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A Conceptual Exploration: Incorporating Physical Education with Metaverse

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ABSTRACT

The term "metaverse" refers to a range of technologies, including chip technology, network communication technology, VR/AR/MR/XR technology, game technology (game engine, game code, multimedia resources), and block chain technology. Augmented reality and virtual reality offer numerous potential application. As the social metaverse becomes more accessible, it is crucial to incorporate additional valuable components. Some experts argue that the use of technology is least essential in the context of physical education. However, challenge persist in the field of physical education. The integration of physical education into metaverse is gaining popularity, as it address the pressing need to overcome the limitations imposed by the lack of physical venues. The evolution of the feasibility of metaverse technologies and their application in sports relies on the utilization of technology definitions and examples. To address the conceptual nature of this essay, an interpretivist research approach has been adopted. This approach emphasizes the analysis of literature rather than data gathering. Additionally, the study incorporates network research and fieldwork to gather educational experiences and metaverse knowledge. This paper delves into the concept of Metaverse integration and explores its potential impact. The metaverse, which is a virtual reality space, has the potential to provide students with an immersive learning experience that enhances their physical education. By incorporating virtual environments, students can simulate real-life situations and learn in a way that mirrors the real world. This paper underscores those significance of metaverse technology in the context to physical education.

Key words: Metaverse, Physical Education, Virtual Reality, Augmented reality, Mixed Reality

INTRODUCTION

In the era of the corona-variant, the integration of physical education into the Metaverse offers as solution to overcome obstacles by leveraging advanced technological advancements. This approach effectively promotes inclusivity and accessibility in the realm of sport activities. The COVID-19 pandemic has significantly diminished face-to-face communication in contemporary society. However, various innovative teaching and learning method have emerged, including learning in the Metaverse, which has created new possibilities for both educators and learners. This essay seeks to explore the implementation of Metaverse courses and assess the concept of physical education in the Metaverse.

Research Question

After then, we would delve into plenty of initial search questions for further conceptual exploration and adopting an interpretive research approach, this study takes a conceptual stance, placing emphasis on interpretation rather than collection. The primary objective of this article is to explore the potential of physical education within the Metaverse. The instances utilized in this study was sourced from a comprehensive collection of scholarly papers available through the internet.

1. What categories of Metaverse technology ought to be implemented in Physical Education, and what is the applicability of Metaverse technology in the domain of sports instruction?

Drawing upon the research conducted by Senarith et al. (2022) in their article titled "The Future of Immersive Teaching & Learning: Metaverse in Education," as well as the review article "Rezzil Player 22 Review: Stay Fit In VR While Learning Sports!" published by Skarredghost (2021), this essay endeavors to showcase the potential ramifications of the metaverse on the field of physical education. By examining several features of this technology, this essay seeks to explore the potential impact on pedagogical practices within the domain of physical education.

2. To what extent can Metaverse technologies be leveraged and which academic disparities stand to profit from their implementation?

In line with a research conducted by Pricewaterhouse Coopers (PwC) regarding the metaverse in the United States in 2022, this article will explore the potential of the Action Plan for the Development of Virtual Reality Integration and Industry

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Applications (2022-2026) in bridging the educational divide by harnessing the power of metaspace.

DEFINITION OF METAVERSE

The compound word "Metaverse" is derived from combination of the Greek word "Meta," meaning "transcendence or more" and the word "universe" which refers to the "physical" world we inhabit. Recently advancements in artificial intelligence technology have transformed the aspirations of humanity envisioned approximately three decades ago into tangible experiences. Hence, the Metaverse has emerged as an expensive and interconnected domain that bridge the gap between reality and virtual worlds. The Metaverse can be defined as "a 3-dimensional (3D) virtual space where social and economic activities like the real world are used", or "a new world and digitized earth contained in digital media such as smartphones, computers, and the Internet that cannot be limited to the virtual world." (Yu, 2022, 104).

