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Metaverse: The future field of online education

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Abstract: *Promoting the digitization of online education is an important task for the development of modern education. The meta-universe is a digital space parallel to the real world, and it is a collection of many high technologies, which can provide the theoretical basis of embodied cognition, distributed cognition and immersive cognition for online education. The meta-universe enabling online education can expand the learning boundary of online education, deepen the learning experience of online education, and construct multi-dimensional teaching evaluation and other educational practice fields. Promoting the research and development of meta-universe education technology, building the rational framework of meta-universe education, forming the ethical concept of meta-universe education and other approaches provide practical paths for meta-universe enabling online education.*

Keywords: *Meta-universe; Online education; Education; Artificial Intelligence; Cognition*

1. Introduction

The concept of the Metaverse first appeared in Neil Stephenson's science fiction novel Snow Crash, where the author described it as a virtual environment parallel to real life and called it a "meta-realm". With the development of science and technology, the meta-universe has gradually moved from imagination to reality. The meta-universe indicates the development goal of the next generation of Internet, which is an organic collection of new generation of network information technologies including the Internet and big data, artificial intelligence, blockchain, VR, AR, MR, etc., in essence, it aims to build an interactive, immersive, composite, and collaborative virtual space. At present, the use of information technology to promote education reform has become a general trend in the international community, and has been recognized by all countries.[1] Famous educational institutions and scholars have also focused on exploring the broad prospects of the meta-universe in the field of education. Professor Frank Piller of RWTH Aachen University believes that the revolutionary change of the meta-universe to education is unprecedented, and the meta-universe teaching is closer to the learning experience of real classroom teaching than the network teaching.[2] The advantage of embodied immersion in the meta-universe will be able to effectively solve the problems encountered in the current learning space. Professor Stylianos Mystakidis of the University of Patras pointed out that the meta-universe will enable learners to participate equally and learn together.[3] Based on this, it is very important to extend the turning vision of online education to the meta-universe and explore the future field of online education.

2. Universe gives theoretical foundation to online education

2.1 Embodied cognition theory

Embodied cognition theory holds that the process of cognition is the result of the mutual influence and interaction between brain, body and environment, and emphasizes the core role of body in the cognitive process, including two attributes: one is the natural embodied cognition. Naturalistic embodied cognition emphasizes the role of the natural attributes of the body, that is, physiological attributes, in the cognitive process. F.Varela et al., in Mind-body Intelligence: Cognitive Science and Human Experience, argue that embodied "includes the body as a living, experiential structure, as well as the environment or context in which the body serves as a cognitive mechanism."[4] Taking the body itself as the cognitive subject, the embodied interaction between the body and the environment, including the physical attributes of the nervous system, the brain, the body senses, neurotransmitters and other factors, thus participates in the cognitive process. The second is social embodied cognition. Social embodied cognition not only emphasizes embodied cognition in physiological sense, but also emphasizes the important role of practice and reflection in the cognitive process. "Embodied means social practice and

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subject action (especially active action, meaning cognitive purpose and motivation)"[5]. In the process of practice, the cognitive subject puts faith, emotion, knowledge, wisdom and effort into the creative practical activities, and regards the human body as not only the organ of movement, but also the organ of perception and cognition. In practice, when the body receives stimulation, it also feels the shape, weight, cold and warm properties of the object, and also triggers people's self-reflection. Reflection is self-awareness and thinking in the process of practice, and it is a dynamic and conscious cognitive process. In the process of social embodied cognition, people's embodied cognition is fully involved in practical activities, and on this basis, people's thinking is triggered, so as to obtain a complete embodied cognition process. To sum up, both natural embodied cognition and social embodied cognition emphasize the role of embodied cognition in the cognitive process, rather than the participation of a certain part of the body in the cognitive process.

Embodied cognition theory is a criticism and transcendence of traditional cognition. Modern online education is constructed in the traditional cognitive system, focusing on the role of the mind in the process of cognitive participation, meta-universe through visual, auditory, tactile and whole-body sensory experience wearable devices can make learners feel as if they are in an immersive social and cultural situation to produce a strong sense of presence. Fully mobilize the body sensorimotor system to interact with the environment world, so as to better promote the formation of learners' cognition.

