**Original Research Article**

**Education metaverse: Innovations and challenges of the new generation of Internet education formats**

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**ABSTRACT**

In the post-epidemic era, the shape of education has undergone significant changes, evolving continuously towards large-scale, digital, virtualized and intelligent. The metaverse has been described as the third Internet revolution, a virtual society and social network that mirrors real scenarios through a decentralized architecture. Education is the main industry scenario and innovation channel of the metaverse, and conducting research on the education metaverse is an important way to seek the path of high-quality education development, reshape the relationship between education subjects, and solve social issues such as educational equity. However, the future of the metaverse, the challenges it will face and the social implications it will have need to be considered in the light of the “hot hype”. From the perspective of technology-society interconstruction, this study analyses the background and theoretical foundation of the educational metaverse, its characteristics and application cases, with the aim of clarifying the ecological structure of the educational metaverse. The study concludes with a critical reflection on the challenges posed by the education metaverse in terms of data maintenance, digital copyright and capital coercion, in order to explore the laws of education under the new Internet education model.

**Keywords:** education metaverse; virtual society; mirror subject

**1. Introduction**

The concept and vision of a metaverse has long been drawn in science fiction in the 1980s, reflecting the human desire to break through the limits of space-time and allow the human body to find a portal to another sensory experience, constituting a shared virtual world of “consensual illusion”[1]. With the China metaverse Summit, the year 2021 has been dubbed the Year of the metaverse. The concept has once again sparked much academic debate, with many technological terms, such as virtual reality, blockchain and digital twin, coexisting with metaverse, adding to the myth of the difference between this concept and the traditional technological concepts of the connected era. Is the metaverse the future or a bubble? Is it a windfall or a...
hype? There is a lot of debate in all sectors. The metaverse is not an accidental emergence, it is a manifestation of the infinite expansion of human imagination, but in contrast to science fiction, the social relations of the metaverse are much closer to reality. What emerges in the metaverse is a mirror image of the real world, a real-time update of the virtual and real worlds, which makes the metaverse a real-world based and perceivable place to perform[2]. Meta-universe theorist Matthew Ball sees metaverse as a living internet, a highly experiential social network formed through the interconnection of two infrastructures, hardware and software[3].

From an industry perspective, education is the main application scenario for the metaverse[4]. This not only reflects the positioning of education as a public good that spans the lifelong development of individuals, but also the integration of technology and education in the future of education. The education meta-universe is crying out at this juncture as an effective model for balancing technological development and educational issues. 2020 saw the University of California, Berkeley, hold a graduation ceremony on My World (Minecraft). The Korean Ministry of Education has also launched the metaverse Creative Science Classroom programme and is piloting it with 2,100 primary and secondary school students in Seoul in an effort to make the platform an integrated hub for future learning[5]. Some regions are even experimenting with city-wide coverage based on the meta-universe. The Shanghai Municipal Economic and Information Technology Commission has made it part of its 14th Five-Year Plan to strengthen the research and development of the underlying core technology infrastructure of the metaverse, promote deeper perception and interaction, and explore industry applications, etc. The new crown epidemic, which began to sweep the world in 2020, has led more educators to understand the value of cross-platform, virtual-real integration in education. The education metaverse has also become a potential solution to complex educational problems, reshaping the logical relationship between individuals, groups and technology under the fusion of reality and imagination.

This study deconstructs the concept of educational metaverse from the perspective of technology-society interconstruction, clarifies its fundamental structure, subjective interaction and breakthrough characteristics, deciphers the innovations and challenges of educational metaverse, explores the laws of education in the new generation of Internet education, provides critical thinking for understanding educational metaverse, exploring the humanity of technology and developing educational modernization, and provides reference for the two-way promotion of technology and society.

2. Concept deconstruction

2.1. Theoretically based on techno-social interconstruction

The epidemic has confronted the global education sector with unprecedented challenges, with online education being particularly controversial [6]. Against the backdrop of existing technologies struggling to break through the bottleneck of educational development, there is yet to be a definitive conclusion on what impact the emergence of an educational metaverse will have.

