Metaverse as a Form of Reality and the Impact of Metaverse in Higher Education

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Abstract—In the metaverse, the characters were avatars working in a 3-dimensional virtual reality. This virtual reality existed beyond reality. The metaverse is a "the post-reality universe"; a perpetual and persistent multiuser environment in which physical reality and digital virtuality are merged. The virtual infrastructure needed to build a metaverse (which is in the process of being created), are: web3 technologies, non-fungible tokens (NFTs), blockchain, smart contracts, and cryptocurrencies. Web3 refers to a new iteration of the actual web2. The actual web2 is dominated by powerful providers like Google, Apple, Amazon, and other corporate tech companies. The vision for web3 is a decentralized, and thus more equitable version of the web. The aim of this paper is, first, to present the Metaverse as a form of reality in which physical reality and digital virtuality combined to provide new experiences to users; second, to discuss the implications for education, specifically for higher education, and how programs will have to be modified so that the skills obtained by graduates match those demanded by the virtual labour market. This paper builds upon a constructivist approach, combining a literature review and research on key publications.

Keywords—Ethics in technology, cross realities, cryptocurrencies, labour market, metaverse, technology in higher education.

I. INTRODUCTION

EXTENDED reality or cross reality is an umbrella term that is used to refer to technologies, digital and electronic environments where data are represented and projected. Cross realities include augmented reality (AR), mixed reality (MR), and virtual reality (VR). In all of these realities, users see and interact in a totally or partially synthetic digital environment created by technology [9]. The Acceleration Studies Foundation (ASF) defines the metaverse as having two main characteristics: the spectrum of technologies, from augmentation to simulation, and the spectrum of identity, where avatars represent human users [7].

In 2006, the ASF presented the metaverse roadmap and the 4 types of connections or combinations between the real world and VR [6]. However, more than a 'combination' of VR and real world, the metaverse designates interactions:

1. AR refers to technologies that embed digital inputs into the physical environment to enhance it. An example of AR is the popular game Pokémon GO, which embedded virtual monsters in the streets, i.e., it linked an abstract figure to concrete objects.
2. Lifelogging augments the inner world, or the body of the user by connecting devices to record their daily activities.

Examples of lifelogging include Facebook, Twitter and Instagram. However, more sophisticated examples of lifelogging are devices that use biometric information to record the activities of the user, like exercise or movement [6].

3. Mirror world is a simulation of the real world which is 'reflected' in a metaverse in which the appearance, the information, and the structure of the real world are transferred to VR as though they were reflected in a mirror [6]. The mirror world allows users to carry out daily activities on the internet or mobile applications. Examples are online shopping and banking, which make life in the real world more efficient. In education, virtual education spaces and like Zoom and Google Meet are examples of mirror worlds. These video conferencing systems substitute for classroom attendance in synchronous face-to-face remote classes.

VR is an immersive reality in which the users see a flat image in 3 dimensions, characterized by a space that multiple users can access and participate simultaneously. Each user is represented by an avatar. The digital identity and the ability to engage with other participants creates an illusion of being in another space, experiencing presence [9].

II. EDUCATIONAL USES OF THE METAVERSE

Online distance education has existed for much longer than the metaverse. However, the COVID-19 pandemic, which disrupted academic activities globally, accelerated the trend of online learning at all educational levels. Online education has two modalities- synchronous e-learning, in which participants meet online at the same time using web conferencing platforms like Zoom, and asynchronous platforms, e.g., Moodle, which give the user flexibility of accessing e-learning anytime and anywhere. While these modalities provided online learning during the COVID-19 pandemic, when all learning centres were physically closed for sanitary reasons, these 2-dimensional learning environments showed great inefficiencies and limitations. Participants showed "Zoom fatigue" causing high dropout rates in distance courses [9]. The main reasons for users dropping out of e-courses were the following:

- Low self-perception i.e., the users are represented as photographs or live webcams with no options
- No presence, which led to distraction
- Passive participation, as interaction was very limited, and
- Limited emotional expression, as the only forms of

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expressing emotions or feelings were smileys and emojis

All of these constraints can be dealt with the use of 3D, immersive spatial environments [9].