2.2 Distributed cognition theory

According to distributed cognition theory, cognitive activities are distributed within individuals, between individuals, media, environment, culture, society and time[6], The elements are closely linked and play their respective functions. Cognition is a systematic and complete activity process in which each element influences and interacts with each other. Hutchins also emphasized that activity is formed through the operation of functional systems[7], The completion of educational activities also requires interaction and coordination between systems. "Cognition exists in learning resources, learning environments, tools used by learners, interactions between learners, and all learners."[8] This kind of analysis unit, which includes the resources, environment, tools related to learning and the interaction between different learners, covers all the things involved in cognition, can effectively promote learners' cognitive activities, and provide learners with rich cognitive environment and diverse sensory stimulation. Compared with traditional cognitive theories, distributed cognitive theory emphasizes the systematicness of cognitive activities, especially the environmental grounding and distribution of cognitive activities.

Today's online education, to a certain extent, transcends the limitations of time and region and has stronger intersubjectivity and flexibility, but its teaching activities, contents and methods are still mainly taught by teachers, supplemented by multimedia presentations such as sound, video and animation, and supplemented by certain forms of courseware such as Power point. As a result, the educational resources around learners are limited in their participation in cognition, the interaction between learners and learning materials is scarce and the frequency is low, and distributed cognition cannot be well reflected. Meta-universe based on distributed cognition theory can enable online education to achieve deep development, not only can provide a broad platform for the systematic interaction of learning resources, learning tools and learning activities, but also enable individual learners to realize the purpose of education through communication and interaction.

2.3 Immersive cognitive theory

Immersion theory is a theoretical category first proposed by Mihalyi Csiksczentmihalyi in the field of psychology, and then widely introduced into the field of education, which is applied to the relevant research on improving students' learning participation. Immersion theory is essentially a description of a state of mind that "describes a state of mind in which one is fully engaged and achieves a state of extreme pleasure."[9] That is to say, when people can devote themselves to a certain activity and enjoy the happiness brought by it, it means that they have reached an immersive psychological state. Immersion theory has two meanings. Narrowly speaking, it means that an individual is fully engaged in the learning situation without interference from external factors. In a broad sense, it is based on the "integration of environment and body" state achieved by immersive devices. When learners are invested in a free and open learning space, their knowledge realm can be further improved to cope with higher challenges, thus presenting a positive mental state to achieve the effect of immersion, because relevant studies have shown that challenge and skills are the main factors affecting immersion. In a word, immersion theory describes the state of learners participating in learning activities, so as to achieve the purpose of

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effectively improving the learning effect.

The current online education is mainly the process of transferring classroom resources from traditional offline classroom to online platform, and its transfer capacity will not be larger than the original capacity, and it is limited to the change of form rather than the content, let alone the enhancement of interaction or immersion experience of students. Even this kind of real-time interaction and course experience cannot obtain the sense of presence and immersion compared with traditional offline classroom. The virtual reality in the meta-universe context has a stronger sense of interaction and more prominent immersion experience, "which can provide reference and direction for the learning activities, learning tasks and inquiry project design of online education supported by the meta-universe, so as to enhance the sense of participation and learning motivation of learners in online education."[10] The same educational content will be increased by means of immersive teaching to achieve the effect of "1+1>2".