Technological-social interconstructionism sees technology and society as interdependent and technology and society are interdependent and mutually constructive. The ‘structural rigidity’ of technology places new demands on the structure of organisations and societies, while the ‘technological rigidity’ of society requires adaptation to technology itself and its applications[7]. It is thus clear that the theory of technology-society interconstruction does not work through technology to solve social problems passively and remedially, but rather to find the best balance between technological development and social problems and to explore sustainable development paths. This paper has chosen this perspective because today’s technology and social problems are being solved through the use of technology. This perspective is chosen because education today is also faced with the challenge of reconciling technology and society. The dilemma of
technology-society reconciliation. On the one hand, technology improves learning efficiency, facilitates precision teaching and learning, and helps to build a high-quality on the one hand, and the digital divide on the other. On the other hand, the growing digital divide raises issues of equity in education. For example, the digital form of the curriculum is crowding out time in the classroom, and students are lacking in rich interpersonal and social interaction. The digital divide has also raised issues of equity in education. The digital divide, on the other hand, has also raised issues of equity in education. In the midst of this chaos, a metaverse of education is emerging. From the point of view of the technological construction of social forms, both the German industrial from a technological perspective, both Germany’s Industry 4.0 and Japan’s Society 5.0 have in common the expectation of a “smart” education system. The common denominator of both Germany’s Industry 4.0 and Japan’s Society 5.0 is the expectation that through a high degree of integration of virtual and physical space, cross-domain collaboration can be achieved and solutions to the problem of the virtual space can be found. space to achieve cross-domain synergy and solve the problem of balanced development between technological progress and social issues. The problem of balanced development in both directions.

Looking at the framework system of the meta-universe, most of the research is based on the market value chain constructed from the perspective of industrial division of labor. For example, Jon Radoff proposes a seven-layer metaverse architecture, from bottom to top, infrastructure, human-machine interface, decentralization, spatial computing, economic creation, discovery, and experience. In terms of stages of development, Jonathan Glick, senior editor at the New York Times, sees the development of metaverse as consisting of two stages: the primary stage is dominated by the desire of participants to live in a completely virtual space that is somehow “better” than the real world; the advanced stage is the technological ecology that eventually realizes the link between fact and fiction. Duan et al. summaries the three layers of the education metaverse from a macro-architectural perspective: infrastructure, interaction and ecosystem. The technological and social duality of the metaverse determines that the educational metaverse is not an educational application scenario, let alone an educational technology tool, but a complete ecosystem. Compared to traditional Internet education where flat information interaction is the main focus, the metaverse extends the point and line level of interaction to a three-dimensional, multi-dimensional and real-time interaction space based on the credible digitization of assets and identities, which greatly enriches and restores the real teaching and learning scenario and the teacher-student relationship.

### 2.2. Real-image subject interaction as content

Based on the above analysis, the framework of the education metaverse is mainly composed of technology support, interaction business and rule design. The interaction business is the core of the entire framework, and the technology and rules are developed around interaction. Teachers and students in the metaverse acquire virtual identities by means of digital mapping, which digitally configures the physical, cultural, psychological and spiritual existence of the real subject, thus forming a mirror incarnation in the educational metaverse. Therefore, compared to traditional Internet interaction, the education metaverse offers a more three-dimensional way of interaction between teachers and students, which will not only enrich the interaction between real subjects, but may also produce two new types of mapping relationships between real subjects and avatars (Person to Avatar) and avatars and avatars (Avatar to Avatar).

Firstly, in terms of the way real subjects interact with each other, the traditional Internet requires real subjects to interact with each other through meeting platforms and chat software, which enables instant communication, but also brings great limitations to the actual interaction. Learners seem to be ‘kidnapped’ by communication software, and learn in a static way with text, voice and images. The ed-
Educational metaverse pans or extends the real educational scene into the digital world. Learners can collaborate dynamically across domains without being removed from their original real-life experimental scenarios. The low latency and high immersion characteristics of the educational metaverse can greatly enhance the authenticity of the virtual scenario for learners, enhancing students' embodied cognition and contextual learning experience, especially allowing for cross-domain collective creation and positive social and psychological impact on learners[11]. Technologies supporting this scenario include two categories: virtual augmented and extended reality (XR), represented by spatial positioning, 3D rendering, cross-platform streaming and somatic interaction technologies, which enhance the virtual immersive reality experience of users on multiple sensory levels, enabling virtual simulation and virtual reality[12]. Another type of information transfer technology is based on 5G/6G and Brain-Computer/Brain-Brain Interface (BCI/BBI). For example, brain-brain interfaces allow learners to structure their thinking and emotional data and effectively communicate it to other learners through mirroring avatars[13].

