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The Innovation and Transformation of Education Models Driven by Artificial Intelligence -- Taking Compulsory Education and Higher Education as Examples

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Abstract: The world is undergoing technological innovation, with the integration of artificial intelligence technology into various fields bringing about profound changes. In the field of education, major countries have raced to develop and deploy artificial intelligence, fully preparing for the digital transformation of education. This paper focuses on three main aspects: existing achievements, the brought changes, and future prospects, and deeply analyzes the impact of artificial intelligence in the education field. Taking China and the United States as examples, in the United States, K-12 education has vigorously promoted the implementation of artificial intelligence tools in basic education through means such as financial support, policy promulgation, and improving the artificial intelligence capabilities of educators. In China, the government has carried out large-scale teacher training programs on teaching methods which were related with artificial intelligence, constructed an integrated education platform for artificial intelligence to provide rich digital learning resources, and developed artificial intelligence-based education courses to cultivate students' digital literacy and innovative thinking. Nevertheless, countries around the world face many challenges, such as data privacy and security, ethical issues in the application of artificial intelligence, and the digital divide in education access. In the future, the author firmly believes that artificial intelligence will be further integrated into the education field. Countries should focus on cultivating and introducing technical talents, constructing agile and efficient governance frameworks, and adhering to the education concept of putting people at the center and using artificial intelligence as a supplement.

Keywords: Artificial Intelligence, Personalized Learning, Compulsory Education, Higher Education, Education and Teaching

1. Introduction

With the continuous development of computer and information and communication technologies over the years, artificial intelligence has emerged. According to Coppin, artificial intelligence is the ability of machines to adapt to new situations, handle emerging situations, solve problems, answer questions, plan for equipment, and perform various other functions [1]. The future trend of education development is the in-depth collaboration between humans and artificial intelligence. Giving full play to the various advantages of humans and machines is the key to improving education productivity.

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Traditional education is gradually failing to meet the requirements of the times. Artificial intelligence can explore students' learning characteristics and needs through data analysis, achieving personalized teaching. Moreover, with the help of technologies such as virtual reality and intelligent tutoring systems, teaching methods can be enriched, and students' learning experience and efficiency can be improved.

However, the diffenrences among education systems, technical foundations, and social cultures among different countries, which makes the development of artificial intelligence in the education field face many challenges. Therefore, it is necessary to deeply analyze the current application of artificial intelligence in the education field, explore the existing achievements and innovations, the brought changes, and the future development direction. Regarding the current achievements of artificial intelligence in the education field, China's Ministry of Education serves as an example by introducing the *Artificial Intelligence Innovation Action Plan for Higher Education Institutions* in 2018, encouraging the exploration of the "Artificial Intelligence + X" talent training model [2]. In 2024, the first and second batches of typical cases of "Artificial Intelligence + Higher Education" application scenarios were announced, further demonstrating the effective implementation of artificial intelligence in the Chinese education field [3]. However, the challenges brought by artificial intelligence cannot be ignored, such as possible cognitive, technical, and resource obstacles. Currently, artificial intelligence is still in the initial stage of use. Therefore, researchers need to make certain predictions and judgments about challenges and risks in advance to solve these difficulties. Therefore, this paper deeply analyzes the current application status of artificial intelligence in the education field, reveals the changes and challenges it brings, aiming to promote the innovation and transformation of the education model and provide theoretical support and practical guidance for educators and policymakers.

2. Achievements of Artificial Intelligence in Current Compulsory Education and Higher Education Stages

Artificial intelligence has achieved many accomplishments in the current compulsory education and higher education stages. Taking China as an example, the Oral Virtual Simulation Intelligent Laboratory constructed and applied by Peking University, supported by virtual simulation technology and big data, integrates intelligent IoT, intelligent management, and intelligent learning and assessment, effectively improving the quality of teaching. In basic education stages such as primary and secondary schools, the General Office of the Ministry of Education clearly pointed out in the *Notice of the General Office of the Ministry of Education on Strengthening Artificial Intelligence Education in Primary and Secondary Schools* issued in December 2024 that artificial intelligence will be basically popularized in primary and secondary schools by 2030. In addition to a series of policy supports, there is also a intelligent education platform launched by Feixiang Science and Technology Education Company. Currently, this platform has been regularly used in more than 20 provinces, 180 districts and counties, with more than 3,000 schools across the country connected to it, covering more than 2 million students.

Similarly, the United States has also achieved certain results in exploring the integration of artificial intelligence and education. Especially in the K-12 education field, artificial intelligence-driven adaptive platforms can provide personalized learning plans according to students' current understanding of knowledge, such as providing additional exercises, digital videos, and even targeted one-on-one tutoring suggestions. And all resources can be adjusted according to students' individual learning styles [4]. In addition, artificial intelligence can play an important role in helping special children learn. Its text-to-speech conversion, predictive text, and other technologies can provide inclusive learning opportunities for students with disabilities [5]. For example, the Educational Testing Service (ETS) uses the artificial intelligence services provided by Amazon to

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reduce the time required to convert materials into other formats (such as Braille, audio, larger characters), and provides these students with a more natural and clear text-to-speech function, greatly improving the user experience of students with disabilities [6].

