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Metaverse!
Possible Potential Opportunities and Trends in E-Healthcare and Education

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ABSTRACT

This study aimed to synthesize the literature on Metaverse to highlight its current research, opportunities, and applications in e-healthcare and education to reduce inequalities and for delivering fair and equal opportunities and solutions. The authors employed preferred reporting items for systematic reviews and meta-analyses (PRISMA) to rapidly map the field of a metaverse in health and education. Two major application domains emerged in the literature from the 88 research publications, which include (1) Metaverse in healthcare and (2) Metaverse in education. This study will act as a road map to help academics who desire to continue their research work in the Metaverse for various healthcare and educational services. However, its implementation is required in the future to improve mental healthcare and the effectiveness of mental health services, particularly in low and medium-income (LMIC) and conflict-affected areas.

KEYWORDS

E-Education, Education, Healthcare, Mental Health, Metaverse, Training

1. INTRODUCTION

In the transition from physical to virtual check-ups, information systems (ICTs) have consistently encouraged healthcare organizations to tackle healthcare needs with innovative solutions. With state-of-the-art healthcare technologies in place, individuals have begun to feel more comfortable shifting away from conventional person-to-person interactions regarding healthcare, primarily mental health, due to stigma (Wainberg et al., 2017) (Abd-alrazaq et al., 2019). However, despite technological revolution and transformation throughout the globe, there is still a huge digital divide in terms of health (particularly mental health) and educational disparities between high-income countries (HICs) and low-income countries (LICs), which needs to be strengthened (Landry et al., 2021).

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The World Federation for Mental Health theme in 2021 was "Mental Health in an Unequal World," which emphasizes that access to mental health services continues to remain unequal (*WFMH World Mental Health Day*, 2021). While the Sustainable development goals were founded on a pledge to "leave no one behind". Mental health professionals account for approximately 9 per 100,000 people (median), with 72 per 100,000 in countries with high incomes and fewer than 1 per 100,000 in low –middle-income countries (LMICs) (World Health Organization 2017, n.d.) (Batada & Solano, 2019). The key factor hindering the progress of addressing mental health issues lies in the shortage of specialized mental health practitioners, particularly in conflict settings (Roberts & Fuhr, 2019) and is extravagantly complicated further by fewer mental health professionals graduating from institutes (Batada & Solano, 2019). These factors warrant a new approach to rapidly scale up digital mental health and educational solutions to offer quality mental health and educational services. Addressing these gaps will not only assist in resolving the key challenges but will also help in strengthening the mental health systems and reducing the treatment gap which is otherwise looming in LICs and is not much better in HICs(Landry et al., 2021).

In this case, as recently announced by Facebook, CEO Mark Zuckerberg "Metaverse" could be leveraged as an emerging technology in the digital health space. The novel True Names by American mathematician "Professor Vernor Vinge" served as the inspiration for the concept. The author of this 1981 novel ingeniously imagined a virtual world that might be accessed and sensed through a brain-computer interaction. Later, Affluent American writer Neal Stephenson employed the Metaverse in fiction for the first time in his 1992 dystopian novel Snow Crash, wherein the players traverse an online realm linear to the physical realm, employing digital identities for consciousness and engagement (L. Lee et al., 2021). A form of virtual reality where every online contact might immediately influence the actual world (Mann et al., 2018). According to (*Bloomberg Intelligence*, 2021), the global metaverse market opportunity will rise from USD 500 billion in 2020 to USD 800 billion in 2024, with the online gaming industry accounting for half of the global income. Metaverse is the term formed by combining Meta and Universe to describe a virtual reality world called the matrix (*Metaverse - Wikipedia*, n.d.), and as rightly defined by (Alang, 2021) as "the layer between you and reality". However, when Metaverse first debuted, it was a virtual reality gamble by big tech and an add-on function for online gaming. One must first understand the concept of the metaverse in order to understand the validity and value of deploying it in healthcare. Currently, the term "metaverse" refers to a shared virtual 3D environment or even a number of cross-platform worlds that can offer consumers a truly immersive environment featuring interactive and collaborative tasks. In addition, a metaverse is described in literature as an enhanced virtual environment made by integrating physical and virtual space, where users can engage in augmented reality interactions, virtually meet each other, and engage in virtual activities that replicate real-world experiences.

1.1. Familiarity Development and Motivation

In order to access various medical and educational services, the metaverse offers a powerful means to communicate with people all over the world electronically. Anyone, anywhere can use their web browser to log in to a virtual world and interact with others in real-time by equipping a virtual reality headset ((Mubin et al., 2019)). Because of this, it's ideal to conceive of the metaverse as a virtual replica of the real world that developers and users can personalise to their heart's delight in a world that is increasingly spatially fragmented world due to pandemics, natural disasters, and armed conflicts. It symbolises a brand-new manner of interacting with loved ones and close acquaintances.

The metaverse, which is currently the hottest topic and began with the invention of the block chain, is the most recent iteration of the Internet, according to (Duan et al., 2021). Researchers (Joshua, 2017)and (J. Y. Lee, 2021) stated that "the metaverse is a vast 3D virtual environment parallel to our physical world in which people can interact with digital avatars, i.e. virtual reality is the future aspect of technology" (Moneta, 2020). However, according to (Parisi, 2021), the metaverse is a large realm that may contain anything within its parts and layers. Since the metaverse has lately gained popularity, academic and professional journals have extensively covered and continue to explore the reality of this new subject. Additionally, the term "metaverse" was used to describe a 3D-based virtual reality in which people conduct their everyday routines and do business using avatars that are representations of the real world (Kye et al., 2021). Here, everyday life and economies are considered as extensions of reality, and it is clear that the actual world and virtual space are intertwined, with reality expanding into the virtual realm. In other terms, one identifies with their metaverse avatar as their true selves. The concept of the metaverse is not new because it has existed for decades along with the growth of the Internet and other technologies. The chronology of the metaverse's development is depicted in Figure 1, and it includes a number of significant primary events, including the invention of the internet, its first literary mention, the creation of the first virtual world with Second Life, and more recent metaverse initiatives from major technology firms like Microsoft and Facebook.

