



Thematic Analysis of the Metaverse within Society 5.0 in Education

Hissan Khandakar¹, Khandakar Kamrul Hasan^{2,3}, P. Yukthamarani Permarupan^{3*}, Kazi Fattah Afnan⁴

¹ Cambridge Assessment International Examinations A Level, British Council, Dhaka, Bangladesh

² Department of Business Administration, The International University of Scholars, Dhaka, Bangladesh

³ Malaysian Graduate School of Entrepreneurship and Business, Universiti Malaysia Kelantan, Kelantan, Malaysia

⁴ Department of Electrical and Electronic Engineering, American International University-Bangladesh, Dhaka, Bangladesh

* Corresponding author: yuktha@umk.edu.my

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Abstract: Boasting numerous capabilities, the Metaverse holds great potential for transforming education within the context of Society 5.0. This thematic analysis aims to provide a comprehensive overview of the Metaverse's role within the context of Society 5.0, with a specific focus on its integration into the field of education. Society 5.0, characterized by the merging of physical and cyberspace, aligns seamlessly with the principles of the Metaverse, enabling students to access virtual classrooms and educational content using XR technologies, irrespective of time and location. Within this digital ecosystem, education stands to benefit significantly, as it can transcend physical constraints and provide immersive, personalized, and interactive learning experiences. The study outlines vital objectives, emphasizing the need to discuss the implementation of educational policies in the Metaverse and address potential negative implications for students. Through a comprehensive review of existing literature, the research establishes a conceptual framework based on the Six Pillars, outlining essential principles for creating practical educational applications in the Metaverse. While recognizing the transformative potential of the Metaverse in education, the study also acknowledges its negative implications, such as privacy concerns and ethical issues. This research provides valuable insights for policymakers, educators, and stakeholders seeking to navigate the evolving landscape of education in the digital age.

Keywords: Metaverse, education, Society 5.0.

社会 5.0 教育中的虚拟世界专题分析

摘要：元宇宙拥有众多功能，在社会 5.0 的背景下具有改变教育的巨大潜力。本主题分析旨在全面概述虚拟宇宙在社会 5.0 背景下的作用，特别关注其与教育领域的整合。社会 5.0 的特点是物理空间和网络空间的融合，与元宇宙的原则无缝结合，使学生能够使用 XR 技术访问虚拟教室和教育内容，无论时间和地点。在这个数字生态系统中，教育将受益匪浅，因为它可以超越物理限制并提供沉浸式、个性化和交互式学习体验。该研究概述了重要目标，强调需要讨论元宇宙中教育政策的实施并解决对学生的潜在负面影响。通过对现有文献的全面回顾，该研究建立了一个基于六大支柱的概念框架，概述了在元宇宙中创建实际教育应用

的基本原则。该研究在认识到虚拟宇宙在教育领域的变革潜力的同时，也承认其负面影响，例如隐私问题和道德问题。这项研究为政策制定者、教育工作者和利益相关者提供了宝贵的见解，帮助他们驾驭数字时代不断变化的教育格局。

关键词：元界、教育、社会 5.0.

1. Introduction

The Metaverse is a popular concept among Generation Z, even called the Metaverse Generation [35]. The term was initially coined in a science-fiction novel called *Snow Crash*, in which the characters interacted in a virtual space using virtual reality (VR) headsets [32]. The Metaverse is currently part of ongoing efforts to develop Web 3.0, including blockchain technology [1]. The Metaverse is considered to be the convergence of physical and digital worlds using the Internet of Things IoT technologies and Extended Reality XR [22]. As a connected ecosystem, the Metaverse can support educational systems globally without needing physical interaction or even presence between learners and educators, which will support digital content creation in the Metaverse [19].

Society 5.0 is defined as “an initiative merging physical space and cyberspace by leveraging Information, Communication and Technology (ICT) to its fullest: a ‘super-smart society’ led by scientific and technological innovation, after hunter-gatherer society (Society 1.0), agricultural society (Society 2.0), industrial society (Society 3.0), and information society (Society 4.0)” [15]. Metaverse technology aligns with Society 5.0 and integrates cyberspace with physical space, allowing students to experience virtual classroom experiences through 3D Virtual World Applications [25].

2. Methods/Materials

This study offers an in-depth analysis of the Metaverse within the context of Society 5.0, with a specific emphasis on its integration into the field of education. This study conducts a comprehensive analysis of relevant literature, examining the subject matter’s source, meaning, and characteristics. Additionally, a comprehensive framework for practical application is presented. This article also explores the possible uses, challenges, and prospects for further investigating the Metaverse in education.

The following research objectives, which will be the focus of the study, aim to provide a comprehensive understanding of the role and impact of the Metaverse in the context of Society 5.0 and its application in the field of education:

- To discuss why and how educational policies can be implemented in the Metaverse;

- Negative implications of students who use the Metaverse.

3. Literature Review

This section discusses past research on the core aspects of this paper.

