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Application of artificial intelligence technology in educational metaverse—Path and framework

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Abstract: *In order to explore the application path and framework of artificial intelligence technology in the educational meta-universe, this paper adopts the method of literature review and case analysis to conduct in-depth research on the development, meaning and characteristics of artificial intelligence and educational meta-universe, as well as the application of artificial intelligence in the educational meta-universe. It is found that artificial intelligence technology has wide application prospects in intelligent teaching assistant, intelligent assessment and feedback, virtual experiment and simulation, intelligent campus management and so on. A systematic application framework covering technology layer, data layer and application layer is proposed, and the problems of data privacy and security, integration of technology and education and sustainable development of technology are analyzed in the current technology application. Finally, it is concluded that artificial intelligence technology can significantly improve the quality and efficiency of education in the education meta-universe.*

Keywords: *Artificial intelligence, education meta-universe, meta-universe*

1. Introduction

With the continuous progress of science and technology, artificial intelligence (AI), virtual reality (VR), augmented reality (AR) and other technologies are gradually penetrating into the field of education. Promote the profound reform of education model. The emerging concept of educational metaverse, which integrates cutting-edge technologies such as AI, VR, and AR, aims to create an immersive, interactive, and personalized learning environment that provides students with a new learning experience. The educational meta-universe not only breaks the limitations of time and space, enabling students to conduct experimental operations, simulate historical scenes and interdisciplinary cooperation in a virtual environment, but also provides teachers with intelligent teaching AIDS and management systems. This paper aims to explore the specific application path and framework of AI in the educational meta-universe. By reviewing the development of AI and analyzing its multiple application scenarios in the education meta-universe, a systematic application framework covering the technology layer, data layer and application layer is proposed to help educators and technology developers better design and implement the education meta-universe system. This paper discusses the current problems in the application of the technology, and puts forward the corresponding solutions, in order to provide guidance and reference for the development of the future education meta-universe.

2. Artificial intelligence meaning and development process

2.1. The implications of artificial intelligence

AI refers to the ability of machines to demonstrate similar or superior human intelligence through computer science and technological means. This includes, but is not limited to, intelligent behaviors such as learning, reasoning, problem solving, perceiving the environment, and understanding language[1]. The core goal of artificial intelligence is to enable computer systems to learn from experience, adapt to new situations, and perform complex tasks and decisions autonomously, without explicit human instructions.

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2.2. The development of artificial intelligence

The first phase is the early exploration phase of AI. In 1950, Alan Turing proposed the famous "Turing test", which was designed to determine whether a machine could exhibit behavior similar to human intelligence. At the same time, researchers began to explore methods of logical reasoning and symbol processing in an attempt to build computer systems that could understand and cope with complex tasks.

The second stage is the knowledge explosion and decline of AI. From about 1980 to 1990, AI technology faced challenges and limitations, leading to the "AI Winter." Although expert system has achieved some success in some applications, its limitation lies in the difficulty of knowledge acquisition and the limitation of reasoning ability[2]. As a result, activity in AI research and application has dwindled, and many people are skeptical about the prospects of AI.

The third stage is the rise of machine learning in AI, from the 2000s to the present. With the popularization of the Internet and the development of mobile technology, the generation of big data has promoted the further development of machine learning. In particular, the rise of deep learning technologies has enabled breakthroughs in complex tasks, such as image recognition, speech recognition, and natural language processing, through multi-level neural network structures. At this stage, AI technology not only made significant progress in academic research, but also began to be widely used in commercial applications, affecting and changing many industries, such as medical care, finance, transportation and other fields.

3. The meaning and characteristics of educational meta-universe

3.1. The implications of educational metaverse

The educational meta-universe uses VR, AR, MR And other technologies to create a virtual and immersive learning environment. Through virtual reality headsets or other interactive devices, students can explore three-dimensional space, participate in simulation experiments, interact with virtual objects, participate in role playing and cooperative tasks, etc., thereby enhancing the understanding and memory of knowledge and concepts[3]. Shifting education from the traditional classroom learning model to a more dynamic and diverse learning experience can help stimulate students' interest and creativity, improve learning effectiveness and engagement.

3.2. Characteristics of educational metaverse

1) Hypertemporality

The educational meta-universe uses VR and AR technologies to create learning experiences that transcend the real world. Students can travel through time and space to explore in a virtual three-dimensional environment. This transcendence of time and space makes education no longer limited by geographical location or physical resources, providing learners with a new and open learning space[4].

2) Interactivity

The educational universe emphasizes students' active participation and interaction. Students can interact with objects and scenes in the virtual environment through gestures, voice commands or controllers. Such as manipulating chemical reagents in a virtual chemistry lab, engaging in conversations with historical figures, or interacting in mathematical problem solving. This high level of interactivity not only enhances the enjoyment and engagement of learning, but also improves learning effectiveness and memory.

