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# Characteristics, Mechanisms of Action and Reflections of the Educational Metaverse

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**ABSTRACT**

The concept of the metaverse has gradually become a hot topic. With the continuous development of science and technology, people are trying to explore the development trend and possible application of the metaverse in the future world. With the continuous development of science and technology, people are trying to explore the development trend and possible application of the metaverse in the future world. The article gives a detailed explanation of the characteristics of the education metaverse and the mechanism of action of the education metaverse, which is considered to be one of the main application scenarios of the Metaverse. The article gives a detailed explanation of the characteristics of the education metaverse and the mechanism of action of the education metaverse and reflects on the new teaching form of the education metaverse. From the perspective of critical reflection, it emphasizes adherence to reality-oriented, and people-oriented, and explores the two-way promotion of education and the metaverse.

**Keywords:** metaverse; education metaverse; characteristics, mechanism of action

The term metaverse, born in the 1992 science fiction novel Snow Crash, is essentially a process of virtualisation and digitisation of the real world, requiring a massive transformation of content production, economic systems, user experience and the content of the physical world. But the development of the metaverse has been gradual, supported by shared infrastructure, standards and protocols, with a multitude of tools and platforms that have continued to converge and evolve to take final shape. And long before the concept of metaverse emerged, metaverse-related technologies had already established a deep ideological connection with education. According to some scholars, the Edu-Metaverse can be understood as the creation of digital identities by teachers, students, administrators and other participants in educational activities, the development of formal and informal teaching and learning spaces in a virtual world, and interaction in virtual teaching and learning spaces (Zixun & Muxiong 2021). It is therefore an urgent need of the times to decipher where the innovations and challenges of the Edu-Metaverse lie and to make full use of the human dimension of technology to develop the modernisation of education.

## I. Characteristics of the Educational Metaverse

Long before the concept of metaverse emerged, metaverse-related technologies had already established a deep intellectual connection with education. Virtual reality is one of the supporting technologies of the metaverse, which Qian Xuesen translated in 1990 as "spiritual realm" (Yuanji, 2007), meaning "immersion", and made it an important part of "Dacheng Wisdom". It is also a key technique in Dacheng Wisdom. Qian Xuesen also creatively proposed the "Dacheng Wisdom Project" (Hui, 2020), the core of which is to "integrate human thinking, the results of thinking, human knowledge, wisdom and all kinds of intelligence, materials and information" (Xuemin, 2011). It can be said that Dacheng's wisdom philosophy presupposes the educational application of meta-universe-related technologies and foresees that the systemic construction of the meta-universe has great nurturing value. Thus, the educational metaverse is not only a mirror virtual world connected to the real world system but also a space of freedom and creativity that is imbued with human civilisation and wisdom, thinking and experience. Taken together, the education metaverse is characterised by three features:

(i) *Virtual and reality are fully intertwined*

The educational metaverse does not only stop at the spatial replication of simulation, but also

integrates the real elements of education (educational content, educational purposes, role relations, management models, etc.) into its logical system, and then derives a new educational system based on the associated qualities of the virtual space and the educational system, and finally realises the concluding integration of the virtual educational space system with the real educational system, constituting a crossover between educators, learners and participants in educational activities The foundation conditions for virtual and real education. Teachers and students can interact with each other in a multi-channel way, using terminal devices to simulate visual, audio and tactile interactions to complete learning and communication. In addition, the construction of the educational metaverse not only preserves the value of real-world educational activities but also transcends the spatial limitations and physical barriers of reality, allowing the educational subject to develop an "amphibious" literacy that adapts to both the virtual and the real, allowing him or her to complete educational activities with both freedom and creativity in the interwoven dual space.

(ii) *Full human-machine synergy*

The education metaverse, as a technological ecosystem bridging the virtual and the real, is highly integrated through technologies such as intelligent perception, cloud computing and blockchain, making the labour relationship between the educational subject and the technology close. The labour of the educational subject gradually rises to the design of thinking and creativity, and then through brain-computer interface technology, the design of thinking is instantly transformed into a real scene in virtual space. The educational subject can greatly contribute to the development of students' thinking by building new types of educational spaces at will with imagination and creativity. In addition, the intelligence of smart technologies will be highlighted, for example, the education metaverse provides teachers with a basis for teaching design and differentiated teaching through accurate learner portraits. At the same time, the results of the portraits will also enable the education metaverse to deliver multimodal learning resources to learners more accurately, highlighting the service value of emerging technologies and better meeting the personalised learning of learners. In short, in the education metaverse, the human-technology dependency is more deeply expressed, and the human-machine collaboration mechanism is more flexible and efficient.

