Emergence of the Metaverse and Psychiatric Concerns in Children and Adolescents

Soyeon Kim[1,2] and Eunjoo Kim[1,2]

[1]Department of Psychiatry, Gangnam Severance Hospital, Yonsei University College of Medicine, Seoul, Korea
[2]Institute of Behavioral Sciences in Medicine, Yonsei University College of Medicine, Seoul, Korea

Advancements in digital technology have led to increased usage of digital devices among teenagers. The coronavirus disease 2019 pandemic and the subsequent implementation of social distancing policies have further accelerated this change. Consequently, a new concept called the metaverse has emerged. The metaverse is a combination of a virtual reality universe that allows individuals to meet, socialize, work, play, entertain, and create. This review provides an overview of the concept and main features of the metaverse and examples of its utilization in the real world. It also explains the unique developmental characteristics of childhood and adolescence, as well as the possible negative influences of the metaverse on them, including addiction, antisocial behavior, cyberbullying, and identity confusion. This review summarizes several suggestions for future research because the metaverse is a relatively new concept.

Keywords: Virtual reality; Adolescence; Mental health; Addiction.

INTRODUCTION

The usage rate of digital devices among teenagers has increased as digital technology has advanced. In particular, the past few years, including the period since the coronavirus disease 2019 (COVID-19) outbreak and subsequent implementation of social distancing policies, have had tremendous effects on every aspect of global society. Adolescents worldwide have begun to spend more time on digital devices, and according to 2021 statistics for South Korea [1], 4 out of 10 teenagers (37.0%) appear to be at risk of smartphone addiction.

Digital technology has progressed to create new and innovative concepts of the metaverse with this trend. The term metaverse is a combination of "meta," meaning transcendence and virtuality, and "universe," meaning a three-dimensional (3D) virtual world inhabited by avatars of real people [2]. This combination of virtual reality (VR) universe allows individuals to meet, socialize, work, play, entertain, and create. In the metaverse, it is possible to communicate with different members—avatars, work, and entertainment—and engage in economic activities through the unique assets of the digital world, called non-fungible tokens (NFT). Metaverse attracts the attention of teenagers who are more receptive to new cultures and have high digital literacy. Generation Z, more change-friendly than previous generations, is attracted to the metaverse to form a new, independent culture through virtual spaces [2].

Furthermore, as COVID-19 has physically isolated individuals, adolescents' desire for social relationships has boosted the online world, including the metaverse. Metaverse services have now become an important place in youth's lives as they affect online classes conducted at schools beyond entertainment tools such as "Zepeto" and "Minecraft" [3]. However, along with the opportunities that digital technology brings, there are risks and harm related to the metaverse. As children and adolescents spend an increasing amount of time on digital media, there are growing concerns regarding the impact of this change on their mental and physical health and wellbeing. The metaverse can harm children's mental health, such as exacerbating depression, anxiety, addiction, self-harm, suicidality, or anorexia. Cyberbullying, sexual misbehavior, exploitation of minors online, online gambling, privacy, and security issues can also become serious social issues among teenagers. There are many concerns about how the metaverse will affect society at the individual and long-term environmental levels, but little research has been conducted on this subject. Governments and professionals worldwide are pressured to regulate and offer safety guidelines concerning using the metaverse.

Our review aims to explain the main characteristics of the metaverse, provide examples of its utilization in various fields with the following benefits, and describe the possible psychiatric concerns expected when applied to adolescents.

METAVERSE VS. VR

It is important to note that while the metaverse has its roots in VR, the metaverse, and VR are distinct entities. The concept of VR has existed for more than 50 years and has gradually developed into the concept of augmented reality (AR). In immersive VR, images are presented by a computer, and sensory information is gathered to generate a display system that is moderated by the user's position and orientation and detected by a head-mounted device [4]. AR enhances the physical world by superimposing digital images onto tangible objects. Metaverse encompasses VR and AR and the concept of a physically persistent virtual space [5]. It can provide users with immersive experiences by allowing them to enter a persistent digital space to interact with other users, objects, and the internet environment.

Furthermore, the metaverse is expected to give rise to a new self-sustaining digital economy [6], and NFTs will play a significant role. NFTs enable users to own and trade virtual goods, creations, and experiences within the metaverse. Therefore, unlike traditional media or virtual environments, a metaverse aims to create an immersive and interactive space where users can shape and transform the digital realm by sharing user-created content [7].

