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Application of Artificial Intelligence in Chinese Education based on Bibliometric Analysis



Abstract: - In the last decade, artificial intelligence (AI) has been widely used in education in China. Many scholars have carried out research on the theory of the integration of AI and education and have produced a lot of achievements. In this paper, CiteSpace software is used to visually analyze the research status, progress, hotspot and trend of the application of AI in education in China from the core database of China National Knowledge Net. According to the analysis of the results, it is suggested that educational AI policy and future research should be constructed mutually. AI in education co-constructs a three-dimensional pattern of researchers, research institutions and policy promoters; Focus on the high-quality, scientific and cross-field comprehensive development of AI in education field; Educational AI pays attention to the diversified research of quality combination.

Keywords: Chinese education; Artificial intelligence; citespace; econometric analysis.

I. INTRODUCTION

In recent years, the application of artificial intelligence (AI) in education has become a focus of attention. The application of AI in education involves many aspects, including personalized education, intelligent teaching system, education big data analysis, etc. However, further research is needed on how to integrate AI technology with education and teaching so as to improve the quality and efficiency of education. Through the bibliometric analysis, we will deeply analyze the research of AI application in education in China from the aspects of research theme, research method and research results, and reveal its research hotspot and development trend. The purpose of this paper is to provide a comprehensive understanding and reference for educational practitioners and researchers, and to promote the further application and development of AI technology in China's educational field. Through systematic bibliometric analysis, we will be able to better grasp the vein of AI application research in education field and provide guidance and enlightenment for future research.

II. RESEARCH METHODS AND DATA SOURCES

This research is based on a modeling software of document measurement. This research uses the information visualization software CiteSpace (6.2.R1) to draw the knowledge atlas of the literatures related to the application of AI in the field of education in China. Research frontier detection through citation, coupling, etc.

The core database of China National Knowledge Net is one of the largest comprehensive academic databases in China, covering many disciplines including education, science and technology, medicine, humanities and social sciences. Through CNKI database, researchers can obtain the needed information more conveniently, and promote the development and progress of AI research in education. This study is mainly based on literature data from CNKI (China National Knowledge Infrastructure) core database as the data source. The author uses the advanced retrieval function of CNKI, takes education and AI as the subject word, selects or inputs the national common language as the key word according to Boolean logic, and sets the screening time to March 2024, so as to find the relevant literature on the subject to the maximum extent. Finally, the total number of literatures retrieved is 779. Through the screening and elimination of the relevant conference review, news report, interview and other forms and the literature irrelevant to this study, the author finally obtains 746 valid literatures, and exports the selected literatures through the Refworks format. converted into the WoS database text data format through CiteSpace (6.2.R1), and then the visual analysis operation is carried out.

III. RESEARCH STATUS

A. Research on AI in Education in China

As shown in Figure 1, from 1998 to 2016, there were very few literatures on AI research in education, which was in a period of slow growth. After 2016, the number of articles published increased significantly, and the

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number of literatures remained at a high level in 2023. The reasons for the change in the trend of the volume of papers can be found from the release of relevant policies at home and abroad. In 2016, the United States released the National Strategic Plan for AI Research and Development, which is an important milestone in the world as an AI policy document. Chinese scholars are also keenly aware of the development potential of AI and carry out relevant theoretical research on AI. Therefore, after 2016, relevant research on the application of AI in education has been gradually carried out. Figure 1 shows that there has been an increase in the number of submissions since 2016, but not significantly. Subsequently, in 2017, China issued the Notice on Printing and Distributing the Development Plan for the New Generation of AI, which provided an overall plan for the development of China's AI. In 2018, the Ministry of Education issued the Action Plan on AI Innovation in Institutions of Higher Learning, and a series of policy documents on AI in China were issued intensively, which led to an obvious upward trend in the volume of papers, especially in the past two years. Scholars have a close relationship with the research and policy orientation of AI in education. Therefore, it can be inferred that the research on AI in education will continue to increase in the coming years.