(iii) *Full school-society connection*

By bridging the virtual space and the real space, the educational metaverse dissolves the "walls" and borders between education and society. The American philosopher and educator Dewey proposed the principle of "school as society" in education, but the shackles of reality make this principle difficult to realise. In the education metaverse, with the support of blockchain and virtual reality technology, the school system and the social system can be connected and there are no more walls between school and society. Furthermore, the vision of a truly lifelong education and learning society will become a reality with the education metaverse. Knowledge learning and competency development will be more deeply integrated and articulated, and virtual spaces will greatly facilitate the interaction between theory and practice, enabling knowledge learning to be more efficiently completed with the transformation of the explicit and the implicit, truly promoting the all-around development of knowledge and competency.

## II. Mechanism of Action of the Educational Metaverse

In order to integrate the metaverse naturally into education, the first issue is to clarify the mechanism of action. Based on the deep integration of the virtual and the real, the collection of intelligent digital

technologies, the integration of online and offline relationships and the deepening of the representations of the user's mind, (Geping et al., 2021), the following section analyses the mechanism of the educational metaverse from the perspective of the educational model, environment, resources, activities and evaluation.

(i) *Innovative talent development model*

The education meta-universe will promote significant changes in teaching methods, teaching practices and teaching technologies, realising innovations in teaching models, promoting changes in teaching patterns and improving the quality of talent training. First of all, the innovation of teaching mode. The education metaverse can greatly extend the existing teaching and learning space, enrich teaching and learning methods, and change teaching and learning methods: first, innovation in teaching concepts. The subjectivity and individuality of learners will be more prominent, and the focus of the teaching concept will shift from "teaching" to "learning", promoting independent learning, personalised learning and ubiquitous learning for learners. Second, innovation in teaching practice. The education meta-universe can provide learners with highly realistic practical situations, meet students' practical needs, and promote learners' comprehensive and in-depth understanding and mastery of learning content. Thirdly, innovation in teaching methods. The education metaverse provides intrinsic support for teaching methods through intelligent technology and provides an all-round, all-process and all-time guarantee for teaching method innovation. Fourthly, innovation in teaching methods. The application of the education metaverse provides conditions for inquiry-based teaching, project-based teaching and game-based teaching, which can promote students' active knowledge construction. Fifth, is innovation in the teaching process. As a virtual world that integrates reality and reality, intelligent and open, and ubiquitous and interconnected, the education metaverse can turn the simple and linear teaching process into a free, generative, wisdom-filled and innovative process.

Secondly, it will change the shape of teaching and learning. The education meta-universe will promote the transformation of teaching and learning in terms of teaching objectives, teaching fields, teaching subjects, teaching forms and teaching processes. Firstly, the application of the education metaverse helps to promote the transformation of teaching objectives from learning knowledge and skills to cultivating competence and quality and to adapt to social development changes. Secondly, the education metaverse breaks through the spatial and temporal limitations of traditional education, extending the teaching field from a fixed classroom teaching space to a mixed teaching space that integrates reality and reality, supporting teachers to carry out teaching activities and students' independent learning in a flexible manner. Thirdly, in addition to human avatars, the education metaverse also includes various intelligent "avatars" that can assist teachers in teaching and students in learning, and the teaching subject will be expanded from the original teacher and students to a trinity of teacher, students and intelligent machines. Fourthly, the form of teaching will change from mono-dominant to multi-faceted integration. The education meta-universe can transcend the traditional teaching process of a single medium and a single form, and realize a multi-faceted form of integration with multiple forms of participation, multiple interlocking links and multiple contexts. Finally, the teaching and learning process moves from empirical organisation to data-driven. The education metaverse can record all the details of the teaching process in a comprehensive, three-dimensional and objective manner, and intelligent analysis technology can provide teachers with realistic, reliable and dynamic tools for implementing, intervening and optimising the teaching process.

Thirdly, improve the quality of talent training. The Education Metaverse will promote the

transformation from a talent training model centred on the transfer of knowledge to one centred on student development and improve the quality of talent training in five ways: first, by giving students greater freedom, emphasising their subjectivity and cultivating their sense of subjectivity. Secondly, create an open, flexible and independent classroom learning environment to stimulate students' curiosity and desire for knowledge, and cultivate a critical and innovative spirit. Thirdly, provide students with an ideal practical and experimental environment to facilitate the internalisation of knowledge and improve their higher-order thinking skills of problem identification and problem-solving. Fourth, it realises wise adaptive learning, providing students with personalised learning paths, resources, partners, etc. It can also break through the limitations of physical time and space, and support students to carry out independent learning according to their interests and hobbies, etc. Fifth, it breaks through the original talent training curriculum system and supports the development of interdisciplinary teaching and learning, such as STEM education and creator education, to cultivate students' innovative spirit and creative practical skills.