Uses of AR

In the spectrum between the real and the virtual environments, AR would be located more towards the "real environment" [8]. As stated above, AR embeds digital elements into a physical site and thus can enhance and contextualize learning. AR has specific uses that make it attractive as a didactic technology: By blending two environments, the real and the digital, learning is placed in a physical environment and can thus be more concrete and situated; AR supports meaning making interactions for an active and collaborative construction of knowledge, and AR enables engagement with 3D objects from multiple perspectives, thus supporting the development of different cognitive abilities [8]. An example of AR used in biology lessons is the Virtually-Tee T-shirt, which allows students to examine the inside of the human body as though it were an anatomy laboratory [6]. AR provides a deep understanding of content that can be difficult to explain or observe with words. Furthermore, it makes interactive activities possible while the participants are immersed in the learning context [6]. Nonetheless, AR, like all new learning technologies, has its drawbacks: As [8] points out, AR can bring advantages to education if teachers are able to integrate AR tools into their teaching and can identify the learning outcomes that would result from the integration of AR tools. Furthermore, AR tools must be affordable and user-friendly for the students: there are AR tools that require sophisticated hardware, like the Hololens, and others that simply require downloading an App to a smartphone. The accessibility perspective will often limit educators to using free or affordable Apps in smartphones [8]. Furthermore, teachers' attitudes to the employment of new didactic technologies will depend on factors like the teacher's age, whether s/he is a "digital native" or not, and his or her confidence in using technology [8]. Another important aspect that should not be ignored is that new technologies require a considerable training time for teachers who are often overworked, underpaid, and stressed.

Uses of Lifelogging

Lifelogging is recording the events of the user's life, his or her thoughts and experiences in social networking services (SNS) like Facebook, YouTube or Instagram. SNS provide users with online networking possibilities. The user can reflect and review on his or her daily life, and obtain feedback from others, which provides reinforcement. Furthermore, it provides users with the possibility of exploring information on the lifelogging platform, and of reflecting about learning and improving it. Moreover, teachers can provide customized help and support for their students based on their learning analytics.

Uses of the Mirror World

The mirror world enabled teachers around the globe to overcome the social distancing limitation imposed during the COVID-19 pandemic, as learning could take place in the metaverse, with students participating in lessons from their homes. The mirror world included video conferencing tools like Google Meets, Zoom and Teams. Furthermore, the mirror world gives the students the opportunity to explore other regions by visiting virtual -or mirror- cities. For [3, p.4] mirror cities relate to the physical reality of a real city- a city that represents the real world within a computer… a "city in the computer". While virtual worlds can have elements from the mirror world, the main difference lies in that, while virtual worlds may resemble the real world, virtual worlds are created without importing iconic elements from reality.

Uses of VR

VR is used in education for four primary purposes: 1. For rehearsing and practicing dangerous activities, e.g., airplane piloting simulators; 2. For re-enacting complicated or stressful situations, such as handling difficult clients; 3. For performing impossible tasks, e.g., observing body organs, and 4. For doing "field trips" to places that would be difficult, dangerous or too expensive [9]. VR is created using 3D technology that enables students to have a sense of being in another space, era, culture or space and interact with each other as avatars. VR is used for practices in virtual simulations of places that in the real world are dangerous or difficult, e.g., a natural catastrophe scene, dangerous surgery, flight control. Moreover, collective VR spaces provide participants with blended active learner-centred activities such as problem-, project and game-based learning [9]. VR has also substituted for cruel experiments in biology and veterinary medicine, as real animals are no longer needed for learning anatomy and physiology. Simulations and serious games in VR give students the opportunity to apply theoretical knowledge, use new equipment, practice complex skills and learn from their mistakes without the consequences such practices would have in the real world [9]. Lee et al. [6] propose an educational method that combines abstract and specific learning. As these researchers put it, VR technologies allow users to immerse themselves in a virtual environment, offering an alternative to distance education. VR can be subdivided into two categories: non-immersive and immersive. The first one enables partial insertion into a different environment using a monitor, while the second one allows the user to be completely immersed in a different environment by using a head-mounted display (HMD). The HMD blocks any view of the user's surroundings, giving him or her a feeling of being in an alternate reality [6]. There are many advantages provided by VR, among them: providing flexible hours and locations for learning, providing the experience of shared remote presence, and providing students with learning by doing opportunities without negative consequences [6]. However, VR has significant setbacks: Equipment is costly and its implementation is complex; as few classrooms are equipped with VR technology, its application is very limited, and, perhaps the most significant limitation is that a great deal of effort is required from educators to use VR equipment [6].