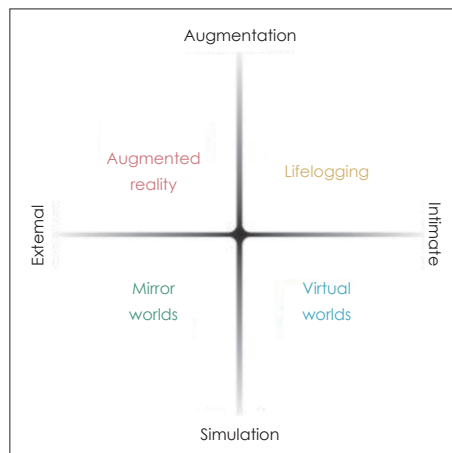## FOUR FEATURES OF THE METAVERSE

Acceleration Studies Foundation presented the "Metaverse Roadmap" in 2007, categorizing the metaverse into four types: AR, lifelogging, mirror world, and VR [5], which is shown in Fig. 1.

AR

AR supplements the real world with virtual content by overlaying digital images of physical objects. It provides an environment that enables users to interact with virtual objects in the real world. The online game Pokémon Go is a good example in which AR provides a strong sense of reality, immersing us in virtual space.

Lifelogging

Lifelogging is a technology that captures, stores, and describes everyday experiences and information about things and people. Every moment in daily life is captured as text, videos, sounds, etc., stored on a server, and shared with oth-

Fig. 1. Four features of the metaverse: augumented reality, lifelogging, mirror worlds, and virtual worlds. Adapted from Acceleration Studies Foundation [5], under the terms of the Creative Commons Attribution Non-commercial Share Alike License (CC BY NC SA).

ers. Facebook, Instagram, Twitter, and KakaoStory can all be included in lifelogging metaverse [2]. The individuals participated in the study in two ways. First, they record various aspects of their lives, such as learning, work, daily life, and every moment that happens to them in text, images, and videos, and store them on an online platform. Second, they look at the storage posted by other users, leave their thoughts in text, display their emotions with emoticons, and bring them to their lifelogging site to see or share them later. Through these platforms, we can show various identities (in other words, multiple personas) in various spaces.

Mirror world

The mirror world is a virtual world that reflects the real world as much as possible but expands to offer more information and is created by adding efficiency and scalability to the real world [2]. Delivery applications and internet map services offered by Google Earth and NAVER Maps are examples of the mirror world. Although one mirror world does not contain the entire real world, it is widely used in various fields, such as business, education, transportation, distribution, and cultural content, based on its efficiency and scalability.

Virtual world

The virtual world is a metaverse world that designs and lives in spaces, times, cultural backgrounds, characters, and social systems that differ from reality. In the virtual world, users engage in activities similar to economic and social activities in the real world through avatars rather than their original appearance. They enjoy new ways of exploration, communication, and achievement [2]. Exploration, communication, and achievement can only be enjoyed in the virtual

world, and many things can be experienced more efficiently in the virtual world than in the real world. Examples include games played in VR are examples.

METAVERSE AROUND US AND ITS POSITIVE ASPECTS

Metaverses are already used in various ways despite being a relatively recent concept. Some examples are listed below, and the benefits of the metaverse are discussed later.

Roblox is a VR platform launched in 2006, where one can create one's own space and games on various topics such as shooting, strategy, and communication using a tool called Roblox Studio, decorate their characters, and purchase various accessories using the virtual currency system called "Robux" [2]. Mainstream users are between the ages of 6 and 16, and in the United States, more than half of the children under age 16 years enjoy Roblox. In Roblox, children play not only as players in the world created by others but also as creators who create a space for others to enjoy. Teenagers make money by creating a virtual world metaverse they imagine as Roblox and providing it to other users.

Zepeto, launched in 2018, is an AR avatar service offered by NAVER and is one of the most frequently used metaverse platforms in Korea [8]. Users create a 3D avatar that represents themselves and use it to communicate with others. Various activities, such as games and educational roleplay, can be performed through multiple maps. Teachers can select a classroom map and provide space for students to interact with each other through voice or messages.

In psychology and psychiatry, the metaverse can create opportunities for individuals to consult mental health professionals uniquely and potentially more comfortably by using avatars [9]. Using avatars can particularly benefit individuals with high social anxiety and interpersonal trauma levels. In an experimental study by Slater et al. [10], participants enacted internal dialogue in VR by alternating two different virtual bodies, one representing themselves and the other representing Sigmund Freud as shown in Fig. 2. This method is considered possible for self-counselling.

