

Current Status, Hotspots, and Trends of "Artificial Intelligence + Education" Research in China

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Abstract: The rapid development of artificial intelligence technology is profoundly leading education towards an intelligent direction. This article takes the literature related to "Artificial Intelligence + Education" published in the core journals of CSSCI from 2013 to 2024 as the research object, and uses the CiteSpace tool for visualization analysis. It combs and discusses the current status of domestic research in this field from aspects such as publication status, authors, institutions, and keyword co-occurrence and burst words, analyzes research hotspots, and predicts research trends. The results show that: in the past decade, the number of publications in this field in China can be divided into three stages: preliminary exploration, rapid development, and steady growth; some high-productivity authors have gradually formed a core group of authors, showing an overall development trend of multi-author cooperation and multi-unit collaboration; the types of publishing institutions are mainly normal colleges and departments of colleges and universities, with relatively low participation of enterprises and government institutions; research hotspots focus on three aspects: educational reform, categories of education, and educational technology, revealing the active exploration of the education field for intelligent technology; with the transformation of education and the development of technology, the combination of artificial intelligence and digital economy, new requirements for citizens' core literacy, and new challenges for teachers' professional literacy and educational models have become hot topics in current artificial intelligence research.

Keywords: Artificial Intelligence, Education, CiteSpace, Visualization Analysis.

1. Introduction

The development of the times and the advancement of technology have made artificial intelligence a key driving force in many fields. In recent years, the Party and the state have attached great importance to the integrated development of artificial intelligence and education, and have successively published policy documents such as the "New Generation Artificial Intelligence Development Plan" and the "College Artificial Intelligence Innovation Action Plan" to encourage, support, and guide the integrated development of artificial intelligence and education.

Looking back over the past decade in China, the application research of artificial intelligence in the field of education has mainly focused on the rationality of application, specific types of application, hidden worries of application, and future directions, mostly belonging to the category of qualitative research, while quantitative research pays attention to a single dimension, with relatively outdated

data, making it difficult to accurately and timely grasp the frontier hotspots of artificial intelligence research.

In view of this, this paper uses CiteSpace software to conduct a bibliometric analysis of the CSSCI journal literature with the theme of "Artificial Intelligence + Education" in the China National Knowledge Infrastructure (CNKI) database, combing and summarizing the research status, research hotspots, and development trends of this field in the past decade, adapting to the intelligent wave, and promoting high-quality development of education promoted by artificial intelligence.

2. Research Design

2.1. Data Source

The data of this study comes from the CNKI database, with "Artificial Intelligence + Education" as the keyword and "CSSCI" as the journal category for precise retrieval, spanning from 2013 to 2024. After retrieval and manual screening, a total of 3393 valid literatures were obtained.

2.2. Research Methods and Tools

The CiteSpace software is used to select authors, institutions, and keywords for visualization analysis of the sample literature, obtaining knowledge maps of author co-occurrence, institution co-occurrence, keyword co-occurrence, and burst words, as well as related data, and analyzing the research trend of "Artificial Intelligence + Education" based on this.

3. Data Statistics and Analysis

3.1. Distribution of Annual Publication Volume

The annual publication volume can reveal the research enthusiasm and development trend of the research field, which is of great reference value for understanding its academic ecology and guiding future research directions. Figure 1 can be roughly divided into three stages as a whole.

1. Preliminary Exploration Stage (2013-2016)

In this stage, the application of artificial intelligence in education began to attract attention, and the research mainly focused on the exploration of its theory and basic applications. Although there were not many results, it laid an important foundation for the rapid development that followed.

2. Rapid Development Stage (2017-2021)

With the rapid development of technologies such as big data, parallel computing, and deep learning, the application of artificial intelligence in education has been significantly advanced. In March 2017, the "Two Sessions" in China first included "artificial intelligence" in the government work report for the first time, elevating its development to a national strategy [1]. In July of the same year, the State Council issued the "New Generation Artificial Intelligence Development Plan" [2], proposing "intelligent education," which pointed out the development direction for "Artificial Intelligence + Education."

3. Stable Growth Stage (2022 to present)

In this stage, the application of artificial intelligence technology in the field of education has become more mature, and the focus of research has begun to shift to aspects such as education quality, teaching ethics, and the digital economy. At the end of 2022, with the advent of ChatGPT, the academic community's exploration and research of "Artificial Intelligence + Education" entered a new climax.