By 2025, experts predict, as the global pandemic progresses, people will become more dependent on rapidly evolving digital tools, both for good and for bad. As a result of this dramatic change, health systems around the world will speed up the adoption of digital health techniques to provide care in both high- and low-income settings (Anderson et al., 2021). Based on data leveraged from Google Trends(*Google Trends*, 2022) over the last one year, as depicted in Figure 2 metaverse technologies identify a clear shift in popularity gain, particularly in healthcare. Similarly, the popularity of mental health together with metaverse and artificial intelligence is increasing day-by-day, as depicted in Figure 3.

2. OBJECTIVE

Conflicts around the world and the COVID-19 epidemic have significantly altered social interactions. Policies requiring social segregation, lockdowns, and compelled quarantines have accelerated electronic communication mediation at a previously unheard-of rate. Office work, education, healthcare, and conferences are just a few physical activities that have gone online thanks to social networking apps,

Figure 1.
A chronology of major events from 1991 to 2021 that reflect the growth of the metaverse. [adapted from (CNBCTV18.com, 2022)]

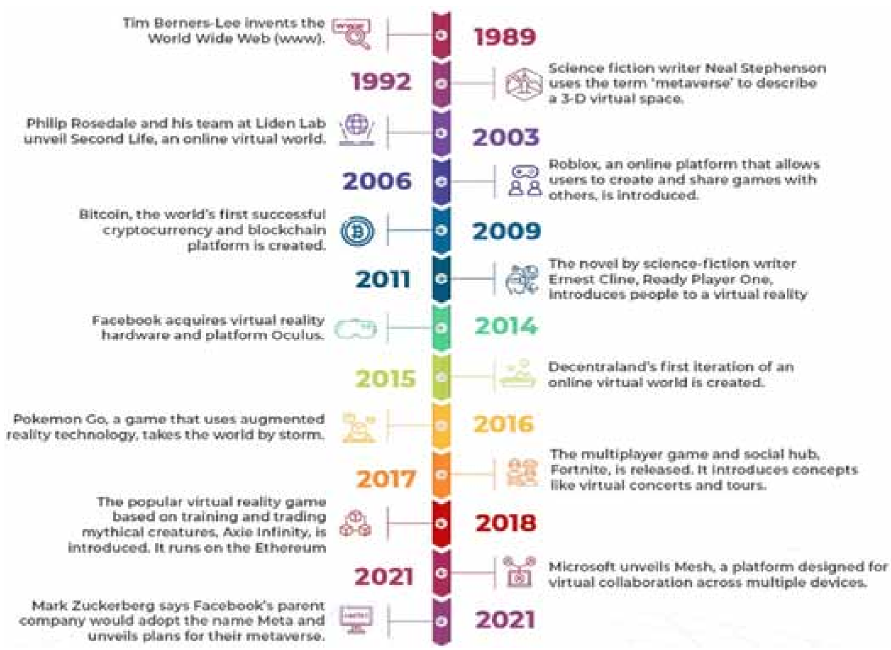


Figure 2. T
he Metaverse and Healthcare global popularity score through time, with a scale of 0 (min) to 120 (max), where the x-axis shows the timestamp information and the y-axis shows the matching score

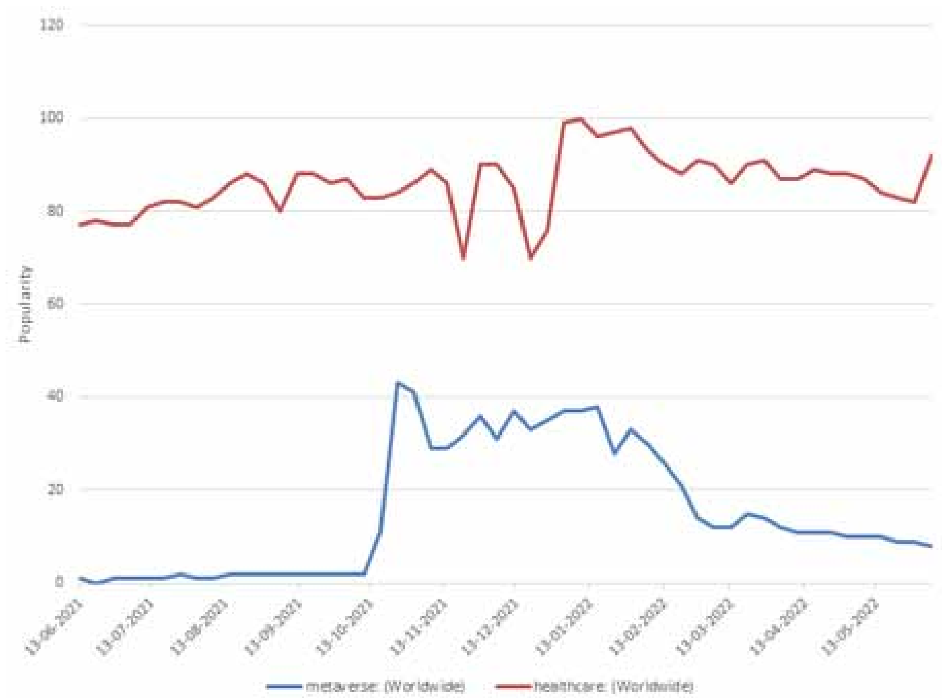
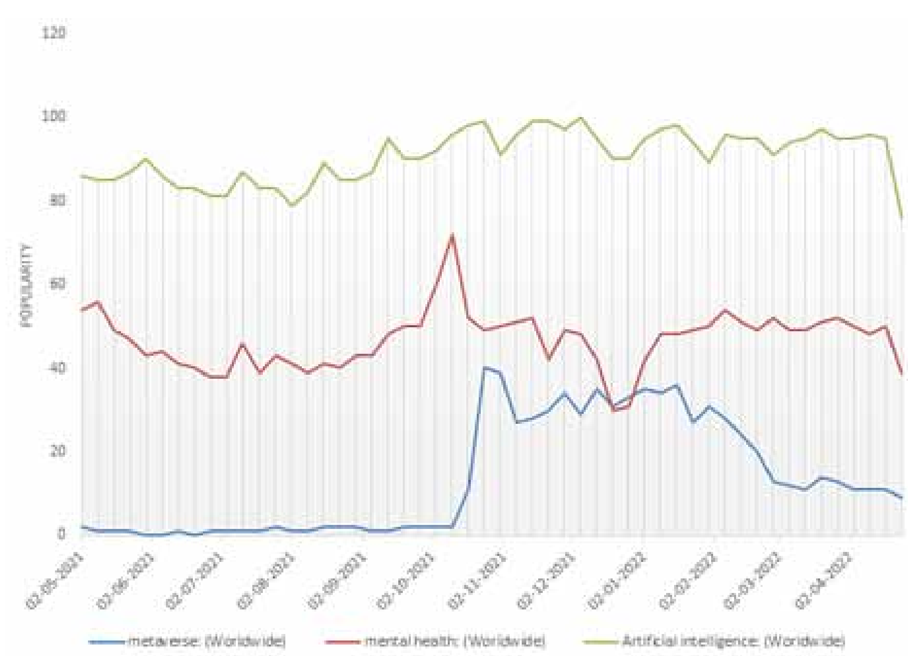