Secondly, in terms of the interaction between the real subject and the mirror subject in the educational metaverse, the high degree of overlap between the real world and the mirror world is conducive to the complementarity and balance of the two worlds from educational content, educational data to educational concepts, forming a new educational ecology. This type of interaction includes the “interaction between the real subject and the mirror ontology” and the “interaction between the real subject and the mirror other”. The former is based on the “digital twin”, as the interaction presupposes that teachers and student pass personal information to the mirror subject in real time. In this scenario, the relevant data in the metaverse can be predicted by artificial intelligence and simulation models, and learners can make predictions about their own teaching or learning behavior by observing the learning performance trends of the mirror subject. In addition, the mirror other is seen as an intelligent body that has been trained with data. The interaction between the real subject and the mirrored other crosses spatial and temporal boundaries in a broader dimension, and the learner can share it with a master teacher or peer at any time. These intelligences are based on digital twins with a high degree of data overlap, enabling high levels of simulation. There are two main types of technology supporting this scenario: one is network arithmetic technology, including the integration of edge computing and cloud computing. It increases the efficiency of digital twin data synchronization; the other category is blockchain technology. It ensures the openness, transparency and tamper-evident nature of personal data in synchronization, effectively guaranteeing the security of personal and mirror data synchronization. The current digital add-on is maintained by the operator, which means that digital property rights belong to the operator, not the user. Blockchain technology will play a crucial role in the protection of digital intellectual property created by teachers and students in the metaverse[14].

Finally, it cannot be overlooked that there is also interaction between the mirror subjects in the educational metaverse. The social nature of the educational metaverse is not only reflected in the parallel relationship with the real society, but also in the ability of the avatars to learn by themselves and to spontaneously build social relationships, and to communicate, discuss and learn in the educational metaverse, creating new knowledge content and learning forms, so that the “digital twin. The “digital twin” moves towards the “digital native”. With the support of artificial intelligence technologies such as natural language processing and group intelligence, mirror subjects are highly simulated and their spontaneous activities become possible. On the one hand, simple collaborative tasks can be completed by mirror subjects, and the results of interaction can be used as a reference for real subjects, making the interaction between real subjects more relevant. On the other hand, virtual subjects may form breakthrough knowledge based on the exchange, fitting and simulation of virtual data. These two aspects will significantly reshape the architec-
ture of collaborative and self-directed learning, enriching learning and making relatively static educational scenarios more dynamic\cite{15}. Similarly, the interaction between mirror bodies has also provoked reflection. Some scholars argue that the value of metaverse is primarily in enduring creativity that “continues to exist and develop internally even when no one is interacting with it”\cite{2}. In order to make interactions between mirrors more conducive to knowledge production, some scholars have argued that there needs to be a certain level of virtual proximity between mirrors, and others have offered thoughts on data preservation and attribution of new knowledge generation for interactions between mirrors\cite{16}.

2.3. Characterized by boundary breaching

As a new form of education, the education metaverse relies on interaction-centered features, breaking through the boundaries of the traditional Internet in terms of space-time, relationships, communication and emotional dimensions.

**Space-time boundaries**

The education metaverse has a deeper social dimension than existing virtual reality scenarios, and is closely linked to the attributes and elements of the real society, so the education metaverse has a broader and deeper application scenario for the breakthrough of spatio-temporal boundaries.