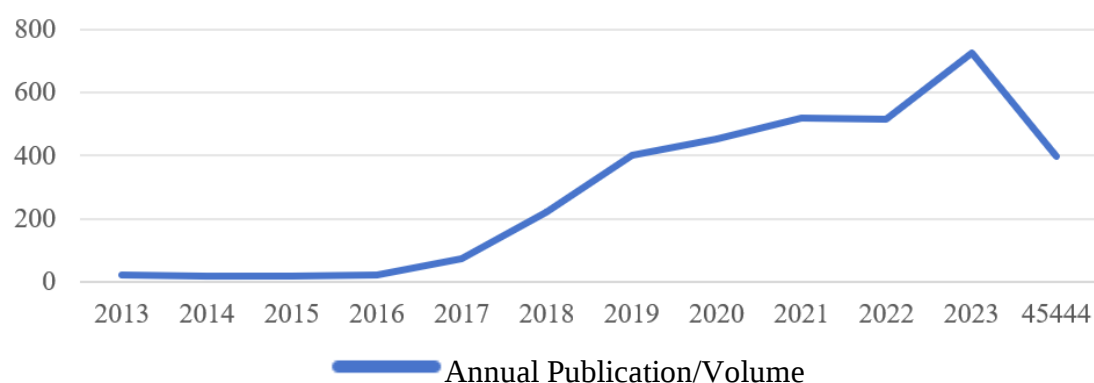


Figure 1: Annual Publication Volume of "Artificial Intelligence + Education" Research in the Past Decade

3.2. Core Author Analysis

The volume of publications to some extent reflects the academic community's attention to and research capacity in the field. As can be seen from Table 1, the author with the highest number of publications is Gu Xiaoqing with 58, followed by Zhu Zhiting with 35, and Huang Ronghuai with 24. Gu Xiaoqing focuses on the development of education in the era of artificial intelligence, researching future education trends and the optimization of digital educational resources; Zhu Zhiting focuses on educational innovation in the era of artificial intelligence, covering key areas such as smart education, digital transformation, and human-computer collaboration.

Table 1: Publication Status of Authors in "Artificial Intelligence + Education" Research in the Past Decade

No.	Number of Publications	Year	Author
1	58	2015	Gu Xiaoqing
2	35	2014	Zhu Zhiting
3	24	2017	Huang Ronghuai
4	22	2021	Zhao Leilei
5	19	2021	Zheng Yonghe

3.3. Analysis of Core Publishing Institutions

Analyzing the research institutions can clarify the research clusters in a field. As shown in Table 2, the institutions with a higher volume of publications are: Department of Educational Technology at East China Normal University with 55 publications, Faculty of Education at Beijing Normal University with 50 publications, and Faculty of Education at Southwest University with 38 publications. Currently, the institutions conducting research in this field are mainly normal colleges and departments of colleges and universities, and the researchers are also mostly teachers and scientific researchers from colleges and universities.

Table 2: Publication Status of Research Institutions in "Artificial Intelligence + Education" in the Past Decade

No.	Number of Publications	Year	Institution
1	55	2016	Department of Educational Technology, East China Normal University
2	50	2016	Faculty of Education, Beijing Normal University
3	38	2019	Faculty of Education, Southwest University
4	36	2017	School of Education, Tianjin University
5	34	2014	School of Educational Information Technology, South China Normal University

3.4. Co-occurrence Analysis of Keywords

Co-occurrence analysis of keywords can effectively reveal the hot topics within a research field. With the help of CiteSpace, the keyword co-occurrence map of "Artificial Intelligence + Education" was obtained, and the top 20 high-frequency keywords data were exported (see Table 3), which can be roughly summarized into three aspects:

Educational Transformation: Keywords such as "Intelligent Education," "Smart Education," "Intelligent Era," and "Future Education" reflect that smart education is a new form of future education, and talent cultivation must meet the demands of the intelligent era.

Types of Education: Keywords like "Higher Education," "Vocational Education," and "New Engineering" indicate that the integrated development of artificial intelligence and education is mainly reflected in higher and vocational education, with less application in basic education [3], and is widely applied in the curriculum training system of New Engineering at present.

Educational Technology: Keywords corresponding to technologies such as "Artificial Intelligence," "Big Data," "Human-Computer Collaboration," and "Deep Learning" are the hot technologies that researchers generally focus on.

Table 3: Co-occurrence Analysis of Keywords in "Artificial Intelligence + Education" Research in the Past Decade

Frequency	Centrality	Keyword	Frequency	Centrality	Keyword
1226	0.22	Artificial Intelligence	45	0.08	Deep Learning
103	0.31	Intelligent Education	44	0.04	Educational Reform
101	0.18	Higher Education	41	0.00	Future Education
95	0.36	Big Data	35	0.00	Metaverse
93	0.39	Smart Education	34	0.34	Learning Analytics
85	0.00	Talent Cultivation	28	0.21	Educational Technology
79	0.01	Human-Machine Collaboration	27	0.01	New Engineering
76	0.00	Intelligent Era	22	0.01	Information Technology

Table 3: (continued).

69	0.46	Education	20	0.00	Digital Technology
50	0.31	Intelligent Technology	20	0.01	Vocational Education

3.5. Burst Analysis of Keywords

Burst analysis of keywords can detect research trends and cutting-edge dynamics within a certain period of time. This study obtained a keyword burst diagram with 18 nodes (see Figure 2), where the earliest appearing words are "Virtual Reality," "MOOCs," and "Learning Sciences," which have continued to receive attention. "Big Data" has the highest burst strength and is a key technology in "Artificial Intelligence + Education" research. "Learning Sciences" has the longest burst time and has continued to attract the attention of scholars. "Digital Economy," "Core Literacy," and "Teacher Education" have the most recent burst times and are frontier topics of research in recent years.