Figure 3.
The global popularity score of mental health, metaverse, and artificial intelligence topics through time, using a scale from 0 (min) to 120 (max), where the x-axis shows timestamp data and the y-axis shows the matching score



the Metaverse, or mobile devices. Due to its popularity and necessity, the number of studies on the metaverse is constantly growing. This study is unique because it addresses metaverse as a crucial new technology with essential applications in e-health care, including mental health and educational services. Accordingly, this review examined this developing field's scientific and grey literature.

3. METHODOLOGY

A comprehensive review methodology was used to map the state of the metaverse in mental health to limit the outcome bias (Stratton, 2016). Secondly, the reporting guidelines established by (Tricco et al., 2018)were adopted to fulfil this article's purpose, which is to map metaverse with mental health and educational service to concentrate primarily on broadening one's understanding of the nature of research activities. The study's primary search terms were metaverse, e-healthcare, mental health, e-education, virtual reality, and conflict. Because of the dynamic nature of the metaverse, the search covered both academic and grey literature. The grey literature search was guided by search techniques provided by (Godin et al., 2015) to improve the rigor of our comprehensive literature search.

3.1. Search Strategy

The screening approach was based on an analogous review of artificial intelligence in healthcare (Sunarti et al., 2021). The search string used to facilitate searching in selected libraries have four dimensions with their sub-domains: Metaverse, healthcare, education and study objective. The crucial keywords "healthcare", "mental health", "metaverse", "education", "augmented reality", "training", and "virtual reality" were used in the searches to find relevant material. The search was undertaken in both health and information technology (IT) databases as well as grey literature because metaverse is still in infancy stage and is gaining popularity among healthcare. For analysis, only articles published in English between 2014 and 2022 were considered. A total of (n=2251) research articles (including grey literature) were obtained over a period of twelve years. A total of (n=98) research met the eligibility criteria.Those selected for this literature review had title closest to this review's purpose. The number of papers chosen for this review was (n= 88) (including grey articles).