(ii) *Enabling Smart Education Environments*

The metaverse is a digital application cluster or ecology built on advanced digital technologies such as mixed reality, brain-computer interface, blockchain, cloud computing and new-generation communication technologies. Artificial intelligence technology is embedded in it as the core, making the metaverse an intelligent field that integrates reality and reality, enabling the education sector to build a smart education environment. Firstly, the education metaverse can provide an educational environment with deep integration of virtual and reality. The metaverse is a simulation of real-world scenes, objects and forms of interaction in a virtual space. The virtual space can support the user's own creation and realise the deep integration of the virtual and the real. For the education sector, the metaverse can facilitate the coupling of online and offline learning, so that online and offline are no longer complementary but integrated.

Secondly, the educational metaverse provides an educational environment that is open to creativity and can partially liberate learners from the constraints of reality. The constraints of the real world hinder the development of learners' inquisitive and creative spirits. Learners can have perceptual experiences that transcend reality in the education metaverse, such as reasonable breakthroughs in time and space, free and open innovation and creation, and instant realisation of creative ideas. They can also edit and create scenes, products and even ideas, cultivating innovative thinking and creative abilities, and enriching the mode of cultivating innovative education and innovative thinking.

Once again, the educational metaverse can broaden the school field and provide an educational environment of individual-social interaction. The educational metaverse changes the current form of social organisation. The virtual environment can provide an immersive socialised field and relationship for education, enabling the effective connection of individual-social activities, forming a learning environment of individual-social interaction, and facilitating the transformation of the objectives of education and teaching from knowledge mastery to a knowledge application-oriented and thinking development-oriented one, adapting to the future knowledge and skills mastery and competence-oriented The aim is to facilitate the transformation of educational objectives from knowledge acquisition to knowledge application and thinking development and to adapt to the future of knowledge and skills acquisition and competence-based social life.

Finally, the education metaverse can provide a collaborative human-machine education environment. The education metaverse is a collection of digital and intelligent technologies that can break through the limitations of existing technologies that have not yet been fully integrated into education, and truly realise

the multi-dimensional deployment and integration of technologies, such as virtual digital humans and AI simulation robots, which can intervene in the metaverse to optimise the existing teacher-student structure of classroom teaching and realise an intelligent dual-teacher classroom with human-computer collaboration.

(iii) *Providing Diverse Educational Resources Education*

The virtual world of the metaverse is able to provide rich and realistic scenarios similar to the real world. The boundaries between the virtual world and the real world are no longer clear, so it is natural to provide learners with diverse educational resources to meet their different learning experiences and needs, allowing learners to develop an immersive learning experience, gradually transitioning from rational-led initial participation to emotional involvement and full attention, thus achieving a "mindstream" experience of Total Immersion (Emily & Paul, 2004). Firstly, the educational metaverse can present learners with multimodal learning resources. The virtual world of the education metaverse can bring about perceptual experiences that go beyond the real world and thus has a multimodal form of resource presence. Learners can effectively engage their multisensory systems in the learning process, enabling multimodal learning, such as tactile, auditory, visual and olfactory modalities. Multimodal learning is a way of learning that is closer to the real world and allows learners to have a natural, immersive learning experience. At the same time, multimodal learning allows learners to have an embodied learning experience, engaging the bodily sensory system in learning, facilitating concept formation, acquisition and development, and developing higher-order thinking through continuous perceptual practice. Secondly, the education metaverse enables the sharing of educational resources. The extreme openness, social participation and ubiquity of the education metaverse allow users to freely access and edit and create educational resources, so that there is no single provider of educational resources, but rather multiple players, such as learners, teachers, schools, education administrators, governments and enterprises, to co-create educational resources and create rich, comprehensive and personalised educational resources. At the same time, the large-scale "digital intelligence" technology of the education metaverse enables the flow and sharing of educational resources, realising the maximum value of educational resources. Again, the education metaverse can optimise the way education resources are allocated. The ubiquitous interconnection and intelligent open environment provided by the education metaverse can eliminate regional differences and urban-rural barriers to existing education resources, promote the effective circulation of education resources, and optimise the allocation of education resources. All levels of education, regions and schools will be able to receive adequate distribution of quality educational resources, and different learners will be able to enjoy rich and diverse educational resources, thus promoting the efficient and fair allocation of educational resources.

