

Application and Development Trends of Artificial Intelligence in Education

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Abstract: In the era of artificial intelligence, significant changes have occurred in society and education, with artificial intelligence becoming a crucial driving force for the future development of education. This article explores the application and development trends of artificial intelligence in education from a theoretical perspective, providing direction for research on educational informatization.

Keywords: Artificial Intelligence; Education; Application; Development Trends.

1. Introduction

In recent years, the development of artificial intelligence has had a profound impact on our social life, education, and teaching, leading to changes in educational methods, teaching modes, and student learning. At the same time, China has also introduced a series of policies to promote the development of artificial intelligence. To seize the first-mover advantage in development, accelerate the construction of an innovative country and a global technological power, on July 20, 2017, the State Council issued the "New Generation Artificial Intelligence Development Plan"[1], which outlines the guiding ideology, strategic objectives, key tasks, and supporting measures for the development of China's new generation of artificial intelligence by 2030, laying an important foundation for the further accelerated development of artificial intelligence in China. From August 20 to 22, 2020, the 2020 Global Smart Education Conference was held in Beijing. The conference conducted deep discussions on frontier topics such as the impact and challenges of artificial intelligence on future education. It was pointed out that a new generation of information technology represented by artificial intelligence is redefining the value of human knowledge and abilities. Future education will be supported by information technologies such as artificial intelligence, ushering in a new phase of smart education"[2]. Different from traditional education, smart education is characterized by intelligent technologies represented by artificial intelligence, which accelerate the transformation of talent cultivation models and achieve the combination of large-scale education and personalized training [3]. It can be seen that artificial intelligence is gradually becoming an important driving force for the development of education.

2. Artificial Intelligence and Education

Many domestic scholars have studied the application of artificial intelligence in the field of education. Zhang Shanshan et al. point out that educational artificial intelligence uses artificial intelligence technology as the technical support and core method to improve school management, teacher teaching, and student learning, enhancing management effectiveness and teaching efficiency, and achieving personalized and precise learning. It mainly

focuses on the application level of artificial intelligence[4]. Xu Hui notes that educational artificial intelligence is the "advanced stage" after the deep integration of artificial intelligence and education, representing the "ideal form" of artificial intelligence development in the field of education[5]. Fang Ying points out that educational artificial intelligence is the deep integration of artificial intelligence and the field of education, making education more intelligent[6]. Meng Chong et al. categorize the concept of artificial intelligence in education into two types: artificial intelligence-enabled education and artificial intelligence subject education. Artificial intelligence-enabled education emphasizes the use of artificial intelligence to promote and support learning from a tool-oriented perspective. Artificial intelligence subject education emphasizes the role of artificial intelligence as an integrated discipline of learning science and educational science in cultivating artificial intelligence talents from a disciplinary perspective [7]. Meng Qingquan et al. propose that artificial intelligence education is not just new educational technology and equipment; it is education that cultivates high-intelligence talents in the era of artificial intelligence and is future-oriented education. By focusing on building a "smart education community" and deeply integrating students, teachers, technology, knowledge, learning environments, and real life, students, teachers, and artificial intelligence systems closely collaborate and innovate together to achieve coordinated development[8].

In summary, the application of artificial intelligence in education has become a trend in the field of education, and scholars' research on artificial intelligence education is also ongoing. The deep exploration and research on the theoretical level of artificial intelligence education provide theoretical guidance for related practices.

3. Application of Artificial Intelligence in Education

The application of artificial intelligence in education is increasingly widespread, mainly including intelligent teaching systems, virtual reality technology, educational robots, and educational decision support systems.