The preceding notion suggests that the incorporation of Metaverse into the realm of education has vast potential for application across a broad range of fields. This implies that the development and implementation of Metaverse-based educational programs can greatly benefit industries such as healthcare, business, and entertainment to name a few. By leveraging the immersive and interactive properties of Metaverse technology, educators can create personalized learning environments that engage students in a way that traditional methods cannot. The potential uses of Metaverse in education are myriad and hold promising implications for the future of learning.

DEFINITION OF PHYSICAL EDUCATION

Physical education is a culturally ingrained practice that incorporate physical exercise as a foundational element to promote comprehensive and cognitive progress. Physical involves wide range of activities including but not limited to football, netball, hockey, rounders, cricket, four square, racing, and various other children's games. Additionally, Physical curriculum address essential topics such as nutrition, fostering healthy habits, and recognizing the individuality of needs (Mitchell & Walton-Fisette, 2016).

Physical education is the foundation of a Comprehensive School Physical Activity. It is an academic subject characterized by a planned, sequential K–12 curriculum (course of study) that is based on the national standards for physical education. Supporting schools to establish physical education daily can provide students with the ability and confidence to be physically active for a lifetime (CDC, 2019). There are many benefits of physical education in schools. When students get physical education, they can:

- Increase their level of physical activity.
- Improve their grades and standardized test scores.
- Stay on-task in the classroom.

According to a study (CDC, 2019), it has been found that an extended duration of engagement in physical education does a positive impact on the academic performance of students.

METAVERSE TECHNOLOGIES

The concept of the Metaverse engages a wide range of technologies, which can be broadly categorized into four main segments: Virtual Reality, Augmented Reality, Mixed Reality, and Multisensory Extended Reality.

Virtual Reality (VR)

According to Sheldon (2022) and Figure 1, Virtual Reality is a computer-generated environment that provides users with sense of being present in the real word. In VR, gamers can engage in activities depicted in the storyline, such as running, and experiencing various sensations. However, it is important to note that VR industry remains in early development and has yet to fully realize its vision of creating diverse business and investment opportunities. Nevertheless, this technology give rise to unprecedented business and learning models, which in turn will lead to emergence of new educational patterns and the creation of diverse business and investment opportunities.

Augmented Reality (AR)

Augmented Reality (AR) is a technology that combines real-world elements with computer-generated content and graphics allowing for an interactive experience where users can engage with virtual scenarios generated by serves.

Milgram et al. (1995) introduced the term 'monitor-based (non-immersive)' or 'window-on-the-world' (WoW); while AR refers to a type of display system wherein computer-generated images are overlaid onto live or stored video images. Figure 1 is an example of an AR.

Furthermore, augmented reality has potential to act as our "perception organs" through the use of AR devices. The unique experience offered by AR can be either embraced or rejected by our cognitive faculties.

Mixed Reality (MR)

Mixed Reality (MR) refers to the integration of physical reality with a computer-generated environment, which has the potential to allowing users to fully immerse themselves in the realm of the Metaverse. MR has the ability to simulate the authentic real-word experience, while also creating deep sense of embodiment within a virtual word.

Figure 1. Augmented reality (AR)

Simulation-based learning includes training methods that utilize VR and AR facilitating interactive and experiential learning. The application of Mixed Reality in both educational and professional training environment. In the domain of education, AR has been employed to recreate historical battles, theory offering students an unparalleled immersive encounter and potentially augmenting learning experiences (Phakamach et al., 2022).

Mixed Reality (MR) fundamentally combines Augmented Reality (AR) and Virtual Reality (VR), resulting in a distinctive fusion. This integration facilitates the convergence of the physical and digital domains, offering a remarkable prospect to merge simulated experiences with actuality.