3.1. Metaverse in Education

Education is an essential development in the Metaverse that will gradually occur over the coming years. In this particular context, it is possible to view the Metaverse as an educational setting augmented by XR technologies that seamlessly integrate with virtual and physical world components [29] [34]. Therefore, students are not bound by time and location and can use wearable devices to enter the cyberspace of the Metaverse. Therefore, the Metaverse will fulfil the aim of Society 5.0 of providing free or low-cost education worldwide [15]. Metaverse integration in education offers immersive, personalized, and interactive learning experiences beyond traditional methods [21], [33], [37].

To access the Metaverse, learners will be equipped with intelligent wearable devices such as headsets or head-mounted displays (HMD), which are essential hardware components that link the natural and virtual worlds [27]. Using avatars in the Metaverse gives learners an immersive experience of cyberspace and a sense of embodiment in their digital presence [9], [43]. Non-player characters (NPC) in the Metaverse are AI-driven jobs like “teachers, intelligent NPC learners, and intelligent NPC peers” [14], [17]. They are essential to teaching ‘arbitration, simulation, and decision-making’ [16]. Realistic learning scenes replicate classroom layouts according to the learning content, enhancing learning experiences for intangible concepts and objects unobservable easily [6], [29], [39], thus making the Metaverse experience more immersive for learners and enabling them to understand lessons more clearly. Metaverse uses modeling and rendering technologies to visualize abstract concepts and enhance learning resources through decentralized technologies, enabling editing, creation, and sharing [8], [39], [43]. Metaverse enables teachers to “review and observe the learning process, capturing daily experiences and information for effective teaching” [29], [31]. Learning in the Metaverse relies on AI and vast data analysis, enabling learners to showcase their achievements and

performance in a digital world [40], [42]. Since the Metaverse is more “open, shared, and decentralized than traditional virtual spaces” [16] [40], non-fungible token (NFT) technologies, such as Blockchain, enable learners’ work authentication in the virtual Metaverse, preventing privacy breaches and tracing of virtual work, ensuring secure and open learning environments [3], [38], [41].

3.2. Society 5.0 in Education

The Metaverse attempts to converge physical space and cyberspace. Thus, by definition, it is a part of Society 5.0. Cyberspace is ‘an imagined or virtual realm, where swathes of raw data are readily accessible and turned into usable knowledge, which may subsequently be shared’ [15]. A massive arrangement of computer networks supports the infrastructure for cyberspace.

In his lecture at the 2019 World Economic Forum Annual Meeting, Nakanishi highlighted that in Society 5.0, individuals would be freed from several limitations that earlier civilizations could not overcome [26].

Instead of focusing on efficiency using economies of scale [28], people emphasize satisfying ‘individual needs, solving problems, and creating value, leading to problem-solving and value creation’. By promoting diversity, there will be no need to maintain a uniform identity, as people will be freed from suppressive influences on individuality, such as discrimination based on gender, ethnicity, and nationality, and alienation due to their values and life methods [26]. The inequality caused by some people having the most wealth and knowledge will disappear, and ordinary citizens can participate anytime, anywhere through decentralization [30]. Less fear of terrorism, calamities, and cyberattacks will make society less vulnerable. Thus, the impoverished and unemployed may live with resilience and enhanced safety nets [10]. Mass consumption of resources will reduce as people will be liberated from resources and environmental constraints and can live sustainably in any region of the globe [18]. Since the fundamental aspect of Society 5.0 is creating a decentralized society, people can live anywhere on Earth without constraints. Hence, resources are less likely to be focused on one community as people are spread apart.

4. Conceptual Framework

None of the papers selected for review to conduct this study showed a relationship between Society 5.0 and the Metaverse. There is no doubt that the Metaverse is a part of Society 5.0, and that it can further the goals of Society 5.0. Thus, basing the principles of the Metaverse on the six pillars [12], [44], the framework of the Metaverse within Society 5.0 in education (Fig. 1) shows how Society 5.0 and the Metaverse are connected while also showcasing what the Metaverse must include to function effectively for

students.

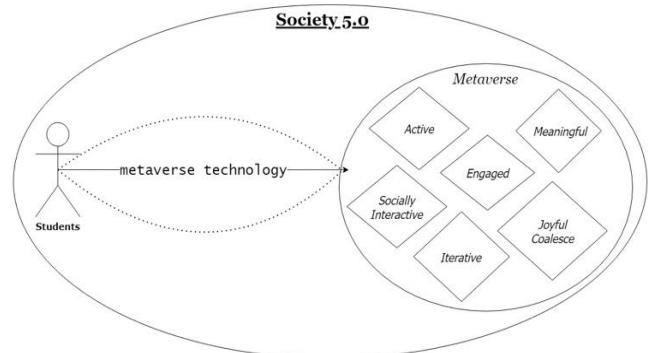


Fig. 1 Framework of the Metaverse within Society 5.0 in education

The six pillars are discussed in detail:

1) *Active*: The Metaverse should foster a learning environment that encourages active thinking, meaning it must involve students in the activities.

