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# Research On the Application of Artificial Intelligence in International Education: Literature Review

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## Abstract

Currently, the digital transformation and intelligent upgrading of education are developing at an accelerating pace. Artificial intelligence technology has begun to be fully and deeply integrated with all aspects of education and teaching, creating a new form of smart education. This article, through a literature review, explores and analyzes the development process, policies and educational practices of artificial intelligence in the field of education in the United States, Singapore, Germany, the United Kingdom and China. This article discusses how national policies and educational practices in five countries can be integrated and innovatively developed, analyzes the common features and differences in the development of artificial intelligence education, and points out the potential and advantages of artificial intelligence in the field of education. Finally, this paper proposes the future development direction of artificial intelligence and educational practice, providing a reference for the deep integration of artificial intelligence and the education field on a global scale.

## Keywords

Artificial Intelligence, International education, Education policy, Literature Review

## 1. Introduction

Artificial intelligence has entered a stage of rapid development, and its application in the field of education is becoming increasingly widespread. Especially, the research on its application in digital classrooms of colleges and universities is receiving more and more attention. For a long time, artificial intelligence has been highly anticipated in promoting the improvement of educational and teaching quality, and related international research has also shown a continuous warming trend. Like other educational technologies, artificial intelligence in educational contexts has not only attracted high attention from the international community but also sparked extensive discussions in both the academic and practical fields. Judging from the existing research results, China has become one of the important countries in the

research of educational artificial intelligence, and the development of educational artificial intelligence has been elevated to the height of the national education strategy. Against this backdrop, a systematic review of the research achievements in educational artificial intelligence not only helps to objectively understand its application status in the field of education, but also reveals the difficulties and challenges it faces in its development process, and provides references for further development directions.

# 2.Literature Review

## 2.1 Application of Artificial Intelligence in the Field of Education in the United States

From 2021 to 2025, a search was conducted on Google Scholar for the keyword "Artificial Intelligence and American Education", and a total of 15,000 related documents were found. At present, research and information retrieval related to themes such as the application of artificial intelligence in education, educational transformation in the era of artificial intelligence, artificial intelligence topics at international education conferences, and the strategic blueprint for artificial intelligence education have shown a high level of attention.

The United States started its exploration of artificial intelligence in the field of education relatively early. As early as the 1950s, the United States attempted to utilize the computing speed and storage capacity of computers to carry out computer-assisted education. In the summer of 1956, scientists such as McCarthy and Minsky held a meeting at Dartmouth College and proposed the concept of "Artificial Intelligence (AI)" for the first time. This is the first academic symposium on artificial intelligence in human history, marking the birth of the discipline of artificial intelligence and holding significant historical importance. In 1970, Carbonell proposed the concept of intelligent computer-assisted instruction (ICAI) and designed an intelligent tutoring computer system, which was a significant landmark event in the application of artificial intelligence in the field of education. In 2010, with the breakthrough of deep learning technology, the application of artificial intelligence in education ushered in new development opportunities. By the beginning of 2023, the emergence of ChatGPT had further sparked widespread attention and discussion on the application of artificial intelligence in education worldwide.

At the educational policy level, the United States emphasizes the full coverage and cross-disciplinary integration of artificial intelligence education across all educational stages, and attaches great importance to building an open community for artificial intelligence resources in the basic education stage to promote the sharing and collaboration of teaching resources. May 2023 Office of Educational Technology of the United States Department of Education the U.S. Department of Education released the policy report "Artificial Intelligence and the Future of Teaching and Learning". The report explicitly puts forward the necessity of sharing knowledge, providing support and formulating policies, emphasizing that artificial intelligence, as a core capability for identifying patterns and automating actions, brings new opportunities to the priorities of educational policies, while also paying attention to the potential risks in the application process.