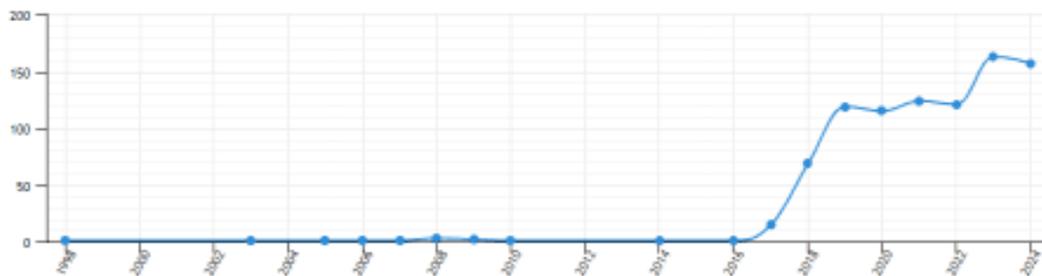


Fig. 1 Change Trend of Document Amount with Time

B. Bibliometric Analysis of AI Research in Education in China

The following is an analysis of the characteristics of AI research in education in China from the dimensions of discipline attributes, authors, institutions, journals, and highly cited subjects.

1) distribution of disciplines

According to statistics, the research on AI in education in China currently covers many subjects in the core database of Knowledge Net, among which there are more than 3 articles in 19 disciplines, as follows: 534 articles on education theory and education management, 426 articles on computer software and computer application, 155 articles on automation technology, 137 articles on higher education, 54 articles on vocational education, 41 articles on secondary education, 15 articles on adult education and special education, 13 articles on library information and digital library, 13 articles on ideological and political education, and 12 articles on news and media. According to the subject scope of AI research in China's education field, AI research in China's education field shows a variety of subject attribute distribution. First of all, educational technology, computer science and technology are the main directions of AI application in education, covering the research of intelligent education system, online learning platform and so on. Secondly, related subjects such as cognitive science and psychology deeply discuss the cognitive process and learning strategy of AI technology in education. In addition, pedagogy, educational technology and other disciplines focus on the analysis of the impact of AI on educational practices and policies, promoting educational reform and innovation. Interdisciplinary research plays an important role in the research of AI in education in China, promotes the cross-fusion and cooperation among different disciplines, and provides a broader vision and possibility for the application of AI in education. The distribution of multi-disciplinary attributes is helpful to promote the all-round development of AI research in China's educational field, promote the reform and optimization of educational system, and promote the process of educational intelligence.

2) high-yield author

Open the CiteSpace (6.2.R1) software main view with the Time Slicing operation area selected from 1998 to 2024 and the slice selected as 1 year. Select Title, Abstract, Author Keywords and Keywords Plus in the Text Processing interface. Select "Author" in node types operation area, and leave others unchecked. The selection criteria select g-index, K=25. Statistics show that there are more AI institutions in education published in the CNKI core database. Among them, 30 people published more than 3 articles, and Gu Xiaoqing published 24 papers, followed by Li Shijing 12, Zhao Leilei 10, Liu Jin 7, Huang Ronghuai, Zhong Bochang, Sun Lihui, Jia Jiyou, Liu Kai, etc. each published 6 papers, Hu Xiaoyong, Wang Youmei, Wang Qiong, Yang Xin, Huang Yao,

Miao Fengchun, Liu Chenchen, Xu Hua, Shen Yuan, etc. each published 5 papers, Zhong Shaochun, Wu Yonghe, Li Yan, Lei Jianghua, Tian Fen, Li Rui and Wang Ping each published 4 papers, Yu Shengquan, Ren Youqun, Xu Peng, Yuan Liping, Dai Ruihua and other 5 people published 3 papers. From the perspective of authors, high-yield authors often have rich academic background and research experience in AI research in education in China. They may be experts in the fields of educational technology, computer science and technology, cognitive science, etc. They are good at using AI technology to solve educational problems. These high-yield authors usually have a high reputation and influence in academic circles, and their research results are published in top journals and international conferences, promoting the continuous progress of AI research in education in China. At the same time, high-yield authors may perform well in interdisciplinary cooperation, and cooperate with educators, psychologists, computer scientists and others to carry out multidimensional research, promoting knowledge exchange and innovation in different fields. Through their continuous research efforts and cooperative spirit, these high-yield authors have injected vitality and impetus into the development of AI research in education in China, and provided important support for the intelligent transformation in education. For example, Gu Xiaoqing, professor and doctoral supervisor of East China Normal University. Director of Education Information Technology Department, Director of Shanghai Digital Education Equipment Engineering Technology Research Center, Chairman of Information Technology Education Professional Committee of Primary and Middle Schools of China Education Association, selected as the 2011 New Century Excellent Talents Program of the Ministry of Education. He is currently a leading expert in the field.