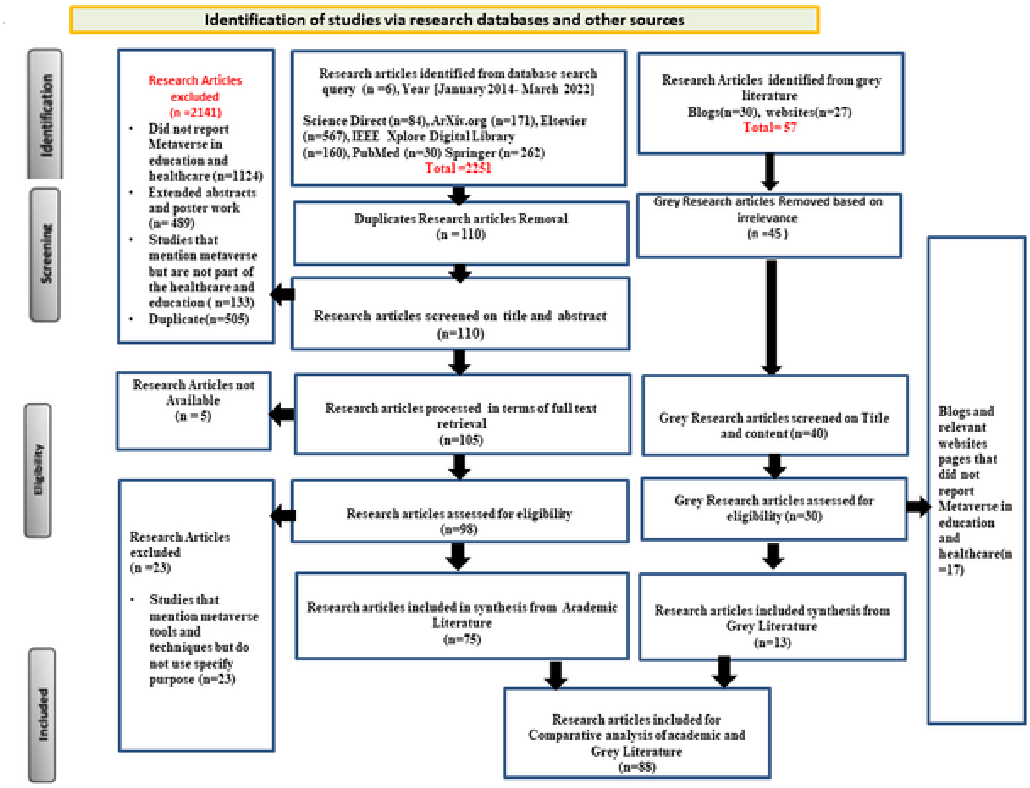
3.2. Inclusion/Exclusion Criteria

In the first instance, PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) was used to perform a literature search using a health and technology-related online research database from the year 2014-to 2021, (see Figure 4. In second instance, the associated literature search was conducted through metaverse related research databases, including Science Direct, ArXiv.org, Elsevier, IEEE Xplore Digital Library, PubMed, and Springer. Duplicate studies were eliminated after gathering the studies. Only the most comprehensive version was picked if there were many studies. The following inclusion and exclusion criteria were used to choose papers to address identified research concerns and locate the most relevant studies. Studies using at minimum one tool from the metaverse; studies that address at least one issue related to mental health; studies that use the metaverse for education and training – studies that specifically address the problem of healthcare – studies that are solely in English were the inclusion criteria. Extended presentations and poster works; studies that mention metaverse but are not part of the healthcare and education; studies that mention metaverse tools and techniques but do not use them to specify purpose; studies that were not available were exclusion criteria.

4. RESULTS

By using the research methodology and inclusion/exclusion criteria, relevant studies were identified. Two thousand two hundred fifty-one (n=2251) research studies were found after searching the seven

Figure 4.
PRISMA Flowchart of Research Methodology



electronic databases mentioned above, as seen in Figure 3. There were one hundred ten papers left after the initial three exclusion criteria and the duplicate studies were eliminated. Then a meta-data (title, keywords, and abstract)-based search was conducted. After unsuitable studies were discarded based on the title, abstract, and keywords, only 75 research remained. Every study's complete text was read. There was no inconvenience; hence no elimination was done. As a result, it was decided that 75 studies on the metaverse in healthcare and education—including grey literature—were appropriate for analysis. Twenty additional papers pertinent to the research were added as sources through reference lists after reading the complete texts of these studies. Thirteen grey publications that were specifically relevant to the inquiry were thus chosen. While we scale up and integrate, we must remain compliant with regulations and barriers (Schlieter et al., 2020) to extend health care service innovation and opportunities. Two main themes emerged as per the predefined objective from literature (1) Metaverse for healthcare (including mental healthcare) and (2) Metaverse for Education (which includes e-learning).

4.1. Theme 1: Metaverse for E-Healthcare

E-Health is generally defined as the secure and cost-effective application of information and communications technology (ICT) to promote the fields of health and health-related activities, such as healthcare services, health surveillance, health literature, and health education, knowledge, and research (*FIFTY-EIGHTH WORLD HEALTH ASSEMBLY*, 2005)(Al-Shorbaji, 2008). These technologies use a variety of system forms, but eHealth systems often rely on a combination of synchronous and asynchronous information transmission via text, teleconference, online chat, or telephonic discussion (Bowsher et al., 2021). These technologies' use in healthcare delivery across conflict-affected regions and stable low- and middle-income settings has progressively increased as their adoption in high-income health sectors has grown(Lam & Poropatich, 2008).

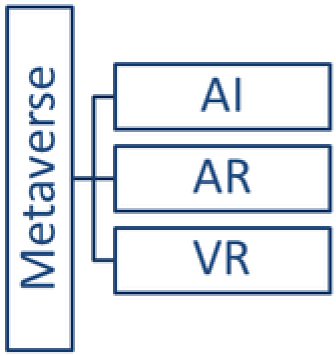
The goal of Health 4.0 is to coordinate its three central pillars—people, technology, and design—so that the healthcare system can effectively and consistently recognise the value of data to enhance healthcare services and interconnections between healthcare stakeholders. The goal of Health 4.0 is to coordinate its three central pillars—people, technology, and design—so that the healthcare system can better effectively and consistently appreciate the value of data to enhance healthcare services and interconnections between healthcare stakeholders. They ultimately assisted the transition of the entire healthcare sector from a passive, service-oriented charging system to a value-based system (Esfahani, 2019), as the metaverse applications in healthcare have considerable potential. Recent trends in metaverse technologies being used in the medical domain identify a clear shift from physical to virtual mental healthcare services. Using information and data gathered from Google Trends (*Google Trends*, 2022) over the last year, it is clear that metaverse and healthcare are gaining a huge trend, as shown in Figure 1.The popularity of metaverse together with mental health is increasing day by day, which is shown in Figure 2.

The usage of a metaverse in healthcare and medicine has increased significantly in recent years (Liu et al., 2022). According to (Yang et al., 2022) the year 2022 is designated as the Year of the Metaverse in Medicine, as the metaverse has the potential to be a significant technological game-changer for healthcare in 2022. Additionally, it is anticipated that this new idea will enhance overall healthcare as well as disease prevention, diagnosis, and treatment (Riva, 2011)(Valmaggia et al., 2016)(Chirico et al., 2016)(Mubin et al., 2019) and diagnosis (Tyrrell et al., 2018),(Cooper et al., 2018),(Hajesmaeel Gohari et al., 2019). Further, it was revealed (Thomason, 2021) that metaverse will enable coordinated medical procedures and concurrent planning, teaching, and training. Moreover, it was found that metaverse will be used for surgical simulations, diagnostic imaging, patient care management, rehabilitation, and health management (Mozumder et al., 2022)(Maharg et al., 2007) and will help speed up patients' learning about ailments or treatment options. Researchers (Mozumder et al., 2022) agree that the metaverse involves the intersection of three relevant technologies, i.e., artificial intelligence (AI), augmented reality (AR), and virtual reality (VR), as defined in Table 1 and depicted in Figure 4. Individually, these technologies are already being utilized in healthcare to change how we diagnose and treat diseases, manage data, and even train surgeons. When used in conjunction with radiology, augmented reality (AR) can give medical professionals the ability to project medical images, such as CT (Computed Tomography) scans, immediately onto the patient and in orientation with the patient's body, even when the patient is moving (Ahuja, 2019), (Kermany et al., 2018). This technological support gives medical professionals better views into internal human body anatomy.