2) *Engaged*: The Metaverse must engage students and keep them from the lessons by providing only elements essential to their learning.

3) *Meaningful*: The Metaverse should be relatable to students’ daily lives. Thus, the settings should emulate the real world so that students can form connections with the lessons.

4) *Socially Interactive*: The Metaverse should encourage students to interact with the virtual avatars of other students, as social skills must be integrated as a critical element of the lessons.

5) *Iterative*: The Metaverse should allow different approaches to solving each problem, as it will foster good problem-solving skills among students. Each approach should offer a different experience, and students may be rewarded for their approach.

6) *Joyful Coalesce*: The Metaverse must be a happy experience for students to improve their learning gain and encourage them to return to the Metaverse.

5. Results and Discussion

5.1. Ensuring Implementation of Educational Policies in the Metaverse

It is important to identify on what basis an application in the Metaverse needs to be built, as this will promote effective design and implementation to meet goals [5]. The six pillars were developed to create good educational apps, drawing from consensus on the science of how children learn [12], [44]. These principles are collectively known as ‘playful learning’ [13].

Accordingly, the apps that will be developed should encourage active learning so that students learn best in environments that are “mind-on”. Moreover, the app should be engaging rather than distracting. Thus, it should contain only the material essential to learning. Furthermore, the app should give meaning to students’ learning by making it relatable to their lives, thus offering a higher learning gain. Even though virtual

interactions will be the primary method of socializing, the app should actively encourage students to seek social interactions outside the app space. Additionally, the app should foster good problem-solving skills and allow for critical thinking by providing numerous ways to solve problems, ensuring that the overall experience is interesting for students.

5.2. Negative Implications of the Metaverse

Social relationships in the Metaverse are weaker than interactions in the real world. In the Metaverse, where real-time data are gathered and processed, privacy violation is a concern in social activities [4]. The Metaverse provides users with high freedom but also poses risks to young adolescents [20]. Administrators can only predict some user actions, making it a lawless zone, thus presenting a significant risk for young adolescents with limited social experience and unestablished identities [37]. Citizenship in the virtual world necessitates ethics education, given that users may experience confusion regarding their real identity [2], [24].

5.3. Research Gap

This study analyzed several research articles regarding the Metaverse and Society 5.0 within the educational context. Some significant gaps in these studies include the need for the research to provide practical implications of the Metaverse in education. Instead, it merely discusses the advantages and disadvantages of the Metaverse within Society 5.0. The research implies that the Metaverse will soon replace traditional learning and thus conclude a more significant pedagogical impact. However, existing research cannot correctly conclude how Metaverse technology can be implemented, considering the technological gap between countries. Table 1 has been provided that compiles some articles to give a more thorough idea.

Table 1 Review of the research articles

Sources	Major Findings	Future Scope
[7]	Metaverse's human-centered computing vision benefits society, but its development is nascent. Its three-layer design enhances campus life for both students and faculty	The prototype of the Metaverse will be continuously improved. Many research topics in the Metaverse must be studied and are yet to be touched upon.
[11]	Metaverse school design must consider accessibility, safety, humanity, trust, education, and cognition, requiring strict rules, revised pedagogy, and new digital literacy skills.	Society 5.0 implementation in poorer countries is challenging due to democratic governance issues and resource constraints.
[23]	Metaverse-enhanced education offers equity	Future research on the Metaverse in education

	and exceptional visualization, but rapid technological evolution necessitates further research	should explore its development, potential changes, ethical issues, and field needs.
[36]	The Metaverse offers sustainability opportunities but raises concerns about addiction, privacy, design, and accuracy	Research directions for the Metaverse include investigating theoretical frameworks and approaches and building ecosystems for human-machine collaboration.
[42]	The Metaverse enhances education with security and privacy opportunities but requires high-standard infrastructure, raising pedagogical, privacy, security, and ethical questions.	The Metaverse enhances education with security and privacy opportunities but requires high-standard infrastructure, raising pedagogical, privacy, security, and ethical questions.

6. Conclusion

This paper discussed the Metaverse within Society 5.0 and how it can be integrated with education. The findings of this study can be used by legislators, administrators, and technology stakeholders to facilitate a smooth transition into the Metaverse, more specifically in the domain of education. It may also encourage more educational-friendly applications of the Metaverse as the paper outlines certain principles on which they should be created. However, this study has certain limitations. It does not delve into potential improvements to make the Metaverse more suitable for educational purposes, as it relies on past studies rather than experimental findings. Publication bias may exist because reports with irrelevant conclusions may not have been disseminated. In today's context, one of the critical challenges of successfully adopting the Metaverse within Society 5.0 is the knowledge and technological gap in certain countries. Integrating the Metaverse with education can only be effective if researchers from several disciplines collaborate.

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