3) *INSTITUTION*

Select "Institution" in the node types operation area in the main interface of CiteSpace (6.2.R1) software main view, and click "GO" if other settings remain unchanged. Statistics show that there are more AI authors in education published in the CNKI core database. Among them, there are more than 5 articles published by 40 units, East China Normal University has 78 papers, followed by Beijing Normal University (53), Central China Normal University (28), Northeast Normal University (26), South China Normal University (21), Southwest University (20), Peking University (16), Shaanxi Normal University, Tsinghua University and Jiangnan University (14 papers), Nanjing Normal University, Zhejiang University, Tianjin University and Capital Normal University (13 papers), Qufu Normal University and Beijing University of Technology (11 papers) and Jiangsu Normal University (10 papers). It is these institutions that carry out relevant theoretical research for the development of AI in education in China. East China Normal University has made the greatest contribution, and the teachers' colleges and universities dominate in these institutions, which is also consistent with the theme of the application of AI in education in this study. China's AI research institutions in education are diversified and flourishing. In the field of colleges and universities, Tsinghua University, Peking University and Huazhong University of Science and Technology have set up educational technology institutes, focusing on the application and innovation of AI in education. At the same time, research institutes affiliated to the Chinese Academy of Sciences, such as the Automation Research Institute, are also devoted to the research in the field of intelligent education. The integration of technology and education has been promoted. Through cross-border cooperation and international exchange, these institutions have promoted the dissemination and application of AI research results in education, and provided new possibilities and innovative directions for improving the quality of education and personalized teaching. Its continuous exploration and practice will bring positive influence on the intelligent development of China's education system.

4) *major journal*

In general, core journals are often leading the academic frontier. In recent years, AI has become a modern high-frequency word, and AI has become an important focus topic in that field of education in China. By counting the number of articles published in the journals, we can know which journals in China focus on the research of AI in education. Statistics shows that there are 20 periodicals with more than 3 papers, including 16 papers in People's Education, 15 papers in Political Teaching Reference of Middle School, 14 papers in Ideological and Theoretical Education, 13 papers in School Party Construction and Ideological Education, 11 papers in Adult Education, 10 papers in Vocational Education Forum, 10 papers in Education and Occupation and 9 papers in Heilongjiang Higher Education Research. Science and Technology Management Research, Educational Theory and Practice, Chinese Examination, Contemporary Educational Science and Vocational and Technical Education all have 8 papers. Contemporary Education Forum published 7 articles. In addition, "Publication Plaza", "China University Science and Technology" and "China Educational Science" and other journals have more articles. Research on AI in China's education field is mainly published in People's Education, Political Teaching Reference in Middle School and other journals. People's Education focuses on the

development of education technology and education informatization, provides a platform to show the application of AI in education, focuses on the field of computer technology and application, and provides an interdisciplinary perspective for the research of AI technology in education. These journals provide a platform for AI researchers in education in China to show their research achievements and exchange academic views, promote the development and cooperation in the academic field, and promote the application and innovation of AI technology in education.

5) Highly Cited Articles

Cited frequency is the most intuitive index to measure the academic influence of an article. Generally speaking, whether the article is cited reflects the academic influence of the article, and the more frequently the article is cited by peers, the greater the academic value of the article. Table 1 lists the top ten highly cited articles on AI in China's education field in recent years.

Table 1 Highly Cited Articles of AI in Chinese Education

Title of the paper	First Author	Source	Year	Unit	is cited	Download
Connotation, Key Technology and Application Trend of Educational Artificial Intelligence	Yan Zhiming	Journal of Distance Education	2017	Ludong University	583	48756
Analysis of the Present Situation, Typical Characteristics and Development Trend of the Application of Artificial Intelligence in Education	Liang Yingli	audio-visual education in China	2018	Nanjing University of Posts and Telecommunications	414	26553
Constructing the Ecosystem of "Artificial Intelligence + Education"	Wu Yonghe	Journal of Distance Education	2017	East China Normal University	379	23833
Wisdom Education: Educational Reform in the Age of Artificial Intelligence	Peijie Cao	educational research	2018	Chinese Academy of Educational Sciences	252	12603
The Transformation of Information Literacy from the Perspective of Artificial Intelligence and the Target Orientation of AI Education;	Chen Kaiquan	Journal of Distance Education	2018	Ocean University of China	236	13266
New Areas, Misunderstandings, Blind Areas and Prohibited Areas in the Application and Research of Artificial Intelligence Education	Zhang Kunying	Journal of Distance Education	2017	Huaibei Normal University	232	12520
Educational Application and Innovation of Machine Learning from the Perspective of Artificial Intelligence	Yu Minghua	Journal of Distance Education	2017	East China Normal University	214	16262
Research on a New Type of "Double Teacher Classroom" Supported by Artificial Intelligence Educational Robot	Shichong Wang	Journal of Distance Education	2019	Capital Normal University	187	11106
Research on the Development Path of the Application of Artificial Intelligence Education in the Age of Wisdom Education	Ma Yuhui	audio-visual education in China	2019	Bohai University	184	16021
Research on the Development Model and Path of "Artificial Intelligence + New Engineering" from the Perspective of Innovation and Entrepreneurship Education	Xu Tao	Journal of Distance Education	2018	Tongji University	172	7371