To further respond to global technological changes and ensure international competitiveness in the field of artificial intelligence, the US government has successively issued strategic documents. On November 9, 2023, the U.S. Department of State released the "AI Strategy for Fiscal Year 2024-2025: Enterprise Artificial Intelligence Strategy FY 2024-2025: Empowering Diplomacy through Responsible AI (EAIS for short), this is the first AI guiding strategy proposed by the State Department, marking the comprehensive policy response of the United States in the era of AI. This strategy aims to promote the responsible use of artificial intelligence, optimize foreign policy and international cooperation, and demonstrate the United States' emphasis on technology ethics and international rules (Gong, 2024). Subsequently, on July 8, 2024, the Office of Educational Technology of the U.S. Department of Education released "Designing Education with Artificial Intelligence: Designing for Education with Artificial Intelligence: The "An Essential Guide for Developers" emphasizes that artificial intelligence models and functions will be increasingly integrated into future educational products to promote educational technology innovation, improve teaching and learning in the national education system, and at the same time encourages developers to develop corresponding artificial intelligence products and services for the education market.

At the practical level, many schools in the United States are actively exploring the application of artificial intelligence in education. According to statistics, currently about 30% of public schools have adopted some form of artificial intelligence tools, with application areas covering curriculum design, student assessment and other aspects. Some school districts have also established special teams to study how to better integrate artificial intelligence to enhance teaching effectiveness. For instance, some school districts in California are piloting AI-based data analysis tools to identify low-performing students and provide targeted support (Mei, 2024).

Overall, the United States is one of the earliest countries to apply artificial intelligence in education and has achieved remarkable results in practice. Artificial intelligence can help teachers automate cumbersome tasks, enhance teaching abilities, and stimulate students' initiative and efficiency in learning. Duan Shifei and Li Jiayi (2025) pointed out that the US government promotes teachers' professional development through legislation and financial support, and establishes an artificial intelligence course training and funding program. At the student level, a systematic path for cultivating artificial intelligence literacy has been established by improving the curriculum system. At the education system level, emphasis is placed on promoting the high-quality development of artificial intelligence education through government initiatives and inter-school cooperation, and stresses interdisciplinary integration to cultivate students' comprehensive abilities. Meanwhile, Chang Tongshan and Zhao Lei (2024) found that in addition to the federal government regulating the application of artificial intelligence through legislation in the United States, universities, academic publishing institutions, and research funding agencies have also formulated response strategies, clarifying the application principles of artificial intelligence in scientific research, teaching, and management. This not only enhances the efficiency of using artificial intelligence tools but also reduces potential risks.

## 2.2 The application of artificial intelligence in the education sector of Singapore

A search for the keyword "Artificial Intelligence and Education in Singapore" on Google Scholar was conducted from 2021 to 2025, and a total of 3,060 related documents were found. Current research mainly focuses on lifelong education of artificial intelligence, artificial intelligence curriculum education, and strategies for cultivating artificial intelligence literacy and education.

Singapore ranks third among the countries that apply artificial intelligence globally, only after the United States and China. As early as 2006, Singapore began to explore the application of artificial intelligence in the field of education under the "Smart Nation 2015 Plan". In 2019, the Singaporean government released the "National AI Strategy", proposing to increase research investment and policy support for AI education, and fundamentally rethink the development model of AI. To enhance the innovation and productivity of the country (Singapore Government, National AI Strategy).

In terms of specific measures, in December 2020, the Singaporean government released the seventh round of the "Research, Innovation and Enterprise 2025" (RIE2025) plan. It was announced that an investment of 25 billion Singapore dollars (approximately 1% of the gross national product) will be made within five years to cultivate high-level research talents with digital literacy, promote transformative innovation, seize the opportunities of digital transformation, and boost economic growth. On October 1, 2024, the Ministry of Digital Development and Information of Singapore announced a grant of 120 million Singapore dollars for the "AI for Science" program to develop interdisciplinary AI methods and tools that can enhance research efficiency and promote scientific discoveries. In the same year, the Ministry of Education of Singapore also launched a pilot project of the AI-driven browser plugin Simpler, aiming to help students better browse and understand online learning content. According to the government's plan, starting from 2025, all primary and secondary school students across the country will receive 5 to 10 hours of basic artificial intelligence education courses and be supported by the STEM Education and Innovation and Enterprise Funding Scheme for artificial intelligence expansion projects (Lianhe Zaobao, 2024). Furthermore, Singapore will officially launch the "Smart Nation Educator Fellowship" in 2025 to build a talent pool of teachers with cutting-edge digital knowledge, comprehensively enhance students' digital skills, and adapt to the rapidly developing technological environment.