Firstly, the educational metaverse is forward-looking in time. The education metaverse is not only able to restore scenes from the past, but also to present the future in a predictive manner. Based on the mapping of real teaching data, the education metaverse can make use of data simulation to carry out realistic simulation of the execution effectiveness of education management models, education reform experiments and other behavioral data, which can, to a certain extent, avoid the execution risks of immature technologies or policies in real education scenarios, thus providing reference for education decision-making. Secondly, the education meta-universe spatially spans the disadvantages of existing silos of teaching and learning resources. One of the important directions of the meta-universe is to realize the streaming of resources from various platforms, solving the problem that resources cannot be docked in different operating platforms and editing tools. With the help of cross-platform information streaming and feedback devices that can restore diverse practice scenarios and support learners’ cross-platform and cross-resource practice operations, it can greatly solve the problem of integrating and utilizing multiple teaching resources in virtual teaching\cite{17}. Finally, the breakthrough of spatio-temporal boundaries helps to realize the digitization of the second classroom. Educational activities are no longer limited to the classroom, but also involve learners’ formal and informal learning activities in different scenarios and at different times, and the metaverse can help reflect learners’ knowledge, abilities, literacy and personality from multiple aspects. The education metaverse also has the potential to truly evaluate the whole cycle of the learner, which is an important tool that can truly deepen education evaluation reform and promote the modernization of education.

**Relationship boundaries**

The educational metaverse reshapes the relationship between the various educational subjects, breaking down the temporal, spatial and organizational limits of the subject. The educational activity between relations is reshaped. The relationship within the educational metaverse breaks through. It is characterized by objectivity, spontaneity and plurality. Firstly, relational interactions within the educational metaverse strictly comply with the interaction of relations within the educational metaverse strictly follows the corresponding procedural norms and rules of calculation. The relationship within the educational metaverse is not based on the subjective will of the subject, which prevents the real learners. The interaction is not subject to the subject’s subjective will, so that the real learners can avoid the harm-avoiding behavior in the process of interaction, such as knowledge hiding behavior. The second is that the
relationships within the educational metaverse are not subjective. Secondly, the relational interactions within the educational metaverse are spontaneous with the support of intelligent algorithms, collaborative learning without the manipulation of the real subject. This process will greatly facilitate the creation of new knowledge. This process will greatly facilitate the creation of new knowledge. Finally, the relational subjects in the educational meta-universe move from a single to a pluralistic approach. The whole ecological mirror simulation is able to bring together individual learners and support groups. The ability to bring together individual learners and support group collaboration, on the one hand, helps to the formation of a group perception network for Internet learning, providing a feedback mechanism for building group perception and promoting group intelligence. On the one hand, it helps to form a group perception network for Internet learning, providing support for building a feedback mechanism for group perception and promoting knowledge production for group intelligence. On the other hand, the relational breakthroughs in the educational metaverse enrich the “teacher-peer-individual-machine. On the other hand, the relational breakthroughs in the educational metaverse enrich the multifaceted hybrid interaction model of “teacher-peer-individual-machine”. The mirroring of subjects will significantly reshape the way teachers work, support cross and collaborative innovation, and expand the intelligent application of human-machine two-way feedback\(^{[14]}\).

**Communication boundaries**

The educational metaverse, as a cross-domain communication space supported by intelligent technology, is a breakthrough in terms of the subject of communication, the tools of communication and the direction of communication. For the subject of communication, the mirror subject is able to play an alternative and refining role at the physiological and psychological levels. Technologies such as speech synthesis, brain-computer interface and brain-brain interface can help learners overcome communication barriers at the physiological level. The plasticity of the mirror subject’s own personality and abilities can also compensate for learners’ communication difficulties at the psychological level, as applied to learners with deaf blindness or autism in the field of special education, or to help non-verbal rural learners to express and communicate better. As for the tools of communication, the communication methods in the education metaverse will become more diversified, with voice, video, 3D images and holographic projections all becoming tools and vehicles for communication, enriching the amount of information transmitted and improving the efficiency of communication. For example, Meta’s XLS-R speech training self-supervised model can help people with different native languages to talk directly in the educational metaverse, and to learn a common language and educate people. For the direction of communication, the decentralized structure of the education metaverse breaks the limitation of one-way transmission of knowledge resources, promotes two-way dissemination of information, and forms a benign symbiosis circle. For example, traditional information technology education equity is simply the transfer of urban education resources to the countryside, without considering that education equity is the mutual delivery of resources and complementary strengths. The education metaverse can also allow urban learners to carry out labor education in rural scenarios and learn about the use of rural resources, realizing two-way sharing of urban and rural resources and two-way output of educational equity.