3) Gameplay

The educational meta-universe adopts the concept of gamification design to motivate students to actively participate in learning activities by setting tasks, challenges and reward mechanisms, and get feedback and rewards after completing tasks[5]. The gamification element can enhance learning motivation and concentration, while promoting teamwork and problem-solving skills through competition and cooperation.

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4. Application of artificial intelligence technology in educational metaverse

4.1. Intelligent teaching assistant

By analyzing a student's learning history, interests, and ability level, the assistant is able to personalize the learning path for each student and recommend specific textbook chapters, video explanations, worksheets, and extended reading materials. Virtual teaching assistants are an important form of intelligent teaching assistants, which provide students with learning support 24/7 through voice assistants or chatbots, answering questions, explaining complex concepts, and guiding students through extracurricular learning tasks. It is also able to recommend relevant learning resources based on the needs of students, including articles, videos and practice questions[6]. Through big data analysis, these assistants can monitor and analyze students' learning behavior, identify learning patterns, spot potential problems, and provide targeted recommendations. In terms of classroom management, intelligent teaching assistants can help teachers take attendance, organize class activities and monitor classroom discipline, allowing teachers to focus on teaching content. The emotional support function identifies the emotional state of students by analyzing their expressions and intonation, and provides corresponding emotional support.

4.2. Intelligent evaluation and feedback

Intelligent assessment and feedback is an important application of AI technology in the educational meta-universe. Through automated assessment and learning analysis, AI can provide fast, accurate feedback to help students and teachers adjust teaching and learning strategies in a timely manner. Using natural language processing and machine learning techniques, AI can automatically evaluate students' assignments and exams[7]. It not only improves the evaluation efficiency, but also reduces human bias and provides more objective evaluation results. Through big data analysis, AI can track students' learning behavior, analyze their learning patterns and problems, and provide suggestions for improvement. Learning analysis can help teachers understand students' learning situation and make more effective teaching plan.

4.3. Virtual experiment and simulation

Virtual experiment and simulation is an important part of educational meta-universe. Through VR and AR technology, students can conduct experimental operations and practical exercises in the virtual environment to increase the safety and operability of the experiment[8]. Virtual laboratory uses VR technology to create a realistic experimental environment in which students can conduct experimental operations and break the restrictions of time and space. For example, the chemistry laboratory can simulate various chemical reaction processes, so that students can conduct experiments in a virtual environment, avoid dangers in actual operation, and improve the safety and efficiency of experiments.

4.4. Intelligent campus management

Intelligent Campus management Through intelligent course scheduling system and campus security monitoring, improve the efficiency and security of campus management. Using AI to optimize the school's class scheduling system can improve the efficiency of resource utilization and meet the needs of students and teachers. The intelligent course scheduling system provides the optimal course scheduling scheme by analyzing the course demand and resource allocation. Monitoring the campus environment through AI technology can prevent and respond to emergencies and ensure campus safety. The intelligent monitoring system can monitor the security situation in the campus in real time, and discover and deal with security risks in time[9]. The system can monitor the flow of personnel on campus through video surveillance and face recognition technology, timely warning of potential security threats, and ensure the safety of students and teachers.

5. Application framework of artificial intelligence technology in education meta-universe

Provide personalized learning and intelligent assessment services for learners, create immersive learning experiences, while ensuring the security and privacy of student data, integrate rich educational resources and promote interdisciplinary collaboration, and improve the efficiency and security of campus management. The application framework with technology layer, data layer and application

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layer as the main body is designed, as shown in Figure 1.