In addition, many countries have also tried to integrate digital technologies into modern education. For example, students taking Data Science and Artificial Intelligence curriculum in Austria should understand the occupations in the field of information and communication technologies, including AI, as well as the applications of emerging technologies in society. They also learn how to create digital media, gain knowledge about cloud computing and its connectivity, and study the theories related to networked computers. Furthermore, students are taught to recognize the ethical dilemmas arising from the use of such technologies and are encouraged to actively participate in social discussions on these issues. This course is offered as a compulsory course with calculated credits in schools, with a total of 144 learning hours [7].

3. Challenges Faced by Artificial Intelligence in the Education Field

Despite the revolutionary changes AI has brought to the education field, it also faces several cognitive, technical, and resource limitations.

3.1. Cognitive Barriers

First, artificial intelligence is likely to weaken direct emotional communication between teachers and students and students' perception of the real world. Some scholars worry that artificial intelligence technology challenges the inter-subjectivity of students' interactions in real-world social situations [8]. After Generative Artificial Intelligence (such as ChatGPT, DeepSeek and other large-model applications) has become a hot social topic, remarks such as 'artificial intelligence will replace teachers' have emerged, leading to fear and a cognitive gap among educators regarding intelligent technology. Second, the overuse of artificial intelligence may turn humans into "machines" that constantly repeat past decisions [9], and people may lack the fun of independent learning and exploration, affecting the breadth and depth of learning. Third, artificial intelligence may pose risks of privacy leakage or data abuse. For example, a 2020 research report by the United States Government Accountability Office showed that student data leakage incidents have exposed various types of student data, including academic records, personal identification information, and other personal information [10]. Undoubtedly, such breaches could harm students to some extent.

3.2. Technical Barriers

First of all, in terms of data collection, a key problem faced by artificial intelligence systems is the selectivity and bias of data. The learning process of artificial intelligence highly relies on the input of a large amount of data. However, it is difficult to fully control the source, quality, and representative of these data, for the data may come from specific regions, groups, or time periods, resulting in sample bias. This bias inadvertently introduce inequalities in terms of gender, race, region, etc., thus affecting the output results of artificial intelligence systems. In addition, irregularities in the data collection process may also lead to artificial intelligence systems generating discriminatory or misleading contents. This problem not only undermines the fairness of education but may also have a negative impact on students' values and cognition. Moreover, the uncertainty of data collection may also cause teachers to face an additional workload when using artificial intelligence tools. Teachers need to spend more time and energy verifying and adjusting the content generated by artificial intelligence to ensure that it meets educational goals and ethical requirements. The time and energy cost might lead to some teachers' resistance to using artificial intelligence tools.

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Secondly, the personalized content generated by artificial intelligence cannot fully meet the needs and cognitive characteristics of students at present. Each student has different learning styles, knowledge levels, and interests, and artificial intelligence systems underperform identifying and adapting to these differences. In practical applications, this content adaptation problem may lead to a decrease in the satisfaction of teachers and students with artificial intelligence tools. While teachers need to spend a lot of time adjusting and supplementing the generated content, students may feel frustrated because they cannot obtain learning resources suitable for themselves. Therefore, the improvement of the adaptability and controllability of artificial intelligence systems in content generation is a crucial issue that needs to be solved in future artificial intelligence education technology.

Finally, while today's artificial intelligence has a strong ability to adapt to complex tasks, it lacks a certain degree of flexibility and depth in non-cognitive factors such as personal emotional states, personality traits, and innate temperaments. Education is not only the imparting of knowledge but also includes the cultivation of students' emotions, attitudes, and values. However, current artificial intelligence systems have limited capabilities in emotional recognition and response and cannot provide emotional support and personalized guidance like human teachers.

3.3. Resource Barriers

The imperfect informatization construction is one of the important challenges faced by the current digital transformation of education, especially in remote and economically underdeveloped areas. These areas often lack sufficient equipment and stable network connections, which not only limits the application of artificial intelligence technology in education but also exacerbates the imbalance in the distribution of educational resources. This regional imbalance not only affects the fairness of education but may also lead to a further widening of the digital divide. Students in cities and developed areas can access advanced artificial intelligence education tools earlier and more conveniently, while students in remote areas may be excluded due to a lack of equipment and network. This gap may create irreversible differences in students' learning opportunities and development potential.