Since 2019, Singapore has increased its investment in the digital transformation of education, promoting the development of artificial intelligence education in aspects such as curriculum development, research funding, and

teacher training. While the government, schools and enterprises are working in collaboration and division of labor, they also actively interact to jointly build digital courses, develop teaching resources and enhance students' digital literacy, providing a solid foundation for the deep integration of education and advanced technology. This not only promotes the effective development of human resources and the improvement of human capital, but also becomes a key driving force for Singapore's sustainable economic development (Kang & Li, 2024).

One of the highlights of Singapore's artificial intelligence education in terms of teacher development lies in its teacher training and selection mechanism. Xu Peng et al. (2022) pointed out that Singapore has carried out innovative reforms in the teacher employment mechanism, actively explored the "dual-teacher system" model, and combined it with regular teaching effectiveness assessment to ensure that teachers can meet the teaching requirements of artificial intelligence courses. Hu Bei (2024) believes that Singapore's ability to stand out in the development of digital education is attributed to its series of strategic plans, the construction of a high-level teaching staff, and the continuous advancement of the integration of education and digital technology. Meanwhile, CAI Lianhua (2022) emphasized that by constructing a conceptual framework for artificial intelligence, Singapore enables students to directly experience the charm of artificial intelligence and deepen their understanding and thinking through case studies, thus forming a more comprehensive cognition of artificial intelligence. Kang Chengxuan and Li Baozhong (2024) further pointed out that Singapore's successful model lies in the government creating an environment through strategic guidance and financial support, schools actively developing digital courses and enhancing teachers' qualities, and enterprises providing support by feeding back talent demands and offering practical bases, thus forming a multi-party collaborative mechanism that promotes the development of artificial intelligence education.

## 2.3 The application of artificial intelligence in the field of education in the UK

A search for the keyword "Artificial Intelligence and UK Education" on Google Scholar was conducted from 2021 to 2025, and a total of 6,300 related documents were found. Current research mainly focuses on the development of the UK teacher education system in the era of artificial intelligence, the application of generative artificial intelligence in education, and the application of generative artificial intelligence in the field of basic education.

From the late 20th century to the early 21st century, the British education sector gradually introduced information technology means such as computer-assisted instruction, laying the foundation for the application of artificial intelligence in education. It is worth noting that although AI-assisted teaching (such as courseware production, drawing and homework correction) has been practiced in the UK, it was not until September 2024 that David Gham College in London officially launched the "Sword Wing" project, introducing AI as the main instructor into classroom teaching for the first time.

At the policy level, the UK Department for Education released the report "The Application of Generative AI in Education" in November 2023, systematically expounding the official stance on the use of generative AI (including large language models such as ChatGPT) in the field of education. The report covers six aspects: understanding generative artificial intelligence, opportunities in the education industry, effective application of artificial intelligence, protection of data and educational communities, formal assessment mechanisms, and the knowledge and skills needed in the future. The Ministry of Education of China pointed out that the rational utilization of generative artificial intelligence can help reduce the non-teaching workload of teachers, thereby alleviating the long-standing work pressure.