Table 1.
Commonly used techniques in intersection with metaverse

Technology	Definition
Artificial Intelligence (AI)(Paul et al., 2018)(Mann et al., 2018)	There are several concerns and disagreements on the general goal of artificial intelligence. There is no widely accepted definition of the field. It is broad. Advances in machine learning and deep learning are generating a paradigm shift in almost every area of the IT business, despite AI being a multidisciplinary science with numerous strategies.
Augmented Reality(AR)(Thomason, 2021)(Kye et al., 2021)(Mann et al., 2018)(Mozumder et al., 2022)	Digital and physical worlds can now be more seamlessly integrated thanks to augmented reality (AR). To identify surfaces and things in the virtual environment, it uses computer vision techniques like pattern recognition, plane identification, image recognition, and motion tracking. The computer superimposes computer-generated data, such as graphics, sounds, images, and messages, on top of these previously recognized planes.
Virtual Reality(VR)(Bell et al., 2020)(Thomason, 2021)(Lucas et al., 2017)(Mozumder et al., 2022)	It is a technology that uses software and headgear to augment one's physical perception with a technologically produced landscape. When you wear full-coverage headgear, you are wholly cut off from your surroundings and the real world. These headgear gadgets' LCDs behind the lenses display a computer-generated simulated reality, replacing the human perspective.

Figure 5.
Depicting Intersection of Metaverse with other technologies. (AI: Artificial Intelligence, AR: Augmented Reality, VR: Virtual Reality)



Additionally, according to (Mann et al., 2018), virtual reality (VR) and augmented reality (AR) technologies both function in virtual environments and are used as tools for patient rehabilitation as well as information and education. The scientific literature on virtual reality (VR) and augmented reality (AR) research in medicine was examined by (Wai et al., 2021) who also reviewed frequently mentioned themes and medical disorders. The scientific literature on virtual reality (VR) and augmented reality (AR) research in medicine was examined by (Wai et al., 2021), who also reviewed frequently mentioned themes and medical disorders. Moreover, metaverse in terms of healthcare has the potential to be an interactive, immersive, and recreational experience tailored to every individual. It can provide new opportunities for healthcare providers to interact with patients in more intimate ways, such as walking through a three-dimensional human body model with patients, discussing diagnoses and treatments or knowing the heart anatomy (Zinchenko et al., 2020). This possibility would allow providers to simulate the effect of a proposed treatment on the patient's body before it is applied, creating a more personal and informative experience compared to what is currently possible with two-dimensional images on a screen.

4.1.1. Metaverse for Mental Healthcare

With state-of-the-art health technologies in place and new developments in the medical field, the healthcare technology sector is continually changing. Individuals have begun to feel more comfortable shifting away from conventional person-to-person interactions regarding mental healthcare (Abd-alrazaq et al., 2019). Transforming healthcare and Finding technologies that can bring healthcare from the hospital to the living room is crucial and is a key enabler of change in the e- healthcare industry (Bell et al., 2020). However, despite technological revolution and transformation throughout the globe, there is still a substantial digital divide and health disparities between HICs, LMICs, and Fragile Conflict populations, which needs to be strengthened(Landry et al., 2021). The World Federation for Mental Health theme in 2021 was "Mental Health in an Unequal World," emphasising that access to mental health services continues to remain unequal(*WFMH World Mental Health Day*, 2021). While the Sustainable development goals were founded on a pledge to "leave no one behind". Mental health professionals account for approximately 9 per 100,000 people (median), with 72 per 100,000 in countries with high incomes and fewer than 1 per 100,000 in low –middle income countries(LMICs)(World Health Organization 2017, n.d.)(Batada & Solano, 2019). The key factor hindering the progress of addressing mental health issues in HICs and LICs lies in the shortage of specialized mental health practitioners (Roberts & Fuhr, 2019). It is further complicated by fewer mental health professionals graduating from institutes(Batada & Solano, 2019). All these factors warrant a new approach to scale up rapidly and extend digital mental health solutions to offer quality mental health services, especially (Bowsher et al., 2021). Addressing these gaps will not only assist in resolving the key challenges but will also help in strengthening the mental health systems and reducing the treatment gap which is otherwise looming in conflict and fragile settings and is not much better in high-income countries (HICs) (Landry et al., 2021).

The development of the metaverse has opened up endless possibilities in various service sectors as researchers seek to understand how the metaverse can be leveraged for healthcare services and sustainable growth (J. Y. Lee, 2021), (Yang et al., 2022), and some researchers are of the view that this technology will reduce depression (Biffi et al., 2017) (YILDIRIM et al., 2018)(Norouzi et al., 2019). Table 2 discusses some of the significant applications of VR in the healthcare field. These developments sparked fresh ideas for leveraging metaverse for the mental health service sector. According to a recent Harvard study, "severe loneliness" affects 36% of all Americans, including 61% of young adults, and is a significant risk factor for mental health issues (Weissbourd et al., n.d.). Further, a recent study by the American cancer society (Alcaraz et al., 2019) analyzed data from more than 580,000 adults and found that social isolation increases the risk of premature death for every race. Researchers further, believe that with advancements in processing power and discoveries in the field of healthcare employing cutting-edge technologies artificial intelligence, researchers are building metaverse to deal with even more complicated and difficult aspects of health care, such mental health. (Ifdil et al., 2022).