The digital transformation of education requires a large amount of capital investment, including the procurement of hardware equipment, the construction of network infrastructure, the development and maintenance of software systems, and teacher training. However, many regions, especially economically underdeveloped regions, due to limited financial budgets, find it difficult to afford these high costs. This problem of insufficient financial resources not only limits the speed and quality of informatization construction but also leads to an imbalance in resource allocation. For example, while urban schools are able obtain funding from the government or enterprises to purchase advanced artificial intelligence education equipment and software, schools in remote areas may only rely on limited financial allocations and can hardly meet basic informatization needs. In addition, insufficient financial resources may also lead to a lack of complete planning and sustainability in the digital transformation of education. Many schools may only be able to carry out partial informatization construction within a limited budget and cannot carry out comprehensive systematic reforms. This fragmented construction method results in a waste of resources and inefficient utilization, making it challenging to form an effective digital education ecosystem.

4. Prospects of Artificial Intelligence in the Education Field

The wide application of artificial intelligence tools is an inevitable trend of the development of the times. With the continuous progress of technology and the increasingly diverse educational needs of society, artificial intelligence is becoming an important driving force in the education field. AI can

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not only provide personalized learning experiences, optimize the allocation of teaching resources, but also improve education efficiency and quality. Therefore, the wide application of AI will promote the comprehensive upgrading of the education system and inject new vitality into the future development of education. Taking the policies of China and the United States in the field of artificial intelligence education applications as examples, during the formulation process, it is evident that although countries have their unique implementation strategies, their vision for common development is also very strong, indirectly reflecting the future trend of international competition and cooperation, with a focus on cultivating and introducing technical talents and constructing agile and efficient governance frameworks [11].

4.1. Intensified Talent Competition

Countries generally recognize that technical talents are the key to promoting the development of artificial intelligence education. Therefore, countries have successively introduced policies to increase the cultivation of artificial intelligence-related professionals. For example, China has successively launched the *New Generation Artificial Intelligence Development Plan and the Artificial Intelligence Innovation Plan for Higher Education*, which not only shows its determination to pursue global scientific and technological talents but also stimulates the strategic adjustments of other countries [12]. The United States, through the continuous improvement of its immigration policy and the provision of policy and financial support, attracts top global talents and promotes innovation in the private sector to maintain its leading position in the field of artificial intelligence. These efforts underscore that the development and introduction of technical talent have become a central focus of national education policies, with countries aiming to enhance the quality of scientific and technological talent cultivation to strengthen their competitive edge on the global stage.

4.2. Formation of Policy Frameworks

In addition to talent cultivation, countries are also committed to constructing agile and efficient governance frameworks to adapt to the rapid development of artificial intelligence education. This includes formulating clear technical standards, ethical norms, and policy support systems. For example, China has issued the *Governance Principles for the New Generation of Artificial Intelligence -- Developing Responsible Artificial Intelligence*, clarifying measures to promote innovation and development by continuously upgrading intelligent technology means and optimizing management mechanisms, and promptly identifying and addressing potential risks. This policy orientation not only helps to standardize the development of artificial intelligence education but also enhances the adaptability and resilience of the intelligent education ecosystem to external changes.

However, it needs to be stressed that teachers are still irreplaceable in cultivating students' critical thinking ability and perceiving students' emotions. Artificial intelligence can only play an auxiliary role and be used as an enhancement or supplement to traditional education [5]. Overall, people should center in the educational field and effectively manipulate artificial intellligence.

5. Conclusion

This paper deeply explores the application of artificial intelligence in the education field. By analyzing its achievements in compulsory education and higher education stages, the challenges it faces, and its future prospects, it reveals the innovation and transformation of artificial intelligence in the education model.

Artificial intelligence has achieved many accomplishments in most developed countries and some developing countries. It is evident that artificial intelligence will still be a hot topic in the education community in the next few decades. However, artificial intelligence faces cognitive, technical, and

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resource limitations in the education field. In the future, countries need to focus on cultivating and introducing technical talents, constructing agile and efficient governance frameworks, and adhering to the education concept of putting people at the center and using artificial intelligence as an assistant.

However, this paper also has certain limitations. For example, during the research process, due to space and resource limitations, it is difficult to comprehensively cover the applications of artificial intelligence in education in all countries and regions. Some data and cases may not be detailed enough, affecting the depth and breadth of the research. In addition, artificial intelligence technology is developing rapidly, and relevant research and practices are still facing ongoing changes. The research results of this paper may not fully reflect the latest developments.

Future research can further focus on the following directions: First, strengthen the discussion on the ethical issues of artificial intelligence in education and propose more targeted and operational solutions. Second, deeply study the in-depth integration model of artificial intelligence technology and education and teaching to provide more practical guidance for educators. Third, expand international cooperation and exchanges, share experiences and achievements in the application of artificial intelligence in education, and jointly promote the intelligent development of global education.

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