In terms of the construction of the education system, Shen Yue (2025) believes that the relative success of teacher education in the UK in the era of artificial intelligence is attributed to a standardized and complete teacher education system, continuous and stable organizational support, as well as the active participation of multiple social entities. Specifically, the UK offers a wide range of computer courses for children and teenagers under the age of 16 and has introduced the "Higher Education Occupational Standards Framework" at the higher education stage, setting minimum competency requirements for teachers from a professional perspective. Meanwhile, Zheng Yanlin and Jia Baolong (2023) pointed out that in the process of promoting balanced educational development in the UK, particular emphasis is placed on enhancing the artificial intelligence literacy of the entire population. The education policy in the UK also emphasizes students' right to make independent choices and implements humanized educational services. For instance, Xie Xingmei (2021) mentioned that many universities in the UK have established entrepreneurship centers to

provide support for students during their studies and the early stages of graduation, including services such as renting entrepreneurial Spaces.

However, artificial intelligence also faces trust and ethical risks in educational applications. Shen Yuan (2024) pointed out that the inherent unpredictability and opacity of machine learning, as well as the improper use of artificial intelligence tools, can easily trigger a crisis of human-machine trust in educational scenarios. If the ethical demands of education are ignored, not only will the expected teaching effects not be achieved, but it may also lead to educational alienation and trigger public resistance (Shen, 2024). Meanwhile, the UK Department for Education also emphasized in its report "The Application of Generative Artificial Intelligence in Education" in October 2023 that attention should be paid to data privacy protection and tool usage norms (Hu, 2024).

The widespread use of generative artificial intelligence has raised new challenges in terms of academic integrity. Although such technologies can generate smooth text based on user prompts, their content may not be accurate and could even be misleading. A survey by the Higher Education Policy Institute in the UK shows that 53% of British undergraduate students are using artificial intelligence to write their papers, among whom 5% admit to directly copying and pasting unedited AI-generated text into their papers, a behavior that seriously violates the principle of academic integrity.

## 2.4 The application of artificial intelligence in the field of education in Germany

A search for the keyword "Artificial Intelligence and German Education" on Google Scholar was conducted from 2021 to 2025, and a total of 5,080 related documents were found. Current research mainly focuses on aspects such as artificial intelligence literacy education, artificial intelligence and vocational and technical education, and artificial intelligence literacy education.

In 2018, Germany launched and vigorously promoted the "Artificial Intelligence Strategy", providing policy support and financial guarantee for the development of artificial intelligence in various fields including education. In 2021, Germany issued the "Guidance on Jointly Promoting the Development of Artificial Intelligence in Higher Education by the Federal and State Governments", explicitly stating that knowledge and skills related to artificial intelligence should be regarded as essential capabilities for future academic researchers in universities, and the advantages of artificial intelligence should be fully utilized to promote the development of higher education. At the end of 2022, the open release of ChatGPT-3 sparked extensive discussions in the German education sector. By 2023, some state education ministers and teachers saw ChatGPT as an educational opportunity and openly opposed its ban.

On August 23, 2023, the German Federal Ministry of Education and Research released the "Artificial Intelligence Action Plan" as an update to the federal government's "Artificial Intelligence Strategy", aiming to promote the development of artificial intelligence in Germany to a higher quality stage (Ge, 2023). in April 2024, the Institute for Teacher Training and Primary and Secondary School Development (LI) of Hamburg, in collaboration with the Hamburg Education Bureau and the Hamburg Center for Artificial Intelligence (ARIC), jointly formulated and released the "Guide to the Use of Artificial Intelligence in Primary and Secondary Schools" (Kunstliche Intelligenz (KI) in der Schule). This guideline, in light of the widespread use of artificial intelligence in primary and secondary schools and its gradual integration into curriculum content, proposes that artificial intelligence should be actively integrated into teaching as a learning theme. It focuses on 12 functions of generative artificial intelligence represented by ChatGPT, emphasizing that artificial intelligence can not only support students' learning but also provide assistance to teachers. At the same time, establish a connection between student assignment design and learning evaluation mechanisms (Website of the Education Section of the Embassy of the People's Republic of China in Germany, 2024). On October 10, 2024, Germany's education minister meeting (Die Bildungsministerkonferenz) passed a historic action suggested in Berlin, aiming at providing a framework for the education management department, in a positive and prudent attitude to deal with the application of artificial intelligence in the school education, maximize their potential in the teaching and learning process.