Multisensory Extended Reality (XR)

Multisensory extended reality (XR) integrates the five conventional senses, namely sight, hearing, smell, taste, and touch. The perception process involves the transmission of signals through the nervous system, where vision relies on light interacting with the retina, smell is mediated by odor molecules, and hearing involves pressure waves. The sensory cues within multisensory extended reality include visual, auditory, olfactory, haptic, and environmental aspects (Santoso et al., 2022, Figure 2).

More specifically, Multisensory extended reality is a unique commixture that combine Virtual Reality (VR), Augmented Reality (AR), and Mixed reality (MR). Particularly in during challenging times, as in the COVID-19 pandemic, when practical limitations often restrict physical events, the conventional means of cheering and supporting one another in stadiums can become inconvenient for citizens. In this context, Metaverse Technologies offer a novel solution to overcome these barriers and enhance the enjoyment of physical activities.

METAVERSE APPLIED TO PHYSICAL EDUCATION

In the course of developmental stages of Metaverse, researchers have consistency uncovered pedagogical approaches for its implementation. Currently the education domain is incorporating further Metaverse technologies to overcome the manifold constraints. This phenomenon is acknowledged as the convergence of 'Technology' and 'Education' in academic communities.

Virtual Reality (VR) in Physical Education

The academic field has placed significant emphasis on Virtual Reality since the discovery of Instructional techniques for utilizing the Metaverse. Notably, VR in education has been integrated into the national strategy in China.

According to Skarredghost (2021), video game applications such as Rezzil Player 22 offer four distinct training modes: Headers, Hoops Vision, Reaction Wall, and Blockz (Figure 3). Each of these modes is tailored to a specific sport and can be utilized for sport-specific preparation and practice sessions.

In contrast, incorporating a virtual reality (VR) fire training simulator and a flight simulator can present a more cost-effective solution (Phakamach et al., 2022).

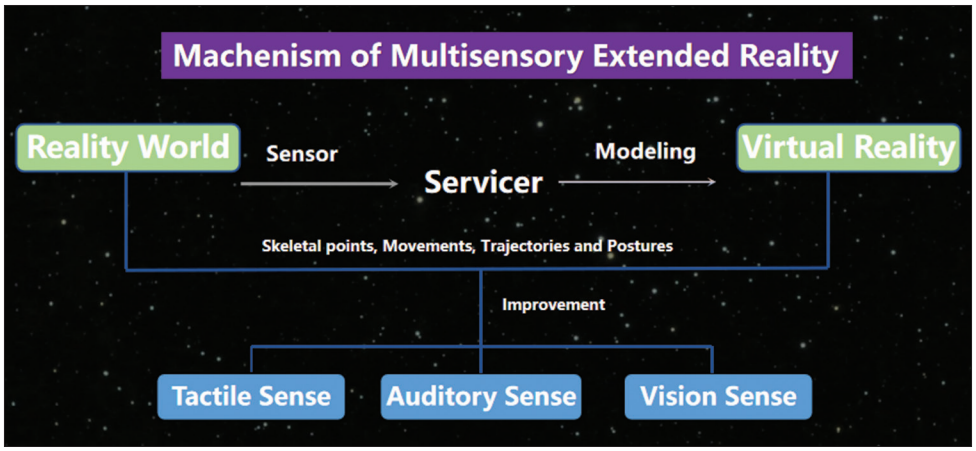

Figure 2. Mechanism of multisensory extended reality (XR)

Figure 3. Training modes in rezzil player 22

The applicability of the aforementioned findings to the domain of physical education is presumed. Notably, sports such as football, tennis, and golf encounter constraints pertaining to training venues, thereby posing challenges in securing field reservations in advance. This inherent predicament serves as the underlying rationale for the limited implementation of Physical Education programs in developed regions. For instance, in Guangzhou, the scarcity of playing fields contributes to the elevated cost of physical education classes. Nevertheless, with the assistance of coaches, rudimentary football lessons can be conducted in alternative settings. It is within this context that meta-universe technology assumes a pivotal role in guiding football instruction. By virtue of its capacity to simulate diverse scenarios, meta-universe technology facilitates tailored pedagogical approaches. However, it is important to note that online courses, in contrast to the metaverse, are unable to cover the subjects of physical education.