As shown in Table 1, the most cited application of AI in China's education field up to now is the connotation, key technology and application trend of AI in education published by Yan Zhiming in the Journal of Distance Education in 2017. The highly cited literature on AI research in China's education field usually focuses on educational technology, online learning, intelligent education system, etc. These literatures may be related to the research fields of education data mining, personalized education, intelligent assistant teaching and so on. The

highly cited documents are often published by research teams or interdisciplinary cooperation teams of well-known universities such as Tsinghua University and Peking University, which have high academic influence. These highly cited literatures play an important role in promoting the development of AI research in China's educational field, leading the academic direction, promoting academic exchange and cooperation, and provide important reference and support for the development of intellectualization in educational field.

IV. AN ANALYSIS OF THE HOT TOPICS OF AI RESEARCH IN EDUCATION IN CHINA

Select “Keyword” in the node types operation area in the CiteSpace (6.2.R1) software main view main interface, and other settings remain unchanged. Through visual analysis, there are 292 keyword nodes, among which, the number of connecting lines is 504, and the density is 0.0008. Table 2 shows the high-frequency keywords of AI in the field of Chinese education in recent years.

Table 2 High-frequency keywords of AI in education in China

S/N	Frequency	centrality	Year	Keywords
1	343	1.35	2014	artificial intelligence
2	25	0.00	2017	vocational education
3	23	0.00	2018	Education
4	22	0.02	2018	Higher Education
5	14	0.03	2017	machine learning
6	14	0.00	2017	cultivation of talents
7	13	0.00	2017	wisdom education
8	12	0.01	2017	intelligent education
9	12	0.01	2018	human-computer cooperation
10	11	0.01	2017	educational application
11	11	0.00	2017	deep learning
12	10	0.00	2019	educational reform

Table 2 shows that AI is most widely used in vocational education and higher education in China in recent years, and has been paid more attention by scholars.

Select “Burstness” interface in the control window pop-up of default view generation interface of CiteSpace (6.2.R1), adjust Minimum Duration to 1, γ value to 0.1, and click “View” button to generate sudden keyword atlas. The “deep learning” in 2017 was the most intense, followed by the “intelligence education” in 2017. According to the pop-up map of AI application keywords in the education field, the 25 generated keywords have no high burst intensity, which indicates that the research hotspot related to AI application in China's education field is scattered, and the burst keywords mainly include learning analysis, education application, machine learning and reform, indicating that the research with the above keywords as the core is the focus of recent attention. The emergence time of “Ethical Originality” is 4 years, which is relatively long, indicating that the focus on this keyword is relatively long between 2020 and 2024.

The name of cluster 0# label is vocational education, and the cluster contains keywords such as education governance, physical education, education evaluation, primary and secondary schools, maker education and education declaration. AI technology can be used to optimize the decision-making of education governance, individual physical education, intelligent evaluation of student achievement, intelligent teaching model design, maker education project management and the dissemination and promotion of educational manifesto. These applications will bring innovative changes to China's education, improve the quality and efficiency of education, and promote the development of intellectualization in education. Chen Kaiquan and others believe that the launching of new educational practices such as maker education provides sufficient preparation for the promotion of AI education. ^[1] Zhong Baichang and Liu Xiaofan believe that AI education in primary and secondary schools still faces many problems such as vague curriculum orientation. ^[2] It will be an effective way to develop AI general education guided by innovation and entrepreneurship. ^[3]