The wide application of digital technology has played a positive role in the internationalization of education and the development of higher education. Wang Cuiying et al. (2021) pointed out that especially in the post-pandemic period, the advantages of digital technology in promoting cross-border personnel exchanges and cooperation have become increasingly prominent, making global educational cooperation among German universities more in-depth and flexible.

Wu Rui and Chen Zheng (2023) further emphasized that seizing the new opportunities in the development of global digital education is conducive to achieving a leapfrog development in the internationalization of higher education and also provides references for the internationalization of Chinese education. Meanwhile, German universities are actively promoting digital transformation, providing not only research and talent support for the development of artificial intelligence but also injecting impetus into the "Industry 4.0" strategy. GUI Xiaolu (2023) research shows that German universities have become an important force in scientific research support and talent supply.

In terms of the strategic vision for artificial intelligence, the German federal government hopes to build the country into a "research, innovation and business center that is attractive to domestic and foreign AI experts" in order to attract and retain top talents. Wang Tianjian (2023) pointed out that ChatGPT has demonstrated potential in driving the innovation of learning methods. It can provide learners with tasks, questions, examples and models through personalized design, supporting self-learning. At the same time, Germany pays close attention to the safety and ethics of artificial intelligence development, emphasizing openness and sustainability. Xiao Xiaoyun and Xu Siji (2023) pointed out that the target groups of Germany's artificial intelligence policy cover both enterprises and citizens, both of which are key support targets. Peng Yue and Kong Yan (2024) hold that Germany's practice of promoting the "AI ethical label" demonstrates its efforts to transform AI ethical principles into practical operations and implements the core concept of its AI strategy, which is "designed for ethics".

## 2.5 The application of artificial intelligence in China's education sector

A search for the keyword "Artificial Intelligence and Chinese Education" on Google Scholar was conducted from 2021 to 2025, and a total of 16,300 related documents were found. Current research mainly focuses on the empowerment of medical college faculty development by artificial intelligence, the integration of generative artificial intelligence with the modernization of educational governance, and the relationship between generative artificial intelligence and higher education.

In December 2024, the General Office of the Ministry of Education issued the "Notice on Strengthening Artificial Intelligence Education in Primary and Secondary Schools" (Jiaoji Ting Han [2024] No. 32), clearly putting forward the overall requirements for artificial intelligence education, emphasizing core principles such as fostering virtue and nurturing talent, all-round development, stimulating interest and encouraging exploration, as well as overall planning and steady advancement. Meanwhile, the document sets out six major tasks and measures, including: building a systematic curriculum system, implementing regular teaching and evaluation, developing universal teaching resources, creating a ubiquitous teaching environment, promoting large-scale teacher supply, and organizing diverse exchange activities.

In China, with the continuous development and popularization of emerging technologies such as artificial intelligence, the education sector has gradually taken on a development pattern of "artificial intelligence + education". Ji Xiaoyan (2020) pointed out that artificial intelligence should be studied as an independent branch in educational applications. It is necessary to approach from multiple dimensions such as imagery thinking, logical thinking, and inspiration thinking to promote interdisciplinary teaching and development of artificial intelligence, so that it cannot only play a role as a teaching tool but also enhance its own value and application efficiency. Li Zhongliang (2020) summarized "the integration of artificial intelligence and education" into two aspects: the first is "intelligent education", which takes intelligent technology itself as teaching content to cultivate students' intelligent technology literacy; The second is "intelligent education", which means using intelligent technologies as a means to change the traditional teaching model, optimize the allocation of educational elements, and promote the innovative development of education.