Based on the research conducted by Li et al., this study compares the effectiveness of artificial intelligence (AI)-guided football teaching strategies and metaverse-empowered strategies in the context of the mobile internet environment. The primary objective is to enhance the quality of teaching. The findings of this research highlight several critical issues in content delivery network (CDN) research, including the improvement of proxy server hit ratio, reduction in origin server load pressure, minimization of student request latency, and optimization of proxy server caching resources. Building upon these challenges, a K-means-based optimized 360-degree panoramic virtual reality (VR) football teaching video delivery strategy is proposed. This strategy is then analyzed through simulation experiments using CDNSim, a simulation environment developed on the OMNeT++ framework. OMNeT++ is an open-source network simulation platform based on discrete events. The simulation results demonstrate that the proposed improved strategy achieves favorable performance in terms of hit ratio and response time, ultimately leading to an enhanced football teaching experience for students.

Augmented Reality (AR) in Physical Education

Augmented reality technology includes three key sectors: head-mounted displays, tracking systems, and mobile computing capacity. These sectors collectively generate a digital illusion within a three-dimensional environment. Through the utilization of educational influences and spatial applications, users can explore the metaverse in augmented reality, thereby enabling the integration of digital imagery into their visual perception. Hence, AR technology holds potential benefits for referee training in the field of Physical Education. For instance, in high-profile football tournaments such as the World Cup, controversial penalties often arise, with offside decisions frequently taking center stage as they determine the validity of goals. However, relying solely on the naked eye, referees face challenges in accurately judging offside situations (Figure 4). AR technology can address these challenges by employing digital images and calculations to identify offside positions. In the context of referee education, augmented reality can also enhance the delivery of comprehensive material overviews, facilitating learners' absorption and comprehension of study cases. Moreover, AR exhibits the potential to motivate learners' interest and inspire their intellectual curiosity.

Lifelogging in Physical Education

Lifelogging refers to a recording mechanism that enable the capture and preservation of an individual's daily experiences. In the context of sports, students can utilize lifelogging to document and analyze their progress, thereby gaining insights into area where mistake were made or improvements are needed. By reviewing these recorded instances, students can effectively identify areas for growth and make necessary adjustments in future. This remarkable approach empowers students to proactively learn from their experiences, fostering a preparedness that enhances their overall learning journey.

Multisensory Extended Reality (XR) in Physical Education

The phenomenon of XR physical fitness has gained significant traction in recent times. XR physical fitness offers fitness services equipped with a coaching system that performs a comprehensive analysis of athletes' conditions. This system

Figure 4. Controversial offside in FIFA world cup qatar 2022

further monitors athletes' movements through XR technology, utilizing cameras and sensors. Additionally, it provides detailed explanations regarding the mechanics and consequences of exercises, as well as exercise content for tracking and reporting purposes. While a multitude of YouTube channels and fitness applications offer diverse exercise content, their streaming options are limited. Moreover, certain fitness applications merely monitor users' exercise duration and running distance, and are unable to effectively address posture issues or gauge athletes' current physical state (Lee et al., 2023).

In recent years, Zwift has emerged as a highly sought-after XR physical fitness service. Serving as a simulation program that interfaces with Smart Bike Roller for indoor cycling, the platform boasts capabilities for virtual riding via a computer or mobile device, supplemented with a plethora of training programs tailored to enhance one's athletic capacity (Zwift Inc., 2022). In terms of group events, users can partake in group rides or races, affording opportunities for skill assessment through friendly competition with peers. It is worth noting that the different difficulty levels of group riding allow for tailored participation according to the varying degrees of participant skills. In addition to cycling, Zwift also provides training programs for running, measured by a worn device named the Runpod, which gauges user speed and cadence, thus affording users the experience of virtual running at an equivalent pace of their real-life counterparts utilizing a treadmill.