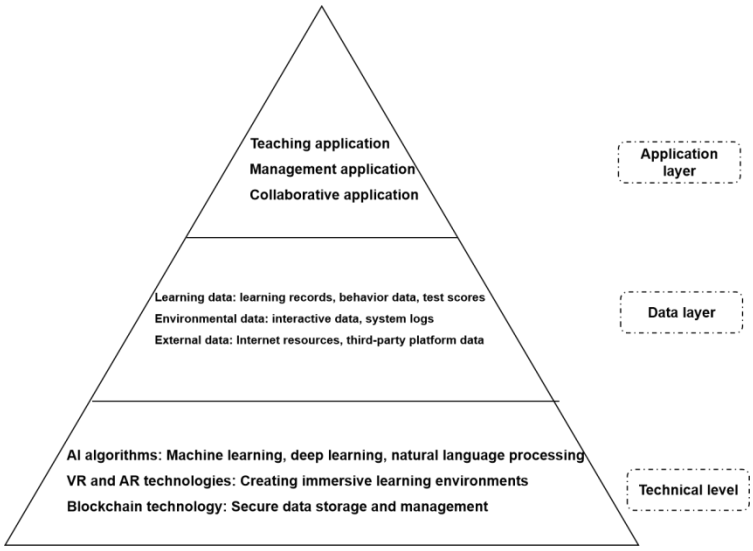

Figure 1: Application frame diagram

5.1. Technical level

AI algorithms include machine learning, deep learning, and natural language processing. Through AI algorithms, data analysis, pattern recognition and intelligent decision-making can be realized. Machine learning algorithms can analyze students' learning data, identify learning patterns, and predict learning needs. Natural language processing technology can understand and generate natural language, enabling intelligent dialogue and automatic evaluation. VR and AR technologies are used to create immersive learning environments that enhance the learning experience. VR technology can create a virtual laboratory and allow students to conduct experimental operations in a virtual environment. AR technology can superimpose virtual information on the real world to provide an enhanced learning experience. Blockchain technology is used for secure storage and management of student data, ensuring data privacy and immutability[10]. Through blockchain technology, secure storage and sharing of student grades and learning records can be achieved.

5.2. Data layer

The data layer includes learning data, environmental data and external data. Learning data includes students' learning records, behavior data, test scores and so on. By analyzing learning data, students' learning situation can be understood and personalized learning recommendations and improvement suggestions can be provided. Environmental data includes interactive data and system logs in virtual environments. By analyzing the environmental data, the design and functionality of the virtual environment can be optimized to improve the user experience. External data includes Internet resources, third-party education platform data, etc. By integrating external data, educational resources can be enriched and more learning opportunities can be provided.

5.3. Application layer

Teaching applications include personalized learning, intelligent assessment, virtual experiment and so on. Through AI technology, personalized teaching services can be provided to improve the quality of teaching. Personalized learning system can provide customized learning programs and resources based on students' learning data. Intelligent assessment system can automatically evaluate students' learning results, provide timely feedback and suggestions for improvement; Virtual experiment system can provide realistic experiment environment through VR technology, so that students can carry out experiment operation in virtual environment.

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results, provide timely feedback and suggestions for improvement; Virtual experiment system can provide realistic experiment environment through VR technology, so that students can carry out experiment operation in virtual environment[11].

Collaborative applications include virtual classroom, interdisciplinary cooperation platform and so on. Through AI technology, teacher-student interaction and interdisciplinary cooperation can be promoted to provide a diversified learning experience. For example, virtual classroom system can create immersive learning environment through VR technology to promote teacher-student interaction and communication; The interdisciplinary cooperation platform can enhance the comprehensive ability of students by integrating resources and experts from different disciplines, providing diversified learning opportunities and projects.

6. The challenges and future development of artificial intelligence technology in the educational meta-universe

6.1. Data Privacy and Security

Through blockchain technology and encryption technology, the privacy and security of student data can be ensured. In the process of data storage and transmission, advanced encryption technology is adopted to prevent data leakage and tampering. Establish a sound data security management system to ensure the safe use of student data. Use permission management and audit mechanisms to prevent data abuse and unauthorized access.

6.2. Integration of technology and education

In the application of technology, educators need to change the educational concept, accept and adapt to the new education model. Through training and guidance, we help teachers and students adapt to the learning environment of the educational meta-universe. In the educational meta-universe, innovative instructional design is needed to make full use of AI, VR, and AR technologies to provide personalized, interactive learning experiences. Stimulate students' interest and motivation by designing interesting and beneficial learning activities.

6.3. Sustainable development of technology

Continuous technology research and development and innovation continue to improve the performance and functions of AI, VR and AR technologies. Continuously develop new algorithms and technologies to improve the analysis and decision-making capabilities of artificial intelligence. Improve VR and AR technologies to enhance the fidelity and interactivity of virtual environments and provide a more immersive learning experience. In the application of technology, pay attention to environmental protection and resource conservation, to achieve the sustainable development of technology. Green technology and energy-saving technology can reduce energy consumption and environmental pollution, and promote the sustainable development of the educational meta-universe.

7. Conclusion

The application of artificial intelligence technology in the educational meta-universe brings entirely new possibilities for educational methods and learning experiences. By building intelligent teaching assistants, intelligent assessment systems, virtual experiment platforms, collaborative learning environments and intelligent campus management systems, the quality and efficiency of education can be greatly improved. However, the application of technology also faces many challenges, including data privacy, security concerns, and the adaptability of technology and education integration. Therefore, when promoting the application of AI technology in the educational meta-universe, multi-party collaborative efforts are needed to ensure the reasonable application and sustainable development of the technology.

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