III. CHALLENGES OF USING METAVERSE TECHNOLOGY IN EDUCATION

As stated above, one of the main limitations of using the

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metaverse in education, specifically VR, is the high cost of the equipment, which poses a barrier to mass adoption [9]. Another limitation is how familiar teachers are using the new technologies. Furthermore, there are other disadvantages on the physical, the cognitive, and the psychosocial levels. It has been reported that the use of virtual reality technologies (VRT) can produce cybersickness, nausea, dizziness, obesity, radiation, sleep disorders and cardio-metabolic deficiencies [5]. In a study carried out by Roettl and Terlutter [10] in which a video was shown to students in 2D, 3D and VR, the students of the VR game reported higher levels of dizziness and motion sickness than the participants of the other two groups. Other studies suggest that the prolonged use of videogames by children up to 10 years of age (more than half an hour a day) could compromise the development of their vision [5]. While obesity cannot be directly related to the use of VRT, there is an indirect correlation between obesity and video games: gaming habits which lead to a sedentary life, together with the consumption of high calorie foods and drinks can be interrelated and connected, and may result in cardiometabolic disorders [5]. Sleep disorders have been proven to be directly related to a lower melatonin (sleep hormone) production as a result of using gadgets like iPads, computers or smartphones that emit short wavelengths or blue light shortly before bedtime. While the use of VRT can have negative effects on children's cognitive development, in adults extended use of VRT could cause addiction, social isolation and abstinence from the real, physical world [9]. However, it has been proven that VR is an effective rehabilitative tool for patients who have suffered a stroke or have been affected by Parkinson's disease or other neurological disorders [13]. VR has been proven to have significant positive effects on the cognitive functions in individuals who have had a stroke and can be used as an adjunct treatment for stroke rehabilitation.

The Metaverse Economy

The metaverse, with its virtual infrastructure, will have a parallel economy to the real, or formal economy. However, while in the formal economy the currencies used are "fiat" currencies, or currencies backed by governments, like the USD, GBR or Euro, the currencies used in the metaverse economy are cryptocurrencies- which presently are used in a very restricted manner. The new economy created by the web3 will be divided into mainly three categories: 1. Decentralized finance (*DeFi*), which refers to decentralized financial services based on the blockchain. These services include borrowing, saving, and credit scoring. 2. Decentralized digital services like cloud storage, data analytics and web infrastructure, and 3. Collectibles, like digital artwork, audio files and other virtual goods, also known as NFTs [2]. As Williams [12] points out, the metaverse economy is dependent on the real value that has been given to virtual assets, "motivated by the illusion of virtual scarcity". Unlike the real economy, in which scarcity dictates prices of goods and services, the scarcity of the metaverse economy is unrelated to real scarcity: virtual goods have the value that customers believe they have. The metaverse economy will be reliant on the real economy in that all financial activity is linked to the real economy, i.e., fiat currencies are used to pay for virtual assets, and the latter can only acquire real value when users can obtain profits in hard currency [12].

The metaverse will provide endless possibilities for businesses: For example, NFTs will serve as status symbols in the new economy just like Rolex watches or Louis Vuitton bags are in the real economy. Brands like Balenciaga and Gucci are already offering NFTs to virtual clients. These virtual goods are known as "skins", which allow players in the metaverse to change appearance when playing games. For luxury brands, the metaverse provides an access point for a secondary market [1].

Transactions in the metaverse economy will be governed by smart contracts, or contracts programmed in computer codes. The ideological origin of the crypto movement, which started in the 1970s, was to decentralize- thereby limiting the power of governments and central banks. The Web2 virtual world is controlled by an oligopoly of powerful corporations; in contrast, the Web3 is decentralized, allowing peer-to-peer transactions without the need for intermediaries such as banks, brokers, and lawyers [2]. In the same manner, payments in the metaverse will be made using cryptocurrencies, like Bitcoin and Ethereum. Today about 114 million people own Bitcoin [11]. While trade in cryptocurrencies is decentralized, the possibilities for scam are many. Examples of these include but are not limited to: "rug-pull"- in which the creators of a crypto project take the capital raised from a NFT and disappear; "pump and dump"- in which the creators of a crypto asset inflate its price leading to a short-term boom which raises the price of the asset, then sell their assets and trigger a crash; ponzi schemes, which are similar to pyramid schemes, hacking, and phishing [2].

IV. New Opportunities in the Metaverse Labour Market

There will be more jobs in the metaverse as companies enter the digital universe, and opportunities for candidates familiar with Web3 will increase. An important avenue is of the metaverse universe is the entertainment industry. Within the entertainment industry, gaming is the biggest activity, with around 3 billion regular participants worldwide [1]. As an example, in the Philippines the game Axie Infinity has now 1.8 million daily active users. Some of the players rely on the game as their only source of income, some reporting an influx of around USD 10 a day, while others report making between USD 1,000 to 2,000 a month [1]. Regardless of the opportunities provided by play-to-earn games to players, one of the drawbacks is that the sustainability of the game depends on the willingness of more affluent players of making purchases with fiat currencies. Critics point out that this structure amounts to "blockchain colonialism", in which menial jobs are done by the not affluent players. However, the metaverse promises socializing and remote work experiences that go beyond gaming, assuming that a pandemic situation could repeat itself and the limitations on travel imposed by the Net Zero goal [2]. The 3 categories of Web3 projects mentioned above will create new jobs requiring sophisticated skills: Just like financial services in the formal economy's banking sector require

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specific skills and competencies, DeFi services will require the services of individuals with specific know-how. These will include certified cryptocurrency experts and crypto lawyers, who can help in case of scams. Through increased task automation and increased use of AI technology, which can be used in conjunction with blockchain as well, digital services will undergo a Web3 transformation [4]. Examples of jobs in the digital service branch are e.g., smart contract developers, game development engineers, and NFT creators and "meshers,"- the developers who design the basic 3-D templates that can be customized by others and tailored as virtual products [10]. In the same manner, the NFT branch will require brokers- just like collectibles in the real world.