3. Metaverse opens up the field of practice for online education

3.1 Expand the learning boundaries of online education

Different from the traditional online space, the online education based on the appearance of the meta-universe builds a new type of all-regional educational activity in the two-way chain between the real world and the Internet world, and is a revolutionary "sublation" of traditional online education. The meta-universe can empower the deep integration of theoretical teaching and practical teaching and the all-round education space online and offline. Effectively expand the learning boundaries of online education. Rod P Githens, a professor at the University of Illinois in the United States, believes that the key to improving the effectiveness of online education is to eliminate time and space barriers and enhance human interaction. Expanding learning boundaries is an effective means to break the barrier of time and space and enhance interpersonal interaction. Meta-universe enabled online education breaks through the space-time boundary between virtual and reality. The unique attributes of the meta-universe, such as highly immersive experience, free creation, flexible manipulation, embodied sociability and other features, can provide a realistic pattern for teachers and students to carry out trans-temporal verification learning and collaborative discovery learning. Finally, a future education form with virtual civilization and real civilization as the core will be formed[11], Greatly expand the learning boundaries of online education. One is the expansion of learning styles. The focus of education has gradually shifted from "teaching" to "learning", and the meta-universe gives learners a high degree of creative freedom, which promotes the in-depth development of ubiquitous learning, deep learning, personalized learning and other learning methods. The second is the expansion of learning activities. The online digital virtual scene of the meta-universe can transform the practical ideas that students cannot carry out offline into reality, and enrich the diversified practical needs and learning experience. Third, the expansion of learning methods, the integration of virtual space and technology in the meta-universe, the construction and integration of online platforms and resources, further enrich the selection and presentation of educational content, and provide technical support for the innovation of educational means and methods, so that inquiry education, gamification teaching, virtual teaching, etc., can be deeply applied. Let students better complete the learning and construction of knowledge in the two-line learning.[12] In short, meta-universe breaks the time, place, way and method of traditional online education learning, making online education greatly expanded.

3.2 Deepen the learning experience of online education

Traditional online education provides learners with limited learning resources such as text, pictures, videos, etc., which have some practical problems such as poor interaction, poor experience and poor appeal. Through the integration of multiple technical forms, the meta-universe has formed a new form of immersive visual online course that integrates virtual-reality to deepen the learning experience. First of all, the learning object can be concretized, and its internal logical implication can be explored by rotating, splitting, reorganizing and other contextualized display. Secondly, learners can also conduct experiential learning in the form of "recreating life" by shaping "Second Life". Through digital twin technology, a child in a remote mountainous area can experience the ceremonial education brought by the flag-raising in Tiananmen Square, and they can also have "real classroom" exchanges with first-class teachers in China. Finally, it is the co-shaping of course optimization. According to the dynamic changes of teachers and students' thoughts and behaviors, the data in the learning process is deeply mined for comprehensive analysis, and the optimization and update of course resources are feedbacks in a dynamic form. It can not only create personalized customized scenes for learners, but

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also add self-made scenes according to teaching needs for course transformation, and provide learners with curriculum upgrading.

The meta-universe avoids the limitations of traditional planar online education, and promotes the great liberation of educational productivity through the optimal adaptation of educational resources in virtual space, the balanced distribution of educational elements, and the two-way synchronization of course feedback information. Meta-universe enabled online education, the learning scene is vivid, sound, picture, multiple sensory stimulation, dynamic real-time interaction, for which some scholars believe that "the development of touch perception technology and somatosensory technology will further enhance the learning experience of learners in the meta-universe"[13], It brings pleasant physiological experience and emotional feelings, provides learners with a sense of physical and immersive learning style, and enhances learners' emotional involvement and learning participation.

3.3 Construct multi-dimensional teaching evaluation

Teaching evaluation is the key "last mile" in teaching activities, the important starting point of curriculum content upgrading and teaching process optimization design, and the main way of education quality inspection. In traditional online education, teaching evaluation is difficult to be presented in a multi-dimensional way because of the flat teaching process. The shortcomings of teaching data collection such as unsystematic, incoherent and unpersonalized are the main reasons for the lack of traditional online education evaluation methods. It is impossible to accurately measure the value of limited education in a limited way, which is also the most prone to conflicts in the process of education[14],In addition, teaching evaluation is often mixed with emotion and other irrational factors, which hinder the objectivity of the results to a certain extent. The emergence of the meta-universe can effectively avoid the defects of traditional teaching evaluation, and form a scientific teaching evaluation system that matches the objectives of high-quality education and teaching by constructing multidimensional evaluation methods such as multiple evaluation subjects, multidimensional evaluation processes, diverse evaluation methods and accurate evaluation data.