(iv) *Support for diverse learning activities*

The core of learning spaces is to personalise learning for learners. (Yuhui & Shusheng, 2021) is a smart learning space that supports learners to carry out multi-learning effectively. The Education Meta-Universe can use intelligent technology to meet the needs for a free and open environment, massive resources, data analysis and processing, and smart recommendations for diversified learning, and support learners to achieve independent and personalised learning according to their own learning and cognitive styles, specifically in the following ways: Firstly, it can support the accurate portrait of learners. The smart education environment provided by the Education Meta-Universe can process and process data on learners' learning performance, behaviour, physiological reactions and emotional attitudes during the learning process to create an accurate picture of learners' learning and grasp their true knowledge level and learning

characteristics, which can be used as the basis for the creation of multiple learning activities. Secondly, it can support the creation of multiple learning scenarios. Learning scenarios are the direct place where learners' learning activities take place, and multiple learning activities will create different scenarios based on learners' personal characteristics. The education meta-universe supports the identification, pre-design and co-editing of learning scenarios to match and meet the level and style of different learners, promote the dynamic generation of learning scenarios, realise the creation of learning activities, and meet the differentiated teaching of teachers and the personalised learning needs of learners. Thirdly, it can enrich the form of learning activities. The metaverse provides an environment and resources for the education sector, making it easier for teachers and students to organise and carry out multiple learning activities. Depending on the learning style and content organisation of the learners, the education metaverse can match them with different learning activities, such as inquiry-based learning, discovery learning, project-based learning and problem-solving learning, to effectively meet their individual needs.

(v) *Enabling intelligent teaching and learning assessment*

With big data, blockchain, artificial intelligence and other technologies as the cornerstone of construction, Education Meta-Universe cracks the problems of difficult, incomplete, inaccurate and discontinuous education data collection with the data collection and processing and value discovery of big data, the timestamp and consensus protocol of blockchain technology and the intelligent processing of artificial intelligence to achieve comprehensive, integrated and developmental intelligent teaching evaluation. Firstly, it supports the plurality of evaluation subjects. The plurality of evaluation subjects is an important guarantee for the accuracy and comprehensiveness of education evaluation. The education metaverse relies on an extremely open environment and rich and comprehensive process participation, and places more emphasis on the plurality of evaluation subjects: one is the evaluation of learners themselves. The learner's unique ID in the metaverse will accompany him/her throughout the learning process, and the learner will be able to evaluate himself/herself continuously. Secondly, school evaluation. The focus of school evaluation will no longer just be on the acquisition of knowledge and skills but will shift to the development of thinking and abilities, such as how learners solve problems and adapt to the needs of society. Thirdly, parental assessment. Parental assessment can also be integrated into the meta-universe to truly achieve collaborative home and school participation. Fourthly, enterprise (employer) assessment. Enterprises and employers can create scenarios of real needs, complex problems and social development to test learners' ability to apply their knowledge to problem-solving. Second, expand the assessment methods. First, process evaluation. The collection of intelligent technologies can transform the massive data of the education meta-universe into a process record and evaluation of learners, realising process evaluation at different levels such as before class → during class → after class, school → family → society. Secondly, authenticity evaluation. The education meta-universe simulates the real world and evaluates the authenticity of learners based on the process and results of completing projects or tasks. Third, accurate assessment. The education metaverse is able to assess and predict the learner's status based on the learner's current status and history and intervene effectively to achieve accurate evaluation of the process and results. Again, multi-dimensional assessment is satisfied. The education metaverse can support learning activities such as inquiry-based, experiential, thinking skills development and complex problem solving, so that learning assessment naturally transitions from "knowledge-based" to "competence development" and then to the assessment of learners' core literacy, realising the evaluation of learners' knowledge, competence and literacy. This will enable a multi-dimensional assessment of learners' knowledge, competence and literacy, transcending the 'mark theory' and 'knowledge mastery' per se, and promoting the all-round development

of learners.

**III. Summary 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-centred approach.

(i) *Avoiding the compensatory effects of the educational metaverse*

The emergence of new technologies often leads to a blind technology cult among some people. The educational 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 of the real world and a reflection of its predictions.

(ii) *Retaining the human dimension of the educational metaverse*

The education metaverse needs to maintain a human-centred philosophy to create education with a sense of temperature. A sense of temperature in education manifests itself 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 digitalisation. On the other hand, it also manifests itself in humanistic education for learners, developing their abilities, training their literacy and character on the basis of imparting knowledge content, playing a cultural transmission role, 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 Self, Ego and Superego

(iii) *Exploring the two-way promotion of technology and society*

Behind the educational metaverse lies the underlying ethical logic of the real world, which is bound and regulated by real society. The educational meta-universe affects the development process of society as it continues to evolve. The two cannot be completely separated and need to be viewed from 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, and ensure the rationality, correctness and fairness of the value orientation of education and teaching under technological empowerment, guide technology towards goodness, and realise the two-way promotion and benign development of technology and society.

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