The name of cluster 1# tag is machine learning, and the cluster contains keywords such as cloud computing interactive classroom, five-education integration, knowledge atlas, learning path, intelligent literacy, blockchain visualization, information security, deep learning and intelligent education. Presents a variety of cutting-edge technology applications. These technologies support cloud-driven interactive learning, comprehensive development of five-education, personalized learning path design, intelligent literacy training, blockchain visual teaching management, information security assurance, deep learning algorithm optimization and intelligent education system construction. This cluster deeply integrates the machine learning technology with the education

field, brings the innovative application of cutting-edge science and technology for Chinese education, and promotes the intelligent development of the education field. For example, according to Wu Yinghui, AI accelerated education to develop core literacy and promote the scientific occurrence of deep learning. ^[4] Wu Di and others believe that AI enables education by deep learning. ^[5]

The name of cluster 2# label is the integration of industry and education. The cluster includes the keywords of teaching practice, intelligent era, subjectivity, development direction, reflection, transformation path, etc. These keywords point to the intellectualized transformation in educational practice, emphasizing the cultivation of subjectivity, the direction of future development, the exploration of reflective educational mode and reform path. Through the integration of production and education, education can better adapt to the needs of the intelligent era and train students with innovative and practical abilities. This cluster highlights the close relationship between educational field and industrial cooperation, and provides new ideas and paths for educational reform and innovation. Sun Lihui believes that the subjectivity of "human" should be highlighted in the decision-making of AI teaching. ^[6] Zhang Li and others believed that the application of AI in education should adhere to the rational compliance of the educational practice of the subject and cultivate the digital literacy of the educational subject. ^[7]

The name of cluster 3# label is intelligent education, and the cluster includes enabling path, intersubjectivity, education ethics, man-machine ethics, computational thinking, policy suggestion, principle, dilemma, ecosystem, future education and other keywords. and the multi-dimensional characteristics of the intelligent education are highlighted. The empowerment path focuses on how AI can empower the education field and improve the efficiency and quality of education. Intersubjectivity emphasizes the interaction and cooperation among educational subjects, and promotes the development of intelligent education together. The key words of educational ethics and man-machine ethics embody the importance of ethical values in intelligence education. The concept of computational thinking emphasizes the cultivation of students' computational ability and innovative thinking. Policy suggestions, principles and dilemma keywords provide guidance and reflection for the development of intelligence education. Ecosystem and future education look forward to the future development of intelligent education. This cluster comprehensively considers all aspects of intelligent education, and provides comprehensive thinking and suggestions for promoting the healthy development of intelligent education. Chen Lei believes that the design thinking of the "AI + teacher education" ecosystem should be studied in depth. ^[8]

The name of cluster 4# label is man-machine collaboration, and the cluster contains keywords such as medical education, task substitution, skill substitution, teaching, ethical strategy, core literacy, information literacy, etc. This cluster focuses on the integration of intelligent technology and education, and emphasizes the construction of enabling path, the interaction between subjects, the discussion of educational ethics and man-machine ethics, the cultivation of computational thinking, the formulation of policy suggestions, the following of principles, the coping with dilemma, the construction of ecosystem and the prospect of future education. These keywords reflect the complexity and challenges in the field of intelligent education, provide important reference and direction for educational decision makers and researchers, and promote the future development of Chinese education towards intellectualization and sustainable development. Some believe that programming ability, computational thinking and deep cognition of intelligent society have become important contents of students' information literacy in the age of AI. ^[9]

The label name of cluster 5# is higher education, and the cluster contains keywords such as teaching reform, algorithm value education, personalization, education essence and big data. It highlights the importance of AI in the field of higher education. This cluster discusses how to promote the reform of teaching mode, improve the quality and efficiency of education and realize the goal of personalized education with the aid of AI technology. The concepts of algorithm value education, education essence and big data in the keywords emphasize the application of data-driven algorithm analysis in higher education, mining the education essence and providing better support for personalized learning and teaching. This clustering provides the direction of intellectualized development for higher education institutions, and promotes the innovation and optimization of education and teaching. Li Aixia et al. analyzed the technical architecture of education data center from the aspects of education data collection layer, data storage layer, data development layer, data service layer and data governance layer. ^[10]