Adapting Higher Education Curricula to the Metaverse Labour Market

While traditional professions like lawyers, doctors, nurses, architects etc. will not disappear, as basic human needs will remain, higher education in the 21st century will have to satisfy the needs of an emerging metaverse labour market whose demands are not necessarily met with traditional 4-year university degrees but rather with highly sophisticated, job-specific skills. The metaverse will not also revolutionize the way people work, but also their training and skills development, dramatically reducing the time needed to acquire and develop new skills: Digital coaches enabled by AI could always be available to aid in employee training and provide career advice. Every object in the metaverse, e.g., a training manual, machine, or product, could be interactive, providing 3-D displays and step-by-step "how to" guides. In the same manner, VR simulations could become standard improving the learning experience of the workers by providing highly realistic "serious game" scenarios, such as a conversation with a difficult client, or a sales presentation [10]. Higher education can adapt to the needs of the metaverse labour market by providing portable skills. As [10] points out: Employers, educators, and training institutions can create more "fluid" skills through the creation of properly certified standards for skills acquired in the metaverse, accredited by training providers. In this manner, quality dilution could be avoided, and quality assurance could be provided to metaverse-based workers and future employers.

V. ETHICAL ISSUES

As [1] puts it, the world of blockchain-based digital assets and NFTs is for the moment a hot one. Furthermore, the metaverse is still in its infancy in many respects [10]. There are substantial obstacles that could hinder its future progress. Some of these are the computing infrastructure and power requirements for a full-fledged working metaverse, which are formidable. Moreover, today's metaverse consists of different virtual worlds that are not unified in the way the original internet was. The metaverse also brings an array of regulatory and labour regulation issues, e.g., potential risks of addiction, or unacceptable behaviours such as bullying or harassment in the virtual world [10]. Another pitfall is the energy consumption of the metaverse: Proof-of-work mechanisms, in which individual machines -or nodes- compete for the right to add a transaction to the blockchain, with the winner receiving a reward in cryptocurrency, have a significant carbon footprint. Bitcoin alone consumes more energy than Sweden does [2]. The majority of Web3 projects have a significant environmental impact, something which goes against the Net Zero goals.

VI. CONCLUSION

It is undeniable that the metaverse is a new form of reality in which physical reality and digital virtuality combine to provide new experiences to users. Elements of the metaverse are already used in education, providing students with much richer experiences of learning-by-doing, as with AR, and VR has provided education with experiences that simulate real ones without the associated risks, like plane simulators and virtual surgery. Furthermore, VR has eliminated the need for cruel experiments with animals as these experiments can be performed virtually, with the same learning content but without the suffering of living beings. However, the use of the metaverse poses certain challenges to education: First is the high costs of new metaverse technologies, which make it unaffordable for many educational institutions, secondly, metaverse technologies are of very little use if teachers do not feel comfortable using them. Thirdly, there are pitfalls at the cognitive, the physical and the psychosocial levels, e.g., dangers of addiction, social isolation, and withdrawal from the real world; at the psychosocial level; cybersickness, nausea, radiation, etc. at the physical level, and negative effects on the cognitive development of children and young people. For this reason, metaverse technologies, as all new technologies, should be used carefully. The metaverse economy, while incipient at the moment of writing, has an enormous potential as many companies are adopting a metaverse corporate strategy by establishing their presence in the virtual world. As the metaverse economy grows, so will the metaverse labour market. New professions will arise, like cryptocurrency experts, crypto lawyers, NFT creators and "meshers", and smart contract readers, etc. These new professions will demand new skills that higher education institutions must provide to their clients, skills that are not necessarily obtained through 4-year degrees, but rather through training and development specific to each job. This new development points to the need for the cooperation of employers, educators, and training institutions so they create certified standards for skills acquired in the metaverse, that are also accredited by training providers. The metaverse provides endless possibilities, but also risks, as new technologies do when they are first introduced. Furthermore, the environmental impact of Web3 technologies is very strong, and thus incompatible with the Net Zero goal. Higher education must prepare graduates both for the real world and the metaverse with portable skills and competencies, but also with ethical values and an awareness of the risks posed by this new, alternate reality.

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