills and competencies, decision-making, the ability to evolve in changing environments and the flexibility to cope with processes that are not entirely set in stone.

Secondly, it will have an effect on **how student progress is facilitated and tracked**. The availability of near-real-time data, especially comparative statistics, will lead to possible new assessment methods.

Thirdly, it raises **questions about privacy.** This would require coming up with a way, for example, to monitor conversations among students or work so that they are perhaps not recorded in these monitoring processes. This privacy may interfere with the assessment and monitoring of social learning, i.e., how sharing among students and the skills they display enhance their learning process.

Finally, it will be necessary to **predict how teamwork will evolve** in an environment such as the metaverse that (potentially) individualizes the educational process.

Challenges relating to assessment and monitoring

- Redefine assessment criteria.
- Use data to facilitate and track student progress.
- Find a balance between privacy and social or collaborative learning.
- Think of ways to develop teamwork in an environment that fosters individualized educational processes.

5.4. An ecosystem-based model

a) New partners in education

The world of education has been working towards an ecosystem-based model for some time now. Institutions are teaming up to offer joint educational programmes and pathways, and partnerships are being established with companies in different sectors to create synergies and added value. The current metaverse blueprint seems to show the ecosystem-based model as one of its key pillars, and this is likely to be the case in the future as well.

First of all, **the metaverse will require technological developments that educational institutions will have a tough time achieving on their own.** It certainly makes more sense to build them together with the technology sector.

Secondly, ecosystem-based models will be better in terms of educational content and the format it comes in. Along these lines, we have begun to see models such as **Roblox's, which currently includes some type of collaboration with over 300 educational institutions** of all kinds to create and deliver content.

Finally, picking up from what was said about matching supply and demand in this sector, **it is essential to have ecosystems that involve the same companies where students will eventually work (or already work).**

Put simply, the education sector may take two routes into the metaverse:

- **Adaptation**: educational models, including content and methodology, may adapt to metaverse technology. Educational institutions would create content themselves, leveraging technology developed by a third party to create their own metaverse and move their programmes into the digital environment.
- **Transformation:** unlike above, the creation of ecosystems made up of universities and other educational institutions, businesses and tech companies could transform the model, the content and the programmes to be developed.

Challenges relating to new partners in education

- Make decisions about what model to pursue (educational institutions).
- Identify current ecosystems and explore how to take part (e.g., Roblox).
- Identify potential partners with whom to create these ecosystems.

b) Setting standards

Besides filling a real gap in the market, one of the biggest challenges facing any newly created technology, in order to achieve widespread uptake, is to ensure ease of access and use and, if it is offered by various companies, uniform standards. Without a set standard, every manufacturer or supplier of the technology will follow its own, which makes uptake very difficult.

This is one of the most pressing issues surrounding the metaverse right now. Several big tech companies (e.g., Facebook and Microsoft) have their sights set on this technology, but the **outcome of these ventures will depend on whether their development is based on uniform standards or whether each company follows its own.**

For example, the mainstream device for plugging into a metaverse today is the VR headset. If each company designs its own headset and fails to make it compatible with other platforms, users will either have to purchase multiple devices or stick to one single platform. This is a very basic example, but the matter can become quite complicated if, for instance, the programming languages end up being platform specific.

The various platforms have spoken out about setting standards and ensuring that this does not limit their growth, but their actual intentions are still unknown.

Facebook, for example, has recently presented its metaverse project in the educational sphere, called **Meta Immersive Learning**, which is based on three pillars, all of them linked to the topic of standards.

- **Creators**: the company will launch various initiatives to train the future creators of learning-oriented VR experiences.
- **Content**: Facebook will not create content itself, but instead seek out partnerships with educational institutions to produce high-quality experiences and resources.
- **Accessibility**: to increase access as much as possible, the company plans to subsidize or donate the required infrastructure (hardware) where needed, and to have a presence in educational environments (libraries).

This whole issue of standards applies to the world of education, where regulation and, above all, certification are fundamental. Metaverse-driven changes will not only be in media or hardware, but also in content and, most especially, learning pathways. This could trigger the need to redefine curricular content and certification processes. As of yet, there is virtually no reference to this subject in educational research, but it is certainly something to think about and make decisions on.

c) Interoperability, blockchain and non-fungible tokens

As touched on above, **interoperability is one of the major challenges in the metaverse ecosystem.** Ensuring that all digital assets created in one metaverse can be used in another will undoubtedly be one of the keys to its uptake. This is not currently the case in two of today's major digital ecosystems: social media and video games.

- **Social media:** when users open a social media app for the first time, they have to create a profile, write a description, set a username and search for contacts. This works against them in two ways: firstly, they may not want to spend time registering, and secondly, they may not be able to use the same username across apps if it is already taken on one of them. The only feature linked to interoperability, and one that is not widespread, is the ability to import a network of contacts to see if anyone is already using the app.
- **Video games:** in most games, players can own digital assets that are linked to their account (e.g., clothing or skins). These can be acquired for free on some platforms and for a fee on others. However, when they switch to another game or platform, they cannot take these with them and must get them again somehow.

In the metaverse, this would mean having to create a self-resembling avatar and a username on every new platform. The limitations that this would impose in terms of engaging on different platforms are evident.

There are two factors that offer a glimmer of hope, however:

- **Metaverse drivers:** the main tech companies driving the metaverse (e.g., Facebook and Microsoft) have already expressed their intention and interest in creating features that enable cross-platform interoperability.
- **Blockchain and non-fungible tokens (NFT):** these technologies can enable interoperability, allowing assets acquired on one platform to be validated for another (in NFT format) through blockchain.

Interoperability would open up huge possibilities in the field of education, potentially leading to:

- **Joint programmes:** educational pathways based in different metaverses could be developed.
- **Validation:** thanks to mechanisms such as blockchain, specific qualifications or pathways on one platform could be validated and added to another institution's curriculum.
- **Content creation:** the teaching and learning content created by an educational institution could be used in other environments.

Challenges relating to interoperability

- As a starting point, ensure effective interoperability. This challenge may be beyond the control of educational institutions, but they must lobby to achieve it.
- Create digital assets (i.e., educational resources) within the metaverse that are attractive for other environments.
- Foster collaboration between different environments.

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