Furthermore, some experts believe that VR-assisted psychotherapy has become a popular subject that has drawn much attention (Bergeron et al., 2015)(Tromp et al., 2018)(Matamala-Gomez et al., 2019). Some of this research has taken the viewpoint of specific medical issues, such as rehabilitation (Riva et al., 2020), mental health disorders (Tyrrell et al., 2018)(Cooper et al., 2018)(Hajesmaeel Gohari et al., 2019)(Wiederhold & Riva, 2019), psychiatric disorders (Dellazizzo et al., 2020), and drug addiction(Hone-blanchet et al., 2014). Other studies have also highlighted the potential uses of VR technology in the medical industry and considered the "big picture" of VR-aided therapy (Javaid & Haleem, 2020), concentrating on VR for medical professionals. Since the field is still developing, much of this research has concentrated on VR-based therapies designed for various psychopathologies, particularly for illnesses connected to anxiety and developmental disorders, severe mental disorders, and neurocognitive disorders. (Park et al., 2019)(Bell et al., 2020). Some of the metaverse applications in mental healthcare backed by virtual reality technology as defined in literature are depicted in Table 2.

4.1.2. Metaverse for E- Education

E-education applications are essential, and adopting new technologies is necessary in our era. SARS-CoV-2 virus (H. Lee et al., 2022), which infiltrated human lives in January 2020, had a catastrophic impact on our lives and robbed humankind of countless opportunities in its daily lives. The importance of ideas like e-learning, distance work or online education, and blended learning has expanded due to this virus, which has impacted every area from the production sector to the education sector (Pardo et al., 2019). Haythornth Waite & Andrews (Haythornthwaite & Andrews, 2011) defined e-learning as a system of learning that derives its foundation from formalised instruction and enlists the aid of electronic resources. However, E-learning was first not taken seriously since the human aspect was felt missing (Clark & Mayer, 2011)(Clark & Mayer, 2016), yet it has gained appeal by encouraging electronic technology to be used more in educational curricula outside of the classroom teaching boundary. Additionally,(Watson, 2008) explains how e-learning has virtually made it feasible to offer education on a large scale, eliminating the requirement for traditional classrooms to be provided physically and at various locations. Additionally, e-learning can effectively employ the metaverse as a solution for disciplines like engineering and medical that wholly rely on convergence but cannot be taught online or through remote learning.

Metaverse-based systems can also be used to provide safe and effective environments for education by utilising virtual reality technology and continuously researching and attempting to enhance learning experiences (Jacobs, 2019) (Hyun, 2021), and integrating web and Internet technologies

Table 2. Metaverse virtual reality application in mental healthcare

Reference	Description	Application
Riva, 2011), (Chirico et al., 2016) (Mubin et al., 2019)	● Utilizing this technology, exposure therapy is modified in a way that benefits people with various forms of mental illness. ● It offers low-cost treatment with a lower chance of death and social contact amongst virtual characters, both of which are beneficial for acquiring life skills. ● It supports a patient's therapy while they are struggling with mental health issues.	Treatment of mental illness
(Tyrrell et al., 2018), (Cooper et al., 2018), (Hajesmaeel Gohari et al., 2019)	● virtual reality as a tool for precise diagnosis. ● It eliminates the requirement for a magnetic resonance imaging (MRI) or computer tomography (CT) scan. ● Accurately recognises disease signs and symptoms. ● Gathers patient information for accurate diagnosis.	Diagnosis
(Marco et al., 2013), (Diemer et al., 2015),(Lin et al., 2019)	● Virtual surgery is performed using virtual reality (VR), which reduces risk and saves time. ● It is additionally employed in tele surgery, which enables the surgeon to carry out the procedure from a distance.	Virtual surgery
(Han et al., n.d.)	● For the benefit of virtual service providers, employed a collection of IoT devices running on their metaverse platform (VSPs). ● The interface, crossword ecosystem, infrastructure, and in-world ecosystem are seen as the four main parts of the metaverse. The first three elements link the physical world and the metaverse, while the last element, which is made up of funding, non-fungible tokens (NFT), and user-generated content, constitutes the metaverse (UGC)	Collecting real world data
(Nguyen et al., n.d.)	● Presented a block chain-based application framework for the metaverse. ● Their architecture is made up of three layers: interactions, which explain how users engage, permissions, and resource contributions; block chains, which allow providers and businesses to share data blocks; and applications, which users utilise and should be supported by the metaverse framework.	Resource sharing Via block chain
(Heath et al., 2005)	● Numina was developed as a mobile learning environment. Its architecture is well described, beginning with servers and the protocols and services they provide, moving on to the environment used to create lessons and learning applications, and concluding with the virtual learner communities that use the servers and development environments to access the learning services [30].	E-learning
(Bergeron et al., 2015), (Tromp et al., 2018),(Matamala-Gomez et al., 2019)	● It appears to be a great instrument for psychotherapy to increase effectiveness. ● It has a tremendous potential for treating a variety of other mental illnesses. ● It is practical for regular interpersonal contact, which is useful for altering behaviours and resolving the needed issue	Psychotherapy
(Biffi et al., 2017) (YILDIRIM et al., 2018) (Norouzi et al., 2019)	● By utilising this technology, medical professionals and researchers have demonstrated a decrease in younger people's depression. ● By VR a depressed person's mind and brain can be modified, which improves both their quality of life and that of their children.	Depression Reduction
(Vergara et al., 2017),(Chan et al., 2018), (Peeters, 2019), (Fanchiang & Howard, 2018)	● Patients can conduct virtual workouts in a secure environment, which helps patients reduce discomfort when they engage digitally and successfully recover from trauma so they can execute cognitive functions.	Trauma pain Reduction

with extended reality(XR) in addition to being a virtual reality (VR) environment (L. Lee et al., 2021). Additionally, (Bridges et al., n.d.) asserted that the metaverse's roadmap is separated into four categories: augmented reality, lifelogging, mirror worlds, and virtual worlds where users can directly or indirectly encounter, save, and pair E-Learning keywords with any 3D content via their mobile devices to evaluate or explore information and offer tailored services to users depending on the metaverse without limitations of time and space (Kim, 2021). Additionally, augmented reality (AR) is used to give students hands-on learning opportunities, such as modelling patient and surgical experiences to let medical students see and practise new procedures. Students might engage in even more realistic simulations of surgery where they could perform the procedure as if they were the surgeon themselves (Thomason, 2021). The metaverse applications in education backed by virtual reality technology as defined in literature are depicted in Table 3.