Group therapy sessions in which meditation and mindfulness were practiced were also possible. Pregnant and newborn mothers can use the metaverse to gather and share experiences [9], preventing postpartum depression and subsequent psychiatric issues in early childhood. In addition, a metaverse-based social skills training program for children with autism spectrum disorder (ASD) was developed [11]. In this study, participants diagnosed with ASD were to use wearable devices during the experiment to gather real-time biometric information. They participated in a metaverse-based

Fig. 2. The virtual scenario of self-counselling. Participants were to enact internal dialogue in virtual reality through alternating two different virtual bodies-one representing themselves and the other Sigmund Freud. Adapted from Slater et al. Sci Rep 2019;9: 10903 [10], under the terms of the Creative Commons Attribution License (CC BY).

social skill training program once a week for 60 minutes per session for 4 weeks. This approach is beneficial because of its accessibility and low cost. In addition, if children's emotional changes can be detected using biometric information collected through wearable devices, strong emotions such as anxiety and anger can be managed in advance.

As mentioned above, the metaverse has already begun to be applied in various fields, creating space and increasing accessibility for new experiences and adventures, educational resources, and social interactions. Especially in the medical field, the metaverse has significant potential to transform the healthcare industry, particularly in the therapeutic fields [12]. Psychologists and psychiatrists will be able to personalize environments for individuals in exposure therapy, for children with ASD or attention-deficit hyperactivity disorder to practice social interactions, and for adolescents with anxiety to practice mindfulness and meditation [9].

NEGATIVE ASPECTS OF METAVERSE ON THE MENTAL HEALTH OF CHILDREN AND ADOLESCENTS

As the proportion of metaverse adolescents increases, discussing their impact on adolescents' mental health is also necessary. Adolescence is a developmental period during which brain regions undergo significant changes because of

biological and environmental factors [13]. The cognitive control system matures progressively. Thus, adolescents' ability to self-regulate their behaviors, desires, and emotions is still immature [14]. Previous studies have indicated that intensive digital media use can induce attentional problems [15], reduce working memory capacity because of an increased tendency to conduct multitasking [16], and lower the level and efficiency of text comprehension written on screens compared to papers [17]. In addition, adolescents were shown to be more susceptible to internet addiction than young adults during COVID-19 [18] because of a less developed cognitive control system. Adolescence is characterized by more complicated and hierarchical peer relationships with broader social networks [19], and the increased use of social media has affected teenagers socially and emotionally. Marciano et al. [20] obtained meta-analytic results showing that the time spent on social media was positively correlated with ill-being, implying that using social media platforms was related to higher psychiatric symptoms. Social media use has been associated with higher levels of depression, anxiety, general mental health problems, and lower self-esteem, especially among girls [21]. Heavy social media use showed a positive correlation with suicidal risk [22], and sharing information about deliberate self-harm or suicide plans on social media can lead to normalizing pathologic behaviors [23].

Thus, teenagers with immature self-regulatory functions are more likely to act on metaverse impulses and are socially and emotionally affected. The following section describes some of the expected negative impacts of the metaverse on the mental health of children and adolescents.

Addiction

Digital addiction has gained popularity as the internet has increasingly permeated our lives. The potential for addiction to computer or smartphone games and social media has become a major concern worldwide. Children and adolescents are especially big targets of digital addiction because of their incomplete cognitive control system [18] and increased reward-seeking and risk-taking behavior [24]. Previous research has shown that a younger age increases the risk of symptoms of addiction [25]. Weinstein and Lejoyeux [26] indicated that brain imaging studies of internet gaming disorder, one of the most common addictive disorders among teenagers, share activation in brain regions associated with reward, involving dopamine-mediated reward mechanisms, reduced activity in impulse control areas, and reduced functional connectivity in brain networks involved in cognitive control, executive function, motivation, and reward. Metaversely, VR provides a more real and immersive service that can cause blurred recognition between reality and virtuality

[27]. Recent research has shown that VR gaming is more addictive than other forms of gaming [28]. This addictive nature can be because the metaverse is based on multisensory interactions [29], involving auditory, visual, and haptic (touch) feedback and a 3D feeling of space. Replicating reality is considered the most addictive characteristic of media [30]. Previous research has suggested that feelings of spatial presence can lead to stronger emotional arousal [31] and enjoyment. Metaverse will be the most realistic media thus far and will thus be considered the most addictive form of media. Children with media addiction can have poorer social skills, a higher tendency to act impulsively, and suffer from depression, anxiety, social anxiety, and poor academic performance [32].

Antisocial behavior, cyberbullying, and cybercrime

The threat of antisocial behaviors and cyberbullying is also a major concern for children and adolescent users because of the avatar concept and anonymity [33]. Cyberaggression includes cyberbullying behaviors, and the concept extends to include behaviors that do not typically occur in face-to-face setting [34]. People in a virtual environment can feel more confident when acting in discriminatory and aggressive ways, causing sexual harassment, racism, homophobia, and transphobia within video game communities [35]. Cybercrime can be used to develop and target adolescents. Sexual abuse in adolescents has been frequently reported, and teens lacking morality and familial support are considered more vulnerable [36].