**Emotional boundaries**

Emotions are an important factor in supporting students’ learning and growth. Education Changes in identity and communication in the meta-universe help to break through educational intersubjective emotional boundaries and contribute to the continuous improvement of the personality of real-world learners. This is reflected in the following ways.

A. The emotional support of the mirror subject. In the educational metaverse, the real learner interacts with and is emotionally invested in the avatar, forming an emotional connection between the vir-
tual and the real, and the avatar can therefore act as an emotional companion and support. In addition, the avatar, as a highly similar individual with two sides to the virtual and the real, can provide encouragement to the real learner through its growth. In a global music composition, artists collaborated collectively with the help of a metaverse, a process that allowed participants to receive praise, entertainment and humor, providing an emotional environment to support the creative work\textsuperscript{[11]}.

B. Mirroring the emotional support of others. The Education Meta-Universe will form virtual teaching assistants based on teachers’ data, which can give learners immediate responses without increasing the teachers’ teaching load, solving the real-life problem of insufficient teacher-student ratio and giving students more comprehensive guidance and care. The open and social nature of the education metaverse also helps learners to find like-minded partners, forming a highly interactive and supportive learning community and creating a positive learning and interactive atmosphere.

C. Emotional support in the construction of the environment. The virtual environment in the educational metaverse is highly malleable and creative, allowing not only to restore scenarios that cannot be realized in the real world, but also to allow learners to use their subjective initiative to create in the virtual world, giving students the space to bet on their emotions and build their own personalized learning environment. The educational metaverse can also bring positive feelings and positive experiences back to the real world through the virtual-real interaction process, facilitating real-world change for the better.

3. Innovations and challenges

3.1. Innovation in the form of education

\textit{Innovation in teaching environment and resources}

The integration of underlying technologies such as visual immersion, haptic feedback and information transmission in the educational metaverse offers the possibility of innovative development and widespread application of teaching environments and resources, which can expand learners’ embodied cognition and perception of teaching situations in specific scenarios, as well as enable convenient replication of learning environments and maximum sharing of learning resources in multiple scenarios.

A study at Cheong-un-University in South Korea has successfully constructed a metaverse system that synchronizes physical and virtual campuses by linking face recognition technology and teaching management data\textsuperscript{[4]} To provide a highly interactive metaverse space for students, the Chinese University of Hong Kong (Shenzhen) has integrated sensors, cameras and GPS modules built into smartphones of teachers and students to obtain location data based on Unity rendering technology to accurately simulate a physical library learning place\textsuperscript{[10]}. Zhejiang University has created a metaverse platform, “Research in Zhejiang University 2.0”, which replicates real conference scenarios with high accuracy by linking a crowdfunding hybrid cloud, research data platform, simultaneous interpretation and remote sensing technology, and has been replicated nationally. The International Association for Research on Immersive Learning has created an editable Virbela Campus. In addition to the usual modelling of teaching and learning spaces, the Virbela Campus has been designed with booths, restaurants, boats and other funky communication spaces (see Figure 1).

As an important component of the teaching and learning environment, learning resources have been innovatively developed in the educational metaverse. On the one hand, the decentralized structure of the educational metaverse helps to promote the plurality and development of learning resources. Digitization has made learning resources better editable; they are no longer one-sided, static presentations of knowledge, but rather a community of knowledge constructed by teachers and students, allowing for multi-subject and multi-stage updating and development. The Faculty of
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Education and the Faculty of Engineering of the University of Madura have jointly developed a meta-universe teaching experiment in which teachers are allowed to create virtual environments according to their preferences. The teachers did not have the opportunity to participate in the construction of a physical school, but together they participated in the construction of a virtual school, and this collaborative construction of the environment significantly increased the teachers’ engagement and social skills. On the other hand, the comprehensive mirroring of the real world by the educational metaverse helped to facilitate the sharing and circulation of learning resources that were no longer limited by the form of presentation, the devices used and the platform. KOSEN University in Japan uses Second Life (Second Life) from the Liden Lab as an editorial platform for developing shared instruments for remote areas and other organizations based on engineering collaboration needs.