5. DISCUSSION

This article emphasises contemporary research and practical applications to consolidate research on metaverse applications and potential opportunities for e-healthcare and e-education. It was revealed that the use of metaverse using VR and AR in the healthcare industry and education sector is crucial for enhancing the performance of the medical community in terms of patient services, remote medical education and training. In terms of mental health treatment, it was revealed from the literature that this technology has revolutionized how we seek help from friends, family, co-workers, or healthcare professionals during a mental breakdown. With metaverse in place, it was found that service providers can review the diagnosis and understand the anatomy of a brain MRI for a thorough understanding of the treatment, which will help in scaling up mental health services (Tyrrell et al., 2018)(Cooper

Table 3. Metaverse virtual reality application in education

Reference	Description	Application
(*Gamifying Your Learning*, 2021)	● It serves as a real-world illustration of gamified learning. ● For each lesson attended, each video viewed, each assignment finished, and for select users, NFT crypto collectibles, users are awarded with tokens. ● AI (Artificial Intelligence) educators can use augmented reality to demonstrate how to sing, stand, and project more confidence to students. ● People will be able to learn from a wholly game-like environment employing these tactics, using celebrity trainers to show certain abilities. This might be a "celebrity surgeon," in which case the doctor is compensated for his instruction and the students are compensated for their learning.	Gamified Learning,
(Suzuki et al., 2020)	● A system for learning that can evaluate virtual world objects and show how important it is for cross-border research collaboration. This is referred to as a reaction to facilitate collaboration between distant organisations and nations. ● Provides a conceptual framework for the metaverse's educational system.	Learning system
. (Duan et al., 2021)	● They gave a succinct history of the metaverse's evolution, which uses block chain and serves as a decentralised, essential function required by every system on the metaverse and is the foundation of metaverse technologies. ● They employed the block chain as the infrastructure component before asking, but avoiding answering, concerns about processing power. ● This research suggests a metaverse architecture, it's very simple and abstract nature prevents it from being used to create an e-learning system.	E-learning
(Ariyadewa et al., 2010)	● A 3D virtual world was created online where students may interact with each other. ● It blends environments from 2D and 3D. ● Their model states that the 3D world can only function properly when a combined 2D environment is used as a resource to feed it.	Personalized learning
(Jovanović & Milosavljević, 2022)	● Proposed a high-level software architecture for a more secure metaverse platform, with the main goal of supporting cooperative learning activities in the virtual learning environment (VLE). ● It makes use of contemporary technologies and metaverse ideas.	Collaborative Learning
(Suzuki et al., 2020),	● To adapt education to Society 5.0, which relies on the Internet of Things to disseminate knowledge. ● Proposed a metaverse-based educational system in order to create a VLE. They were initially dependent on a variety of 3D objects and IoT.	Virtual Learning Environment
(Heath et al., 2005)	● Numina was developed as a mobile learning environment. Its architecture is well described, beginning with servers and the protocols and services they provide, moving on to the environment used to create lessons and learning applications, and concluding with the virtual learner communities that use the servers and development environments to access the learning services [30].	E-learning
(Drewett et al., 2019)	● Beneficial in developing the finest learning programme for medical education and training. ● Beneficial to plan and practise a risk-minimizing challenging surgical technique. ● It has also improved students' comprehension of age-related illnesses and problems. ● It has also introduced a novel method of teaching and learning for medical students.	Education and training

et al., 2018)(Hajesmaeel Gohari et al., 2019)(Roberts & Fuhr, 2019). It was discovered that mental health professionals actively employ virtual reality to treat PTS (post-traumatic stress disorder), reduce depression, and ease trauma pain (Biffi et al., 2017)(YILDIRIM et al., 2018)(Norouzi et al., 2019). Further, Owing to poor mental health professionals to population ratio and cost (Batada & Solano, 2019), adapting metaverse based virtual psychotherapy (Javaid & Haleem, 2020) services as defined by (Bergeron et al., 2015), (Tromp et al., 2018), (Matamala-Gomez et al., 2019) could expand access and reduce costs, and a new era of care delivery can be unleashed in tackling the rising demand for mental health therapy because we need faster and cheaper therapeutic options. Further, it was revealed that virtual therapy, improves overall access by providing a more realistic experience, by eliminating the risks of visiting real-world physical sites. For example, Applied (*AppliedVR*, 2022) had got FDA approval for successfully reducing chronic pain, which affects more than 100 million Americans more than cardiovascular disease, cancer and diabetes combined (a public health crisis) without the need for pain medication by utilizing virtual reality treatment.