3.1. Intelligent Teaching Systems

Intelligent teaching systems are a vital component of

artificial intelligence technology in the field of education and teaching, and they are also an in-depth development and new embodiment of related research on computer-assisted instruction. The fundamental purpose of intelligent education systems is to create a more excellent and harmonious learning environment for students, ensuring that students can promptly and effectively access and optimize various resources to receive comprehensive and multi-angle learning services, thereby achieving more ideal learning outcomes[9]. The development of China's teaching systems has roughly gone through three stages, evolving from the first-generation school examination system to the second-generation personalized learning system and now to the third-generation artificial intelligence-based teaching system, namely the intelligent teaching system. This system involves various scientific fields such as artificial intelligence, computer science, cognitive science, education, psychology, and behavioral science[10], and it is comprehensive and adaptive. Currently, intelligent teaching systems primarily utilize intelligent agent technology to effectively construct teacher agents, student agents, and teaching management themes. During specific operations, teaching strategies corresponding to students' physical and mental development characteristics and learning realities can be further designed and formulated, and they are effectively implemented in the specific educational teaching process to provide students with more efficient and personalized teaching services. This not only reflects advancements in science and technology but also demonstrates that education is constantly adapting to technological developments. For example, IBM's Watson tutoring system and the Lumilo blended learning system: the former provides personalized services to students through a human-computer dialogue intelligent tutoring system[11], while the latter can monitor students remotely, quickly identify difficulties they encounter, and provide timely assistance to students, thereby enhancing their learning efficiency [12].

3.2. Intelligent Teaching System

The Intelligent Teaching System is divided into four modules: the expert module, student module, teaching module, and intelligent module. The expert module provides relevant information and references for teachers' next teaching steps. The student module facilitates personalized guidance and teaching according to students' information. The teaching module offers guidance and assistance when students need it. The intelligent module serves as the interface between the system and users, acting as a bridge for information exchange between students and the system. The application of the Intelligent Teaching System enables various teaching and learning methods such as discovery-based learning, inquiry-based learning, and collaborative learning, thereby enhancing teachers' teaching efficiency and supporting students' personalized learning, exploration, and innovation abilities.

3.3. Virtual Reality Technology

Virtual Reality (VR) technology is an immersive teaching technology that integrates computer technology and other related technologies, facilitating scenario simulation in dangerous work areas. With the continuous development of this technology, its application scope in the field of education is expanding, demonstrating good teaching effects. Compared with traditional teaching activities, VR technology actively

constructs a learning environment based on reality. The instruments and equipment used in virtual teaching are vivid, allowing students to freely explore in the virtual space and effectively enhance their learning outcomes. VR technology also creates learning environments and selects learning content according to students' interests and preferences, providing corresponding feedback activities based on students' operations. This interactive nature of the technology is more effective than the dull demonstrations and lectures in traditional teaching processes, enabling students to actively participate in learning activities.

VR technology has several application modes in teaching: "Virtual Laboratory" uses equipment as virtual objects. Experimental teaching requires corresponding experimental equipment, which incurs significant costs. Developing corresponding laboratories through VR technology can effectively meet this demand. Some experiments produce toxic and harmful gases, while others have high risk levels and complex operations, which can lead to safety accidents if not performed carefully. The use of VR technology not only achieves better teaching effects but also ensures a greener and safer operation process. Computers are used to create virtual instruments that objectively reflect the laws of the real world for virtual experiments, allowing students and teachers to conduct virtual experiments and predictive analysis on computers. "Virtual Library" integrates the entire physical structure of a library, including doors, windows, desks, lights, corridors, bookshelves, search machines, books, newspapers, CDs, tapes, etc., into a computer using holographic photography technology, web3D technology, 3D modeling, database technology, etc., to construct a virtual library. The books, newspapers, magazines, etc., in the virtual library are all electronic materials scanned and stored digitally using high-definition scanners. Users can browse all digital resources in the virtual library by moving the mouse. During browsing, each book can be flipped like a real book, accompanied by the sound effect of flipping pages, giving users an immersive and realistic feeling. Additionally, users can borrow their favorite electronic books and place them in their personal virtual library for free reading within a certain period. "Virtual Teaching" involves creating a three-dimensional space using VR technology to provide intuitive, vivid, and visual explanations for content that is difficult to understand or has complex logical relationships during the teaching process, helping students better understand and grasp the underlying laws and relationships. For example, in middle school biology courses, teachers can use VR technology to lead students into the animal and plant world of nature to personally experience the survival of the fittest and natural laws. "Scientific Research" mainly involves setting up real-life objects in simulated scenarios. Researchers conduct detailed observations to explore existing problems, causes, and laws, and then draw actual research conclusions after empirical verification. For instance, in the practical aspects of medical teaching, surgeons can use VR technology to create virtual operating rooms, patients, and human tissues, allowing students to perform virtual surgical operations to improve their surgical skills. "Remote Education" has undergone significant transformations in teaching modes and methods compared to the past due to advancements in information technology, computers, and network technology. However, the inability to achieve face-to-face teaching between teachers and students has persisted. The emergence of VR technology has effectively addressed this issue. In online