DISCUSSION

Whilst it is true that the metaverse has already brought about significant advancements in sports instruction, there remains immense potential for this technology to revolutionize the field of education. In fact, numerous surveys have depicted the extent to which the metaverse holds promise in terms of economic and policy benefits. Therefore, the present investigation aims to explore the extent to which metaverse technologies can be utilized and which academic domains stand to benefit from their implementation.

The Popularization of Metaverse

According to a survey conducted by PwC, which involved over 5,000 US consumers and 1,000 US business leaders, it was found that 50% of consumers expressed excitement about the metaverse. Additionally, the survey revealed that 66% of executives reported active engagement of their companies in metaverse-related activities (PricewaterhouseCoopers, 2022).

According to a survey conducted by PwC, the perceptions of the metaverse were examined among business leaders and consumers. The findings indicate that a mere 3% of business executives and 21% of consumers were found to be unfamiliar with the concept of the metaverse. Additionally, 7% of business executives and 24% of consumers reported having heard of the metaverse, but expressed uncertainty regarding its nature. Conversely, 22% of business executives and 28% of consumers possessed a certain level of familiarity with the metaverse, while a substantial 46% of business executives and 19% of consumers demonstrated a robust cognitive comprehension of the metaverse.

Additionally, it is worth noting that 23% of business executives and 8% of consumers have consistently directed their attention towards the metaverse. Notably, the metaverse has experienced a surge in popularity following the global economic downturn, particularly within the community of business executives. This phenomenon reflects the current trend of seeking new avenues of economic growth.

Governmental Support (Policy)

In a collaborative effort, the Ministry of Education of China, in conjunction with five other departments, including the Ministry of Industry and Information Technology, has recently released an Action Plan for the Integration and Development of Virtual Reality and Industry Applications (2022-2026). The primary objective of this plan is to facilitate the seamless integration of virtual reality technology across various industries. The plan comprises ten distinct categories of virtual reality, such as 'virtual reality + cultural tourism', 'virtual reality + integrated media', and 'virtual reality + education and training'. This presents a unique opportunity for the metaverse to leverage its capabilities in the field of physical education.

Advantages of Metaverse Applied to Physical Education

By integrating Metaverse technology into the domain of Physical Education, the aforementioned challenges can be effectively tackled through the utilization of state-of-the-art resources, including Virtual Reality sports training simulators, lifelogging devices for monitoring sports performance, and Augmented Reality referee assistants. This methodology holds immense potential in enhancing sports education and training, thereby presenting notable benefits.

- The Precision of Physical Education: The integration of virtual reality (VR) technology enhances the precision and convenience of sports data capture, including learners' skeletal points, movements, trajectories, and postures. This enables educators to access scientifically analyzed data, thereby facilitating more precise and rational guidance. The potential of VR technology lies in its ability to assist physical education instructors in cultivating students' interests, mitigating teaching obstacles, and enhancing the overall quality of physical education with minimal effort.
- Venue Shortage in Sports: The scarcity of sports fields in developed regions is a recognized concern that can be effectively tackled through the implementation of metaverse technology. By simulating relevant environments and authentic sports venue, metaverse technology has the potential to enhance the vigor of physical exercise and afford students the opportunity to choose sports scenes aligned with their preferences and backgrounds. The integration of virtual venues in physical education can broaden instructional methods and cater to the diverse interests of students.

- Imbalanced Resources in Physical Education: In China, there exists an unequal distribution of educational resource, particularly evident in the disparity between urban and rural areas. The absence of specialized guidance in physical education within rural region hinders children from engaging in healthy football and basketball activities. However the implementation of metaverse technology including VR/AR/XR in physical education can severe as a means to bridge the educational divide between urban and rural areas. This application has the potential to promote educational equity, thereby reduce the educational disparity between these regions.