The name of cluster 6# label is education, and the cluster contains keywords such as technical logic, ethical dilemma, value conflict, ethical norms, learning theory, frontier, value judgment, boundary, development stage, humanistic education, natural intelligence, etc. This cluster explores the application and influence of AI in education. The ethical dilemma, value conflict and ethical norms in the key words reflect the moral and ethical

challenges that AI education faces, and put forward some thoughts on how to deal with ethical problems in education. At the same time, the concepts of learning theory, humanistic education and natural intelligence emphasize the essence of education and the importance of humanistic care in the age of AI. This clustering provides comprehensive thinking and guidance for the application of AI in education, and leads the development of education towards more intelligent and human culture. Zhao Leilei and others pointed out that the ethical dilemma of responsibility for risk management of education AI is mainly reflected in the fact that the function of education subject encounters the restriction of technology, and data intelligence overrides the spirit of contract.^[11]

The name of the cluster 7# label is labor education, and the cluster contains keywords such as intrinsic game, labor literacy, labor spirit, labor quality and the like. It highlights the importance of labor education in the age of AI. This cluster emphasizes the cultivation of students' labor literacy and spirit through labor education, and promotes the students' all-round development. The internal game in the key words reflects the interaction and coordination between the internal and external environment of the individual in labor education. Labor quality and labor spirit emphasize the importance of labor for the cultivation of students' character and ability. This clustering provides a new perspective for the introduction of AI technology in education, realizes the improvement of students' overall quality through labor education, and promotes the innovation and development of education and teaching mode. Zhang Jiajun and Lv Hanxue believe that it is necessary to cultivate intelligent new workers with labor literacy in the age of AI.^[12]

Cluster 8# label name is basic education, and the cluster contains keywords such as international organization, ethical policy, education, innovation, basic education, etc. It highlights the importance of AI in the field of basic education. This cluster focuses on the role of international organizations in basic education and discusses the guidance and standardization of ethical policies for AI education. The concepts of excellence and innovation emphasize the use of AI technology to provide students with individualized learning paths and promote the development of innovation ability. Key words of basic education embody the great potential of AI in improving the quality and efficiency of basic education. This clustering brings new development opportunities to the field of basic education and provides more possibilities and directions for educational reform. According to Li Zhengtao, the application of ChatGPT in basic education is "legislation" to establish educational law, including educational values and educational thinking.^[13] The research on AI curriculum mainly focuses on the curriculum construction of AI curriculum, the teaching strategy of AI curriculum, and the teaching practice of AI curriculum.^[14] Teachers, students, schools, society and enterprises make use of multiple resources to enable AI in basic education and teaching.^[15]

The tag name of cluster 9# is man-machine co-education, and the cluster contains keywords such as development trend, man-machine symbiosis, etc. It highlights the importance of mutual cooperation and common development between human and machine in education. This cluster explores the future direction of AI and education, and emphasizes the key role of man-machine symbiosis in improving the quality of education and teaching efficiency. The development trend keyword reflects the continuous evolution and innovation of man-machine co-education in education. The man-machine symbiosis emphasizes the combination of AI technology and educational practice to build a more intelligent and personalized learning environment. This clustering provides a new cooperation mode and development direction for the education field, promotes the integration of education and technology, and promotes the progress and innovation of the education industry. Zhang Xuejun and Dong Xiaohui put forward that man-machine symbiosis is the natural choice in the age of AI.^[16] The construction of new engineering subject with "AI +X" as the core will lead the development of education in the direction of online, quantitative, personalized and intelligent.^[17] Through effective integration between robotics learning and education, more help can be given to the education industry in terms of scene technology innovation.^[18] AI and big data technology transform the traditional education model into a new model.^[19] Computer vision and intelligent voice control and other technologies make the early teaching robot convenient for human-computer interaction, so as to be more humanized.^[20]

V. RESEARCH CONCLUSION AND PROSPECT

In this paper, CiteSpace (6.2.R1) is used to visually analyze the literatures related to the application of AI in education in the core database of China National Knowledge Infrastructure, including time distribution, statistical analysis of researchers and research institutions, high-frequency keyword analysis, keyword centrality analysis, keyword mutation analysis, keyword clustering and time line analysis.