The literature by (Riva, 2011)(Valmaggia et al., 2016)(Chirico et al., 2016)(Mubin et al., 2019) indicated that the use of VR and the metaverse for healthcare is still in its infancy and has the potential to digitally empower the younger generation to take control of their health and to educate themselves and their counterparts in a safe social virtual environment. Further, it can be inferred from the current situation that metaverse VR has excellent scalability-and the potential to be integrated with healthcare, education, and training. Moreover, it was revealed that in terms of Collaboration for training, education and providing healthcare care services virtual meetings to be held remotely are expected to reach 75% by 2024 after the pandemic(*Gartner Magic Quadrant for Meeting Solutions*, 2022). During the COVID-19 epidemic, numerous well-established teleconference solutions have been widely used to communicate in both personal and professional contexts. However, in the education context and blackboard Collaboration, popular platforms, which include Zoom, Skype, and Google Meet, have been leveraged. However, existing companies with competence in VR, AR, and XR are accelerating development in this field due to the presence-based inadequacies of these platforms. This research may result in significant advancements in immersive VR, AR, and XR technology in the coming years. In addition, of the 298 participants who took part in the VR survey, 60.9 percent had obtained their VR equipment during the epidemic, in addition to playing games and movies, 46.0 percent of respondents who used VR for business and 37.2 percent of respondents who used it for education, respectively (Ball et al., 2021). Further, metaverse's Horizon Workrooms(*Horizon Workrooms for VR Remote Collaboration | Meta*, 2021) is a leading collaboration tool that enables people to collaborate virtually regardless of their physical location. In terms of education and Training it was found that metaverse would help in imparting quality education and training from the top experts around the world and has the benefit of allowing safe simulations of situations that would be risky in a practical environment (Feng et al., 2018).

Moreover, according to (Faura-Martínez et al., 2022)72% of the 3080 participants said they had trouble following the curriculum after moving to digital education. The metaverse, a three-dimensional virtual reality where users may fully immerse themselves in the environment in terms of visuals and motion, was discovered to be why VR attracts greater attention (Xing et al., 2021). Researchers (Bun et al., 2017) and (Drewett et al., 2019) found that using VR and the metaverse to create the optimal learning programme is beneficial for medical education and training. Additionally, it was discovered that immersive technology, such as virtual reality, is essential for education and training and offers the benefits of flexible training schedules irrespective locations (Pears et al., 2020), however, in many studies (Jou & Wang, 2013)(da Cruz et al., 2016)(Tüzün & Özdinç, 2016)(Rusiñol et al., 2018) it was discovered that adopting VR in education had a favourable impact. It was also found (Yang et al., 2022) (Thomason, 2021)(Kye et al., 2021)(Mann et al., 2018)(Mozumder et al., 2022) that the medical school curriculum already incorporates augmented reality (AR) and virtual reality (VR) to train healthcare professionals to identify child protection issues (Drewett et al., 2019). However, ((Pan et al., 2018) emphasise the necessity of additional training and study to raise this recognition rate.

Additionally, we believe that in the future, the development of metaverse technologies has the potential to help the provision of mental health and educational services in environments of armed conflict. Reviewing and summarizing the evidence from these studies is critical to reaching and extending the use of metaverse in conflict settings to decrease the treatment gap and scale up mental health services in conflict zones, as there is no guarantee that violent conflict will not recur. As noted by (Akbulut-Yuksel, 2014), it is, therefore, necessary to devise strategies that can work in uncertain situations. This attempt will become the basis of future research in the field of metaverse amid the Humanitarian crisis. Additionally, the variety of e-health health technologies to address geographic, epidemiologic, and clinical inequities in conflict has expanded along with the evolution of armed conflict in recent decades. In order to support the further deployment of eHealth services in these situations, more research is needed to build an evidence base.

Further, in future, extending these immersive services to the people living in conflict and fragile states will keep the passion for innovation burning. Further, several complex and diverse issues must be addressed, such as whether one could people become addicted? Will it be harmful to persons who suffer from mental illnesses? On the other hand, will it enable individuals with limited incomes, disabilities, or those living in conflict zones to access mental health? Is it possible that it will change the way psychiatric disorders are treated? It is presently difficult to pinpoint what metaverse is, precisely what ramifications are and what conclusions can be taken, regarding the impacts of metaverse digital addiction.

6. LIMITATION

This review's methodology was chosen to know the possible potential applications of metaverse in mental healthcare and education to produce topical information that guides future investigation so as to leverage the same technology in conflict settings. Given the existing scarce, ad hoc, and varied nature of initiatives examined, it was assessed that a comprehensive vetting process will not provide new insights beyond the already defined theme concepts. A selection bias, for example, could have been introduced because only publications in English were retrieved, eliminating literature written in all other dialects. A similar constraint applies to database choice: more relevant research might have been discovered if more databases or grey literature had been screened. In addition, each review has the potential for selection bias since the number of sources that can be explored efficiently is constantly limited. We aimed to reduce selection bias by searching domain-specific resources in healthcare and technological fields, including the key critical archives in mental health research, virtual technologies, and computer science. As a result, we decided that restricting the compilation to academic journals and few quality reports from grey literature would be a fair quality assurance strategy. In addition, this technology's principal drawback is the high cost of its commercial application in the medical industry. In order to widen the scope of this study, we plan to experiment with several engineering specialties to see if the metaverse is appropriate for technical education.

7. CONCLUSION

The quality of care could be significantly improved if metaverse is successfully integrated into healthcare and education. New mental health diagnosis, surveillance, and intervention techniques may enhance patient outcomes and restructure the workload of clinicians. This will require careful navigation to ensure the successful implementation of this new technology as the metaverse is a new next-generation digital world, and we are yet to see its full potential. Nonetheless, it is never too early to begin researching surrounding the potential and challenges of a metaverse in primary mental health care. This technology is in its infancy and will require another decade before it can be used in the healthcare industry. However, the way companies are investing in the creation of the metaverse. It seems promising that it will transform mental healthcare soon.

Further, many technologies are emerging in terms of e-healthcare and e-education. Although these technologies might be complex and not fully understood at first, they have the potential to alter life profoundly. In conclusion, the metaverse is the most recent technology that has not yet been wholly investigated or applied. The metaverse is a brand-new and exceptional environment for training, education, and wellness. Another developing area is the examination of metaverse applications, whose importance has increased due to the COVID-19 pandemic. This review article can act as a primer for health educators on the potential uses of the metaverse for healthcare and education.

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COMPETING INTERESTS

The authors of this manuscript declare no competing interest.

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