Previous research has also stated that negative, violent, or abusive experiences in the virtual world can cause similar psychological and physiological responses in the real world [37]. Some studies have indicated that VR gaming can induce aggressive behavior [38]. It should be noted that reduced sensitivity and empathy in the metaverse, because of anonymity, can lead to actual violence, not only in the virtual but also in the real world.

Identity confusion

In the metaverse, users can use various forms of avatars, and the sense of embodiment can lead to identifying users with their avatar [39]. In real life, users can escape from their negative selves using an idealized avatar [40]. However, virtual profiles can simultaneously provoke habits of comparing oneself with others, leading to unrealistic standards of beauty and lifestyle [41], and worsening body dysmorphia. Massively using the metaverse and avatar can lead to identity confusion in children and adolescents, as adolescence is critical for identification formation.

FUTURE DIRECTIONS

The metaverse is a relatively recent concept; however, it is rapidly gaining popularity among the younger generation. It is reasonable to anticipate that the metaverse will profoundly impact this demographic in various ways, given the significant influence of past media on teenagers. Thus, further research is required to predict and prevent the potential harm caused by metaverses to teenagers' mental health. However, further investigation is required in some areas.

Impact on cognitive development

Researchers should investigate how prolonged exposure to the metaverse affects children's cognitive skills, including attention span, problem-solving abilities, and memory. This study explored the positive and negative effects, such as the potential for enhanced spatial awareness or the risks of information overload and decreased real-world engagement. However, the metaverse can also offer children enhanced, immersive learning experiences and equal access to various resources and opportunities. Thus, research should aim to balance the various effects of metaverses on cognitive function.

Social interaction and emotional well-being

Metaverse offers new forms of social interaction but may also present unique challenges. Studies have examined how interactions in metaverse environments influence children's social skills and emotional well-being. These studies could investigate factors such as virtual bullying, online friendships, empathy development, and their potential impact on self-esteem and body image. However, as being metaverse can disconnect children from actual social relationships, including those with family and classmates at school, its impact on family relationships and interactions at school should be studied in future research.

Addiction and excessive use

There are concerns about potential addiction or excessive use among children, given the immersive and engaging nature of the metaverse. Future research should explore the prevalence, risk factors, and consequences of metaverse addiction, as well as effective prevention and intervention strategies.

Differentiating virtual and real-world experience

Understanding how children distinguish between metaverse and real-world virtual experiences is valuable. This research explores the potential blurring of boundaries between the virtual and physical worlds and examines whether this impacts children's sense of identity, empathy, or perception of reality.

Ethical considerations and child protection

There is a need for further research on ethical considerations and child protection measures as the metaverse expands. This research could involve investigating privacy concerns, the impact of targeted advertising, potential exposure to inappropriate content, and the role of parental supervision and guidance in a metaverse environment.

Development of intervention and support programs

Research should focus on developing effective intervention strategies and support mechanisms for children who may experience negative mental health effects related to metaversion. This research may explore the role of parental involvement, educational programs, mental health resources, and technological tools in promoting a healthy balance between virtual and real-world experiences.

CONCLUSION

The progressive advancement of technology and the emergence of the metaverse are globally compelling trends that are difficult to resist. The main target of this cutting-edge technology is the new generation. Therefore, we must predict and prepare for the impact of the metaverse on them. Although this review mainly focuses on the negative effects of metaverse on adolescents' mental health, it can also be appropriately used in educational fields and to treat various diseases. Children can engage in various new activities and have the opportunity to cooperate and communicate with their classmates without spatial constraints. Adults need active supervision and regulation because their judgment and decision-making functions are incomplete. Thus, policymakers should set up guidelines to protect young users from potential harm, and child psychiatrists should keep up with this technological transition to understand the new generation and effectively utilize the technology to provide optimal treatment options.

Availability of Data and Material

All data generated or analyzed during the study are included in this published article.

Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

Author Contributions

Conceptualization: Soyeon Kim, Eunjoo Kim. Data curation: Soyeon Kim. Formal analysis: Soyeon Kim. Funding acquisition: Eunjoo Kim. Investigation: Soyeon Kim, Eunjoo Kim. Methodology: Soyeon Kim. Project administration: Eunjoo Kim. Supervision: Eunjoo Kim. Validation: Eunjoo Kim. Visualization: Soyeon Kim. Writing—original draft: Soyeon Kim. Writing—review & editing: Eunjoo Kim.

ORCID iDs

Soyeon Kim   https://orcid.org/0000-0003-1059-444X
Eunjoo Kim   https://orcid.org/0000-0003-3061-2051

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