![Figure 1. “Research in Zhejiang University 2.0” Meta-Universe Platform and Virbela Virtual Campus.](image)

**Teacher-student communication and collaborative innovation**

In the era of Web 1.0 and Web 2.0, Internet education was mainly focused on information exchange. As a new generation of Internet education model, the education metaverse is a teaching space with emotional interaction as the core radiation of educational content. The education metaverse embodies the unity of the shared openness of the virtual world and the infinite extensibility of the real world. The former expands the multiple social objects and channels for teachers and students, while the latter constrains the rights and responsibilities of social relationships. In such an open and constrained space, teachers and students pay more attention to the development of academic reputation, professional commitment, global thinking and empathy. This is because the mirror subject is a digital twin of the real subject, with which learners feel a sense of intimacy as they interact, and the growth and refinement of the avatar has a positive impact on learners; and the highly simulated metaverse world greatly increases learners’ trust in social networks and provides emotional support for learners’ social relationships in the real world. A 2020 survey by the Korean Ministry of Education found that insufficient guided interaction, lack of effective communication and social relationship indifference in online teaching and learning have become the foci of blended learning. A team of researchers at Korea Central University built a metaverse learning and testing platform and collaboratively manipulated a real-space programmed car, allowing learners to create different roles and identities and to find like-minded partners and form spontaneous avatar social relationships in the virtual world. The study concluded that the metaverse platform reduced learners’ communication difficulties from 72% to 30%.

Supported by emotional interaction, the education metaverse changes the shape of teacher-student communication and collaboration in Internet education. The education metaverse is not only a mirror image of the learning environment, but also a real-time simulation of the learner’s behavior and state in the learning space. Unlike traditional Internet education where teachers and students are separated in space and interact in isolation, the education metaverse provides a unified virtual scene for teachers and students. Among other things, the expressions, words and actions of avatars not only enrich the social and emotional feedback between teachers and students, but also greatly expand the form of course organization for remote collaboration. For example, through technological integration, the Chinese University of Hong Kong is able to string together learners in the same scenario through the metaverse to create their own chat rooms, and encourage collaborative workshops among students by issuing virtual tokens to increase the fun of teaching and learning. The university also encourages students to form student councils on the metaverse platform, elect virtual committees and
make efficient decisions on matters. By tracking and analyzing real-time operational data from the metaverse platform, the AI-powered metaverse observer can automatically recommend interesting events that are happening to users, enhancing the accessibility, diversity, equality and humanization of learning activities.

**Educational evaluation and labor innovation**

At present, education issues have broken through the space of classrooms and campuses, such as education equity issues, the construction of a learning society, education for common prosperity, ethnic education issues, and the digital economy and education, all of which are socialized or closely related to education investment\(^\text{[20]}\). The solution of existing education issues still lacks the channels and technical methods of integrated social governance, and is even prone to the “one-size-fits-all” phenomenon of “treating the head when the head aches and treating the foot when the foot hurts”. There are two needs for the integration of education issues into social governance: firstly, there is no scientific evaluation system for education. The failure to integrate education issues into comprehensive social governance is an important reason for the single direction of various types of education assessment. General Secretary Xi Jinping’s proposal to “reverse the unscientific orientation of education evaluation” is essentially a call for education to be centered on helping the economic development of society and the spiritual civilization of the times. The ecological view advocated by the education metaverse is to digitize and visualize the problems associated with education and social development, and to break the “five only aspects” of explicit representations by tapping into the invisible representations of educators’ contributions to society. Secondly, the educational intelligentsia is the main manifestation of digital labor. In the Top Ten Academic Hotspots in China, jointly published by the Book and Newspaper Resource Centre of Renmin University of China, the Theory Department of Guangming Daily and the Editorial Department of Academic Monthly on 31 December 2021, it was suggested that with the changes in the content and mode of labor, the essence and basic characteristics of digital labor have become the focus of discussion. Whether intellectuals can become “labor subjects” and whether they should enjoy “labor rights” has become the core of the discussion. The intelligentsia mapped by intellectuals in the educational metaverse is the main force of digital labor, which makes it possible to integrate the educational metaverse into the comprehensive social governance system.