Shortcoming of Metaverse Applied to Physical Education

- Teacher Interaction: One of the notable limitations associated with the integration of Metaverse technology in the field of Physical Education pertains to the lack of teacher engagement. Although Metaverse technology represents a commendable advancement in terms of innovation and captivating experiences, it falls short in facilitating the requisite level of interaction that holds paramount importance in the context of sports and team-based activities. The presence of teacher engagement assumes a pivotal role in the realm of Physical Education instruction and acquisition, as it enables the provision of personalized feedback, motivation, and guidance. Therefore, it becomes necessary to establish a harmonious equilibrium between the utilization of Metaverse technology and the involvement of teachers, thereby ensuring a well-rounded and effective learning experience.
- Expenses for Metaverse Devices: Currently, the cost of Metaverse Device is prohibitively high. Posing a significant barrier for institution of higher education when considering the integration of metaverse technology into physical education programs.
- Experience of Metaverse teaching: The technical pathways for the implementation of the metaverse are still in early stages and subject to frequent changes. The metaverse represents a novel and unprecedented, approach to physical education which would require a considerable amount of time for teachers to adopt it.
- The trajectory towards Virtual Reality traverses Actual Reality: Despite the potential for metaverse technology to construct an environment that closely approximates reality, obstacles remain concerning objects. An example of this is the replication of the basketball shooting mechanism in a virtual space, wherein the replication of the weight and shooting power may not be feasible.

As technology advances and shapes our world, the relevance of the concept of the social metaverse continues to grow. Previous applications of the Metaverse have achieved some notable progress. For example, the football training application called Rezzil in Metaverse has been implemented through the use of Virtual Reality (VR), and Zwift has incorporated Extended Reality (XR) with Smart Bike Roller for indoor cycling. Such practical applications demonstrate the feasibility of integrating educational instruction with the metaverse.

Notwithstanding, access to the metaverse is limited by various constraints, which manifest in many forms. At times, a lack of technological infrastructure makes it challenging to access the metaverse. In other cases, social or cultural barriers prevent certain groups from accessing the virtual world. Furthermore, economic factors, such as the high cost of virtual reality gear and other necessary tools, can also play a significant role, creating barriers to entry for some. It appears that the social metaverse will become more accessible over time. As technology continues to evolve, virtual reality gear will become cheaper and more widely available, opening up access to the metaverse. Social and cultural barriers can also be overcome through greater exposure and understanding of the concept of the social metaverse. As people become more familiar with the virtual world, different groups can enter it with increased confidence and sense of belonging.

Furthermore, the social metaverse offers immense benefits to society as a whole. In a world where physical distance can create barriers to meaningful social connections, the metaverse offers a unique opportunity to connect with people from all over the world on a more personal level. This connection can lead to greater empathy and understanding, ultimately bridging divides and creating a more harmonious society.

CONCLUSION

In light of the aforementioned evidence, it can be inferred that Physical Education in the Metaverse exhibits considerable potential in real-world contexts. Notwithstanding the limitations imposed by technology, the prospects are remarkable.

In its current state, the Metaverse plays a pivotal role as an essential educational instrument in the domains of gaming and social interaction, which are integral components of physical education. By harnessing the potential of the Metaverse for the purpose of facilitating physical education, educators can augment the effectiveness of their instructional practices, while concurrently addressing the constraints associated with conventional physical education. Nevertheless, the factors that contribute to variations in performance between virtual and physical environments remain ambiguous.

Two potential hypotheses can be put forth to account for this phenomenon. Firstly, it is plausible that physical education courses in the Metaverse may prioritize the foundational principles of sports technique to a greater extent. Alternatively, the Metaverse could give rise to a novel branch of Physical Education altogether. Despite the inherent limitations it possesses, there is a strong conviction that the integration of the Metaverse into Physical Education would yield significant advantages for students. Looking ahead, continued technological advancements hold the potential to further enhance the effectiveness of Metaverse-based physical education.

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