At the level of educational management, the extensive application of informatization and artificial intelligence has driven the transformation of educational management models. Yan (2024) pointed out that artificial intelligence has become an important tool in educational management, which is conducive to promoting the modernization of university educational management under the concept of quality-oriented education. Meanwhile, the advantages of artificial intelligence in education and teaching are gradually becoming prominent. For instance, Lu (2024) holds that artificial intelligence can achieve the integration of educational resources, support data extraction from various types of information platforms, guide and analyze students' experimental and practical training links, enhance the learning

experience and interest, reduce learning costs, and improve students' autonomous learning ability while reducing the burden on teachers.

In addition, Wang Tong et al.,(2023) emphasized that artificial intelligence technology can enhance teaching efficiency, enrich teaching content, improve teaching methods, and promote the cultivation of students' innovative abilities in teaching practice. In general high school education, the application of artificial intelligence not only enhances teaching and management efficiency but also provides students with a more personalized learning experience (Gu, 2025).

# 3. Methodology

This review adopts a structured narrative review approach to explore the development of artificial intelligence in the field of international education, mainly providing an overview of the development process in five countries: the United States, Singapore, the United Kingdom, Germany, and China. By searching for relevant literature in Google Scholar using keywords such as "Artificial Intelligence", "Artificial Intelligence and American Education", "Artificial Intelligence and Singaporean Education", "Artificial Intelligence and German Education", "Artificial Intelligence and British Education", and "Artificial Intelligence and Chinese Education", the research achievements of the past five years were screened out and systematically discussed. This review is not intended to conduct a systematic evaluation, but rather to sort out the core research topics by integrating existing literature. Through the reading and classification of relevant literature, several representative research directions can be summarized. These directions not only form the basis of comprehensive analysis, but also provide important references for explaining the research paths in the fields of artificial intelligence and international education.

# 4. Conclusion

As the first country to apply artificial intelligence in the field of education, the United States has formed a system that integrates artificial intelligence with various disciplines and cross-disciplinary integration. Through policy-making, Singapore has formed a synergy among the government, schools and enterprises to promote the digital transformation of education. The UK mainly focuses on the application of generative artificial intelligence in the field of education, mainly the regulation of the teacher education system and students' right to independently choose to use artificial intelligence for learning. Looking at the exploration and development of artificial intelligence in the field of education in the United States, Singapore, Germany and the United Kingdom, it has laid a foundation and provided some successful experiences for the application and development of artificial intelligence in the field of education in China. The development of artificial intelligence in the field of education is mainly driven by policies, through system construction, and then through the in-depth integration and development of teaching practice.

# 5. Research Trends, Limitations, and Future Directions

This research mainly relies on the review and analysis of existing literature and has the following limitations: Firstly, the selected literature is concentrated in the United States, Singapore, Germany and the United Kingdom, and fails to comprehensively cover the global practice of artificial intelligence education, thus having geographical limitations. Future research can explore some of the current development situations in Latin America and Africa. Secondly, some research only remains at the policy and theoretical level, lacking long-term empirical data support, and thus is difficult to comprehensively reflect the actual effect of artificial intelligence in international education. Finally, artificial intelligence technology is updated and iterated rapidly, and the existing research results may face the problem of insufficient timeliness, which to some extent limits the universality and forward-looking nature of the review conclusions.

Future research can be carried out from the following aspects: First, further deepen the interdisciplinary integration of artificial intelligence and education, especially in the expansion of STEM education, language learning and personalized learning and other fields; Secondly, explore the role of artificial intelligence in educational equity, such as how to narrow the educational gap between regions, urban and rural areas, and groups through intelligent means; Third,

enhance research on artificial intelligence ethics and data security to ensure the sustainable application of artificial intelligence in educational scenarios; Fourth, pay attention to the two-way adaptation mechanism between teachers and students. Explore how teachers can optimize their training, curriculum reform and assessment mechanisms, and how teachers and students can adapt to the changes brought about by artificial intelligence in the field of education.

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