**3.2. The challenges ahead**

The educational metaverse is a deep integration of many cutting-edge technologies with education, teaching and social relations. The challenges facing the educational metaverse are also a juxtaposition of many ethical issues of technology, and new issues arise in new fields of technological integration and application.

**Education data O&M at greater risk**

The education metaverse is a comprehensive digital form of human-computer interaction, human-computer interaction, and machine-computer interaction. Various types of education data are the basis for teaching implementation, evaluation, and decision-making, and the acquisition, application, and storage of data are at risk.

In terms of data acquisition, one is that the underlying data is difficult to access. The construction of the education meta-universe relies deeply on cutting-edge virtual engines and rendering technologies, yet the development and innovation of these technologies are still dominated by developed countries in Europe and the US. If there is no breakthrough in rendering technology, it is difficult to digitize teacher and student behavior data, and to achieve a comprehensive portrait of the learner’s educational meta-universe. Second, the timing and scope of data updates are unclear. When and to what extent the relevant data of real subjects will be updated to the virtualized body remains open to discussion: on the one hand, the timelier and more comprehensive the update, the more authentic the mirror avatar will be, but on the other
hand, data updates that are completely consistent with the real world will also limit the freedom of the mirror avatar itself to expand its space.

In terms of data application, there may be multiple different education meta-universes in different countries and regions or different internet companies, and there may be difficulties in unifying data structures between different education meta-universes and between different scenarios in the education meta-universe. In addition, data in the education meta-universe also involves systems for identity authentication, economic operations, etc. Inappropriate applications of education data may involve numerous aspects of social life and cause additional distress to learners, so the scope and specifications of data applications still need to be clarified.

In terms of data security, more digitization also means more challenges for data security. The education meta-universe will generate huge amounts of data and information, and these data will not only reflect educational scenarios but also be highly relevant to social life, which makes it more difficult to maintain educational data security.

**Digital rights in education are difficult to secure**

Standardized educational digital rights are a prerequisite for knowledge sharing and teaching and research collaboration in the educational metaverse. Only when individual and organizational digital intellectual property rights are protected and organization's digital intellectual property rights, there will be high quality resources and high-quality education.

Firstly, the diversity of roles and the plurality of fields in the education metaverse may bring about confusion in digital knowledge copyright. For example, the same real subject may correspond to different avatars in different educational metaverse, leading to greater difficulties in the authentication of knowledge copyright and the determination of infringement acts. Secondly, the intelligence and creativity of the education metaverse also makes it difficult to trace infringement of intellectual copyright. Based on the technological means in the education metaverse, the threshold for reproducing knowledge and resources has been greatly reduced, while the difficulty of identifying piracy has been increasing. This makes it difficult to determine infringement, and there is a “grey area” in digital copyright protection. Finally, the issue of attribution of knowledge created spontaneously by avatars still needs to be discussed, such as clarifying the real subject of copyright attribution or the subject of management of the educational metaverse.

To address these issues, the technical level can strengthen the copyright protection of digital education resources through blockchain for knowledge annotation and enhanced digital signatures. At the organizational management level, schools or research institutions should actively set up relevant intellectual property law departments to protect the intellectual property rights of teachers and researchers and support them to better build educational resources and share knowledge.

**Equity and fairness in education threatened by capital**

The education metaverse, as part of the overall social meta-universe, involves corresponding economic and social systems, such as money markets, capital markets and commodity markets. While technology is neutral, capital is, however, profit-seeking, which poses a potential risk for capital manipulation of education.

On the one hand, the attention and research on the education metaverse is still dominated by internet companies, and the education metaverse will inevitably be influenced by the new economic system. Whether the chaos of online education brought about by capital will be repeated in the education metaverse and how to effectively regulate this market are still difficult questions to be solved. On the other hand, learners who have difficulty generating revenue for capital will most likely remain at a disadvantage in the education metaverse, further widening the gap between them and superior learners.
under the catalyst of the education metaverse, posing a greater threat to educational equity.