First, the evaluation subject is diversified. Students, teachers, schools, governments, educational organizations, development organizations, etc. all participate in the learning activity itself, and thus can become the main body of teaching evaluation to ensure the accuracy of evaluation. Secondly, the evaluation process is multi-dimensional. Involving the evaluation of students' external learning behavior and the systematic investigation of students' internal psychological dynamics; Pay attention to the review of knowledge system and the comprehensive evaluation of thinking ability, inquiry ability and practical problem solving ability; The change of value orientation from one-dimensional development to comprehensive development organically integrates students' personalized development and dynamic growth into the evaluation process. Thirdly, the evaluation methods are diversified. The comprehensive application of process evaluation, expression evaluation, value-added evaluation and other evaluation methods. Finally, the evaluation data is accurate. In the meta-universe, the dimensions and channels of evaluation data collection increase, covering different scenes such as family, school and society, and different stages before, during and after class, and taking into account different aspects such as learning progress, learning style, learning behavior, learning problems and learning outcomes. In addition, data monitoring is closer to all-round, all-field and all-factor.

Teaching evaluation is an indispensable part of teaching activities, which runs through every link of teaching activities. The various advantages of the meta-universe effectively avoid the limitations of the traditional online education teaching evaluation, and bring a new development picture to the traditional teaching evaluation by empowering the teaching evaluation subject, process, method and data.

4. The practical path of meta-universe enabling online education

4.1 Promote the research and development of meta-cosmic education technology

Technology research and development is the support and foundation for promoting meta-universe empowered online education. The meta-universe is a complex system, including 5G/6G, big data, virtual reality, artificial intelligence digital twin technology, blockchain, somatosensory interaction and many other high-tech, it is necessary to strengthen the infrastructure construction of the meta-universe, promote technology research and development in order to effectively enable the online education of the meta-universe technology advantages.

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First of all, increase the popularization and promotion of 5G/6G technology, and completely break through the communication barriers faced by meta-universe empowerment. 5G technology can break through the communication barrier and provide a network service environment with high speed, low latency, strong connection and low energy consumption for future online education, The holographic communication is realized through the intelligent connection of everything, showing the innovative characteristics of integration, endogenous and integrated, and promoting the deep integration between the meta-universe and online education. Secondly, vigorously develop artificial intelligence digital twin technology, that is, twin digital people technology, to achieve the dynamic growth of resources in the meta-universe. It can not only fully explore, analyze and utilize the meta-universe resources that constantly produce a lot of content, but also produce personalized learning resources according to different educational objects. Thirdly, promote the development of big data technology, build a meta-universe resource allocation service system with the support of advanced cloud computing intelligent technology, and realize the intelligent and scientific allocation of resource allocation according to different situations in reality through the processing of big data. Third, promote the development of blockchain technology. Blockchain technology plays an important role in the analysis of information factors such as credits, abilities, and success of educational objects. Because blockchain has data advantages such as high security, traceability, whole-process retention, and openness and transparency, it can guarantee the integrity of the data information of teaching activities, strengthen the security and reliability of the data, and then certify the achievements, credits and abilities in the meta-universe learning environment.[15] Finally, it is necessary to provide technical support for the development of somatosensory interaction brain-computer interface technology. Brain-computer interaction can achieve an ideal new experience of educational practice, enabling individuals to be deeply immersed in the meta-universe, trans-regional activities, and surreal creation, and even build a "super brain" that integrates virtual machine brain and protozoan brain intelligence to realize "brain-machine integration"[16], providing a beautiful vision for the leap development of online education.

The meta-universe is a community that integrates a variety of technologies. Only by obtaining technical support from many fields can the meta-universe empower the development of online education. Therefore, we should promote the common development and integrated development of high-tech such as 5G/6G, big data, virtual reality, artificial intelligence digital twin technology, blockchain, and somatosensory interaction.

4.2 Build the rational framework of meta-universe education

The meta-universe is a social ecosystem parallel to the real world. By optimizing the top-level design and formulating systematic technical standards through negotiation, the meta-universe provides the operation norms of online education and sets up a rational framework to ensure that this future education system can contribute to the development of human education.

First, negotiate technical standards for the metacomes at the global level. On the one hand, give full play to the role of relevant international and national information technology standardization organizations, in the form of policies, regulations, guidance, industry standards and other documents, through multi-subject consultation, explore and establish the index system of meta-universe + education, and promote its technical standardization, compatibility, and scientific development. On the other hand, the collection of application pilot data can not only serve as the basis for optimizing technical standards, but also verify the correctness of the theory and further promote the optimization and perfection of the meta-universe technical standards system.