remote education institutions, learners can use 3D modeling VR technology to create the image of a teacher in a remote virtual classroom. Students at the learning terminal can enter the teacher's virtual classroom and interact with the teacher in a realistic "face-to-face" manner. In virtual classrooms, teachers can also innovatively use effective teaching methods such as situational classrooms, group discussions, and role-playing to further enhance students' interest and enthusiasm in learning, thereby improving classroom teaching effectiveness and quality.

3.4. Educational Robots

Educational robots represent the application of robots in the field of education. They are typical examples of the application of artificial intelligence, voice recognition, and bionic technology in education, aiming to cultivate students' analytical, creative, and practical abilities. They can provide personalized learning experiences, assist students in solving learning difficulties, monitor student performance, and have a wide range of applications. According to their practical uses, educational robots can be classified into educational activity robots and educational service robots. Educational activity robots are mainly used in teaching courses and classroom teaching activities as teaching aids that directly assist learners in learning and practicing knowledge related to robotics, and support learners in self-assembly or programming. Educational service robots refer to robots that can directly provide intelligent auxiliary services to the teaching process. Their application process is often categorized into three basic roles: tutor, learning companion, and supervisor. Of course, intelligent robots can also provide personalized teaching strategies and resources based on students' styles and characteristics, thereby enhancing learners' learning outcomes. Educational robots play a positive role in promoting different subjects and educational stages. For example, the educational robot "Smart Learning Companion" developed by the Future Education Frontier Innovation Center of Beijing Normal University can provide answers when students encounter difficult problems in their studies.

3.5. Educational Decision Support System

The effective application of Intelligent Decision Support Systems (IDSS) in the field of education involves the integration of artificial intelligence and decision support systems, leveraging expert systems to enhance the effectiveness of decision support systems and fully apply them to human knowledge domains. For instance, descriptive knowledge of decision problems and procedural knowledge in the decision-making process are utilized to address complex decision-making issues through logical reasoning. The components of IDSS include databases, model bases, method bases, human-computer interfaces, intelligent components, and various other factors. Currently, in the field of education, IDSS has become the mainstream development direction within decision support systems and holds immense potential and promising prospects for application in online education.

4. Future Development Trends of AI Education

One significant role of AI technology in education is to expand teachers' knowledge bases through online resources, assisting them in transmitting knowledge to students and

gradually transforming their roles and responsibilities from knowledge providers to spiritual mentors who inspire students' minds. The role of teachers as "guides" is becoming more mature. The pace of development in internet technology often exceeds our imagination. In practice within the education sector, we can infer the general direction and goals of AI's future development based on current information. AI technology can be used in teaching to be as engaging and emotionally rich as offline teaching, actively interacting with students, and, based on its inherent characteristics, the development of education will gradually become more personalized and innovative. The development of AI technology has brought comprehensive societal changes and posed unprecedented requirements for the strategic allocation of human resources in education. How to construct a fair and high-quality AI education ecosystem is a future consideration we need to ponder. The importance of education to a country and a nation is self-evident. We need not only to cultivate professional talent and develop diverse AI education projects, but also to attach great importance to a series of negative issues brought by AI education. In advancing AI education, we must continuously enhance teachers' ability to apply AI technology. In future classrooms, human teachers and AI teachers will collaborate to undertake teaching tasks, each leveraging their respective strengths and fulfilling their respective duties.

Currently, with the rapid development of science and technology, AI technology has also made significant strides, changing people's thinking and behavior patterns to a greater extent, and playing a crucial role in advancing the field of education and teaching, significantly enhancing the efficiency of education and teaching and innovating educational models. In the process of future development, it is believed that with the support of AI systems and their deeper application, this will enable the realization of innovative development in the field of education in China.

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