A. Mutual Structure of National AI Policy and Future Education Research

The number of papers published on AI-related research in China's education field is generally growing steadily. Among them, 1998-2016 is in a period of slow growth. Since 2017, the number of relevant literatures has gradually increased. However, in general, the number of relevant papers published in this field is relatively low. Therefore, it is necessary to appeal for more relevant researchers or interdisciplinary researchers to join and promote the improvement of AI research work in education. The development of AI in education is a national trend in the future. The researchers concerned should pay close attention to the current policy orientation and strategic situation. The relationship between national AI policy and future education research is inseparable. National AI policy not only shapes the development direction of education field, but also influences the content, method and goal of future education. The state has formulated policies to support the development of AI, provided technical support and application scenarios for the education field, and promoted the innovation and upgrading of education and teaching models. At the same time, future education research also provides theoretical basis and practical experience for national AI policy formulation. The achievements and trends of education research provide important reference for policy makers, help them grasp the education demand and development direction more accurately, and promote the organic combination of AI technology and education. The cultivation of programming ability of teenagers has become a new focus of wide concern. Therefore, the relationship of mutual promotion and mutual support has been formed between the national AI policy and the future education research, jointly promoting the integration and development of the education field and AI technology, and providing a solid foundation and strong support for the cultivation of new talents meeting the needs of the future society.

B. Building a three-dimensional structure of researchers, research institutions and policy promoters

First, the low spectral density between the investigator and the research institution indicates that the cooperation between the investigator and the research institution is not close. Secondly, in terms of region, the research institutions and research objects are still mainly distributed in normal colleges and universities, and other universities or private enterprises are rarely studied. Based on the above, we need to call for strengthening the cooperation among research institutions, researchers, research institutions and researchers, and even cross-institutional cooperation. In education in China, the application of AI is gradually constructing a three-dimensional pattern including researchers, research institutions and policy promoters. Researchers play a key role in the research of AI education. They are dedicated to exploring how AI technology can better serve the education cause and promote the innovation and improvement of teaching methods. Through continuous research and practice, the researchers provide theoretical support and practical experience for the application of AI in education. Research institutions play an important role in this three-dimensional landscape. These institutions have the responsibility of integrating and supporting researchers to promote the deep integration of AI technology and education. Through fund support, project management and resource integration, research institutes provide a solid foundation and support system for the development of educational AI. The policy implementer plays the role of decision-maker and guider in this three-dimensional pattern. They formulate and promote relevant policies to guide the rational application of AI technology in education, and regulate and supervise the development of AI education. The role of policy implementers is to ensure that the application of AI in education can conform to ethical norms, promote education equity and improve education quality. This mode of multi-cooperation and coordination provides a solid foundation for the development of AI education, and promotes the direction of intellectualization, personalization and high efficiency in education. In the future, this three-dimensional pattern will continue to play an important role in promoting the further innovation and development of AI in China's education field.

C. Focus on high-quality, scientific and cross-disciplinary development of AI application in education field

The high-quality, scientific and comprehensive development of the application of AI in education is related to the future of education. High-quality AI applications need to realize personalized teaching, intelligent evaluation and other functions based on big data and intelligent algorithms to improve teaching efficiency and quality. Scientific development requires the combination of cognitive science, educational psychology and other multi-disciplinary knowledge to deeply study the effective application of AI technology in education and promote the innovation of teaching methods and technologies. Cross-disciplinary development requires the cooperation of experts in education, computer science, psychology and other fields to explore the organic combination of AI technology and education, promote interdisciplinary fusion and improve the level of education and teaching.

Such comprehensive development will stimulate education innovation, cultivate students' comprehensive ability, promote education equity and tolerance, and help build a talent team to meet the needs of the future society. Through the high-quality, scientific and cross-field comprehensive development, the application of AI in education will provide a wider space for teaching reform and learning, and promote the continuous development of education.

D. AI in education should pay attention to diversified research combining qualitative and quantitative

At present, the research on AI in education in China is in a macroscopic way, and most of the researches mainly focus on the significance, strategies and approaches of popularization. In education, the application of AI should pay attention to the combination of qualitative and quantitative diversified research. Qualitative research can deeply explore the details and cognitive mechanisms behind the teaching process, which is helpful to understand students learning needs and teachers' teaching strategies. At the same time, the quantitative research can reveal the specific indexes such as teaching effect and learning achievement through data analysis and statistical methods, and provide objective basis for educational decision-making. The combination of qualitative and quantitative can make the research more comprehensive and in-depth, not only pay attention to case and detail, but also have universality and falsification, which is helpful to reveal the actual effect and application path of AI technology in education. Diversified research methods can also promote interdisciplinary research and innovation. By combining qualitative and quantitative research methods, it is helpful to reveal the influence of AI technology on education and teaching. Promoting sustainable development in education through the application of AI.

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