Thirdly, adhere to the principle of gradual and orderly development. The systematicness of the meta-cosmic project determines that it should adopt a "building block" development framework. The meta-universe is changing with each passing day, and technology development, demands of teachers and students, supply of learning resources, and goals of teaching and learning are also in constant development and change. Therefore, it is not possible to blindly develop the meta-universe in a hurry, and the rapid expansion and functional perfection of the educational meta-universe can be achieved through the "building block" meta-universe development framework.[17]

Finally, a management system should be formulated to promote the orderly development of online education in the meta-universe. Teaching activities in the meta-universe show new characteristics of blending virtuality and reality, individuation and diversification, and management systems should be established to standardize users' behaviors according to their characteristics, such as student management system, virtual campus management system, teaching management system, and teacher behavior management system. It should be noted that the "sinking" risk in the virtual world is easy to occur, and

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relevant management systems need to be introduced to guide and standardize.

The meta-universe is a parallel world created based on data and a digital mapping of the real world, which is generated in the real world but has its relative independence. Therefore, it is necessary to give the meta-universe a rational framework through common meta-universe technical standards, adhering to the principle of gradual development and formulating management rules and systems, so as to make online education in line with the realistic and rational development and truly used by human beings. For the benefit of mankind.

4.3 Form the ethical concept of meta-universe education

Ethics is the moral response to behavior and relationships. Everything in the meta-universe is presented in digital form, and teaching activities are monitored, recorded, and stored in digital form to form "data monitoring" [18]. It brings great challenges to the privacy and security of users. Some scholars believe that the multidimensional collection and in-depth use of modal data of teachers and students may bring the risk of privacy disclosure and illegal data circulation, such as the illegal use of interpersonal communication, biometric information and other information will violate the personal privacy of teachers and students.[19] Ronald Leenes also stressed that a series of privacy protection measures should be taken in the meta-universe, and believed that the management of user privacy in the meta-universe should focus on internal supervision and external rules. Terms of Service, Community Standards and Privacy Policy.[20] Therefore, it is necessary to forma mandatory privacy protection contract to avoid the educational ethical risks brought by the meta-universe and form educational ethical concepts.

First, cultivate ethical concepts through legal constraints. The government establishes basic virtual world operation rules, individual code of conduct, and data confidentiality principles in the form of regulations, promotes the establishment of sound ethical norms through top-down forms, and then forms ethical concepts.

Second, the ethical concept should be amended through technical guidance. With the help of intelligent, safe and reliable technical principles, we build a parallel technical architecture of "access + authentication" and "operation + protection" to ensure that the meta-universe world is credible, controllable and manageable, and promote the harmonious progress of the real world and the digital world, so as to guide people to correct bad ethical concepts.

Thirdly, through data protection, ethics should be established. The meta-universe provides convenience and efficiency for online education, but the data protection of teaching information is easily ignored by teaching subjects. Therefore, it is necessary to build an intelligent collection system review and rating mechanism among teachers and students. Based on The governance demands and privacy observations of different entities, professional organizations such as rating agencies and rating committees are used to review individual trends, data sources and other data[21], integrated processing of different modal types of data.[22] It is also possible to ensure the security of education users' accounts by using "face, audio, iris and other biometrics"[23]. In order to improve teaching subjects' awareness of strengthening meta-universe data privacy, and to form awareness of data protection in the whole society. To strengthen the ethical concept of privacy protection.

The meta-universe is a new field, and new things bring development opportunities as well as many challenges. In essence, the meta-universe is a world of data construction, which represents the development direction of online education in the future, but it will also bring great challenges to ethical concepts such as privacy disclosure and privacy violation, so it is necessary to promote people's formation of ethical concepts through laws and regulations, technical guidance, and strengthening data protection.

5. Conclusion

The transformation of the meta-universe to online education is fundamental and marks the future picture of online education development. The meta-universe can give online education theoretical advantages and foundations such as embodied cognition, distributed cognition and immersive cognition, and also open up new learning boundaries, learning experience, teaching evaluation and other practical fields for the development of online education. Therefore, we should promote the transformation of online education to the meta-universe by promoting the research and development of meta-universe education technology, building the rational framework of meta-universe education, forming the ethical concept of meta-universe education, and promote the digital and intelligent development of online

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