Faced with the challenge of capital, on 18 May 2021, South Korea announced the creation of a “metaverse alliance” of local companies with the goal of creating a unified national augmented reality platform, clarifying ethical and legal regulations for virtual environments, ensuring that the metaverse “is not a space monopolized by a single large company”, and making virtual services a new public good. The aim is to create a unified national platform for augmented reality, to clarify ethical and legal regulations for virtual environments, to ensure that the metaverse is “not a space monopolized by a single large company” and to make virtual services a new public good. This approach also provides a reference for a rational regulation of the educational metaverse[21].

Educational values confined to numeracy training

Unlike other social activities, education has a major mission to build moral character and has a significant impact on the development of learners’ personality and values. The educational metaverse is a digital learning field built on intelligent algorithms, and it is questionable where the uninterpretable ‘black box’ algorithms will lead learners’ educational values.

The immersive and scene-wide nature of the educational metaverse reinforces the extent of algorithmic training and algorithmic control. The influence of the algorithm on the learner is no longer the bias of a particular learning or social platform, but the potential orientation of the entire learning life scenario. The initial bias is likely to be repeatedly reinforced during the operation of the algorithm due to its continuous learning and optimization. If there is a bias in the orientation of educational values at the design stage of the algorithm, its impact on the mindset and ideology of the learners in the educational meta-universe will be enormous.

The oriented nature of arithmetic has hidden dangers for the development of individuals and society. Long-term exposure to the “information cocoon” of arithmetic training-receiving homogenized information is not only detrimental to the development of critical thinking in learners, but will also dissipate the pluralistic qualities of education, narrow students’ minds, stifle their creativity and imagination, which is not conducive to the all-round development of learners and the perfection of their personality. At the societal level, deviations in the value orientation of algorithm-driven education can lead to problems in the values of society as a whole and induce serious social problems.

4. Conclusion and reflection

In the face of the educational metaverse, a future form of education that presents both opportunities and risks, we should still explore the two-way promotion of education and the metaverse from the perspective of critical reflection, adhering to a reality-oriented and human-centered approach.

4.1. Reality orientation: Avoiding the compensatory effects of the educational metaverse

The emergence of new technologies often leads to a blind technology cult among some people. The education metaverse is not an “ideal state of education” or a “digital utopia”, and should not be a substitute or compensation for the real world, but rather a mapping and predictive reflection of the real world. The educational metaverse expands the imaginary boundaries of education and teaching, offering the possibility of creating a perfect world. The imperfection of reality and the ease of implementation of technology may give rise to the ‘compensatory effect’ of the educational metaverse, where the ideal of inner hope is placed in the educational metaverse. However, if we remain in the “beautiful illusion” of the educational metaverse, the realities of education will remain insoluble. We should always be guided by reality and make the virtual world work for the realization of the world.
4.2. Putting people first: Retaining the human dimension of the educational metaverse

Education is a social activity that nurtures people. The education meta-universe needs to maintain a human-centered philosophy and create education with a sense of temperature. A sense of temperature in education is expressed on the one hand in providing emotional support to learners, bridging the problems of relationship disintegration and emotional desolation that can be brought about by excessive digitalization. On the other hand, it also manifests itself in providing humanistic education to learners, developing their abilities, exercising their literacy and refining their character on the basis of imparting knowledge content, playing the role of cultural transmission, shaping learners into autonomous actors and duty bearers, enabling them to hold the line of morality amidst the possible risks of disorder, and achieving a rational span of the id, ego and superego\(^{[22]}\).

4.3. Human-machine inter-construction: Exploring the two-way facilitation of technology and society

The educational metaverse is the product of a highly developed technology and society, a form of education that transcends the instrumental nature of technology and can empower the future development of people and society at a deeper level. This requires us to take a proper view of the inter-constructive relationship between the two. Behind the educational metaverse lies the underlying ethical logic of the real world, bound and regulated by the real world. The educational meta-universe influences the development process of society as it continues to evolve. The two cannot be completely separated and need to be viewed in a complex and systematic perspective. In addition, we need to bring into play human value judgement and subjective initiative, avoid potential risks that the application of technology may bring to the development of education, ensure the rationality, correctness and fairness of the value orientation of education and teaching under technological empowerment, guide technology towards goodness, and realize the two-way promotion and benign development of technology and society.

Conflict of interest

The authors declare no conflict of interest.

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