Digital Economy: The current economic model has entered the intelligent economy phase driven by artificial intelligence as the core, which has changed the traditional industrial model and brought challenges to the requirements for labor quality and the job market [4].

Core Literacy: The requirements for citizens' literacy in the era of artificial intelligence have been elevated to a new level. Abilities such as programming skills, computational thinking, and deep understanding of an intelligent society [5] are the foundations for effective participation and development of individuals in the digital economy.

Teacher Education: In the intelligent era, the professional literacy of teachers and the teacher education model need to be adaptively adjusted and upgraded to cope with the challenges brought by artificial intelligence.

Top 18 Keywords with the Strongest Citation Bursts

Keywords	Year	Strength	Begin	End	2013 - 2024
VirtualReality	2014	3.72	2014	2017	
MOOCs	2014	2.59	2014	2016	
LearningSciences	2015	2.88	2015	2020	
OnlineLearning	2016	3.02	2016	2020	
Robotics	2016	2.39	2016	2018	
EducationalTechnology	2014	2.35	2016	2018	
BigData	2014	5.98	2017	2019	
ComputationalThinking	2014	5.37	2017	2020	
NewEngineeringDisciplines	2017	4.71	2017	2019	
MachineLearning	2015	3.11	2017	2020	
EducationalApplications	2017	2.83	2017	2019	
LearningSpaces	2018	2.76	2018	2020	
VocationalEducation	2019	3.23	2019	2022	
OnlineEducation	2015	4.09	2020	2022	
SmartClassroom	2020	3.71	2020	2022	
DigitalEconomy	2021	4.19	2021	2024	
CoreLiteracies	2021	3.49	2021	2024	
TeacherEducation	2019	2.8	2021	2024	

Figure 2: Burst Diagram of Keyword Nodes in "Artificial Intelligence + Education" Research in the Past Decade

4. Research Conclusions

From the perspectives of research publication volume, authors, and institutions, the domestic research output in the field of "Artificial Intelligence + Education" has significantly increased over the past decade, becoming a key area of academic focus since 2017. Some highly productive authors have gradually formed a core group of authors, showing an overall development trend of multi-author cooperation and multi-institutional collaboration. However, the proportion of industry-academia collaborative papers is relatively low, reflecting to some extent a lack of interdisciplinary awareness among researchers, with few directly participating in the development, promotion, and evaluation of artificial intelligence education products. The depth and breadth of research still need to be enhanced. At the same time, the types of publishing institutions are mainly normal colleges and departments of colleges and universities, with relatively low participation from enterprises and government institutions, indicating an imbalance. Future research can improve quality and impact by strengthening cross-regional and cross-institutional cooperation.

In terms of research hotspots, over the past decade, the field of education has actively explored intelligent technology, especially in the areas of educational reform, types of education, and educational technology. These hot topics have good stability and timeliness, with continuous attention to the essence of education and innovation in talent cultivation models representing stability, while emerging themes such as smart education and intelligent education have contemporary significance. This kind of diversified and interdisciplinary research not only emphasizes the necessity and urgency of educational model reform but also indicates the future direction of education development,

reflecting the academic community's deep thinking on the intelligent transformation of education and a positive response to national policy orientation.

From the perspective of the frontier trends in artificial intelligence research, the integration of artificial intelligence and the digital economy, new requirements for citizens' core literacy, and new challenges for teachers' professional literacy and educational models are hot issues in current artificial intelligence research. The combination of artificial intelligence and the digital economy is driving a new round of technological revolution, requiring educational system reform to adapt to technological development. Education must cultivate citizens with the ability for innovation and critical thinking. To this end, teachers need to enhance their professional literacy, including in intelligent technology, and adjust teaching models to promote students' success in the era of artificial intelligence.

At the same time, there are some shortcomings in this field of research that are worth further reflection and exploration in the future:

First, the development of generative AI provides new opportunities for achieving human-computer collaborative education. However, the cognitive outsourcing caused by technology may induce cognitive dependency, leading to superficial and fragmented thinking. Future research needs to further explore how to build an effective "teacher-student-computer" collaborative relationship, enhance teachers' digital literacy and students' autonomous learning ability through human-computer integration, and achieve a dual improvement of teaching and learning.

Second, although the number of publications on cutting-edge topics such as "teacher education" and "human-computer collaboration" has increased in recent years, empirical research is insufficient. There is a need for extensive extended practice to prove the mechanism and impact of technological change on teachers and learners [5].

Third, ethical issues such as potential privacy breaches and discrimination in artificial intelligence education need to be widely concerned [6]. Technically, continue to develop innovative privacy protection technologies and anti-bias algorithms to ensure individual information security from the source of technology; legally, formulate and improve legal norms related to AI education to guide the rational use and supervision of AI technology.

As a driving force leading future technological innovation, the role of artificial intelligence in the field of education is becoming increasingly prominent. This study is based on nearly 10 years of literature research on artificial intelligence in China's education field, conducting a visualization analysis of research hotspots and frontiers, and summarizing them. Future research will continue to pay attention to the development of artificial intelligence technology and track its application in the field of education.

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