Metrological Research on the Application Literature of AI Education in China: 2009-2019

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Abstract. Based on the CSSCI (Chinese Social Sciences Citation Index) full-text database of CNKI, this paper selects 468 journal articles on the application of AI in education from 2009 to the present. Based on the measurement visualization software CiteSpace, the data mining and content analysis are carried out, and the in-depth analysis is carried out from six aspects: the overall trend, core authors, research institutions and fund distribution, research hotspot, evolution trend and research clustering, etc. It also shows the research situation in the field of AI education application in recent ten years by means of tables and visual knowledge maps, which can provide important reference for researchers in this field.

1. Introduction
The world today is in the period of dramatic technological transformation driven by artificial intelligence (AI). The continuous development and maturity of AI technology, put education on the wave of AI. The close connection between AI and education has become the status quo of the times, and the deep integration of the two has become the future development trend. As intelligence becomes a new feature of the development of educational informatization, the influence of AI on education is increasingly prominent. It is necessary to sort out the emerging research results in order to objectively show the research status in this field.

2. Research Design

2.1. Data Sources
The core literature often has a certain representativeness in a certain research field, and to some extent reflects the research hotspots and research trends in this field. The authors tend to have a high academic level, and the angle of analysis of the problem is relatively new and has a greater impact. This study conducts cross-database search through China Knowledge Network (CNKI). The search conditions are set to: journal source category CSSCI journals, the subject or title is AI, and the topic or title is called education. The time interval is set to 2009 to 2019, and the retrieval time is On June 5, 2019, the total number of documents searched was 531, and the obtained documents were cleaned up, and no invalid data such as no authors, no keywords, meeting notices, magazine essays, etc., were obtained, and finally the research on the application of AI education was obtained. A total of 468 articles.

2.2. Research Methods
This paper firstly collects the data obtained from CNKI through Excel, and combines the
comprehensive index method to determine and analyze the core authors. Secondly, the data exported from CNKI is outputted by Citespace to identify the converted format "Refworks" and saved. The Citespace software developed by Chen Chao-mei is used to convert the collected data into a format that can be analyzed and processed to realize document visualization analysis. Through cluster analysis method, keyword cluster co-occurrence, hotspot cluster co-occurrence, literature research trend and other analysis, generate visual analysis map, and detect the research characteristics and development trend of AI education application.

3. The Research Results and Analysis

3.1. Overall Trend Analysis
Based on the number of documents in the CSSCI database of CNKI, we know that the core literature of AI education can be roughly divided into two stages since 2009: The annual volume of the core literature from 2009 to 2017 is very stable, with no substantial increase in quantity; The number of documents increased exponentially from 2017 to 2018. It can be seen that since the beginning of 2016, the application of AI in the field of education has been rapidly developed, which has attracted more and more scholars' attention. Since the deadline for document retrieval is June 2019, the amount of publications this year cannot fully reflect the AI in China. The actual situation of domain applications.

3.2. Core Author Assessment and Statistical Analysis
The core author is the backbone of promoting academic innovation and discipline development in a certain research field. It has two basic characteristics: irreplaceable importance and outstanding influence in the discipline. Usually, there are two ways to determine the core author: one is based on the author's published volume, generally based on Price's law; the second is based on the author's quotation to determine, generally determined by the "H" index. What is revealed by Price's law is to find the so-called "core" authors from the perspective of the volume of publications, and to reflect the scientific research output and activity of scientists in this field by paying attention to the "quantity" of scientific research results in a certain field. The H index is used to evaluate the individual academic performance of the researcher. It means that there are h articles in the N articles published by the author, at least each of which is cited no less than h times. The h value is the author's h index, but this method is only effective for the author's single literature contribution value, and it is difficult to evaluate the author's overall situation in the field. Zhong Wenjuan based on the above two indicators, from the "quality" and "quantity" two perspectives proposed a comprehensive index method, based on this method for statistical analysis.

3.2.1 Evaluation of the core author candidate. First, according to Price's law, the lower limit of the core author's published volume can be represented by $N: N = 0.749 \times \sqrt{N_{\text{max}}}$. N is the lower limit of the number of articles issued by the core author, and $N_{\text{max}}$ is the number of articles issued by the highest-produced author. According to the literature data retrieved, the most published articles are Professor Zhu Zhiting and Professor Huang Ronghui, a total of 7 articles; can be obtained by Price's law, $N=1.98$, can be identified as authors of core authors with 2 or more articles People. The AI education application paper has a citation frequency of up to 165 times. According to Price's law, $N=11.5$ is obtained, and those with a citation frequency of 12 or above are determined as core author candidates. As a result, there are 32 people as the AI education application candidates, with a citation frequency of 12 or above are determined as core author candidates. As a result, there are 32 people as the AI education application candidates according to these two criteria, with a total of 117 articles, accounting for 25% of the total CSSCI database in the field. The core author candidate article has been cited 2,903 times, accounting for 62.7% of the total citations. From the above data, we can see that the core author candidate made an important contribution to the research field of AI education application.

3.2.2 Core author assessment. Zhong Wenjuan introduced two evaluation indicators, namely, the publication index X and the cited index Y, in the comprehensive index method proposed by it. The publication index X is expressed by the average value of the core author candidate, The value of X is
The cited indicator Y is represented by the citation of the core author candidate article, The value of Y is 90.7. Using the correlation function, The correlation coefficient is 0.56193.

The scatter plot reflects the strong correlation between the number of posts and the citation frequency. The more the authors send more, the higher the citation frequency. In order to further determine the core author, the same amount of weights and citations are given, and the composite index Z of the core author candidate is obtained:

\[
Z_i = \left( \frac{x_i}{\bar{x}} \times 100 \right) \times 0.5 + \left( \frac{y_i}{\bar{y}} \times 100 \right) \times 0.5
\]

Among them: \(x_i\) is the number of articles issued by the candidate, \(\bar{x}\) is the average number of articles, \(y_i\) is the citation frequency, \(\bar{y}\) is the average frequency of the cited frequency.

3.2.3 Evaluation results. According to formula 2, the comprehensive index of each core author candidate can be calculated separately, and the researchers with the comprehensive index value above 50 are identified as the core authors, a total of 27.

Through the analysis of the core authors, we can find that on the one hand, a group of core authors with great influence have been presented, and outstanding contributions have been made in this field. Among them, there are many well-known experts in the field of education technology, such as Huang Ronghui, He Kekang, Zhu Zhiting, Zhang Jianping, Chen Li and other well-known university professors; also include educational information centers, research institutes of audio-visual halls, such as Wang Tongju and Song Lingqing. It can be seen that the talents in the field of AI education have a strong scientific research continuity. On the other hand, there is a lack of high-level AI teachers in primary and secondary schools with demonstration leadership. The AI education service is mainly for middle and primary school students. The frontline teachers have a stronger awareness of the students' learning needs, but the core authors in this field are mainly professors from well-known normal colleges or educational information centers or audio-visual halls. The teacher rarely sees the figure. Therefore, as the cornerstone of the cultivation of talents in the intelligent era, primary and secondary school teachers should cultivate an AI teacher team with demonstration and leading role, and promote the integration of new ideas, new methods and new technologies of AI education into primary and secondary classrooms. [5]

3.3. Fund Distribution and Research Institutions

3.3.1 Fund distribution. As an important part of scientific research, research funds play a vital role in effectively promoting the progress of scientific research. According to the analysis results, the National Education Science Planning Project, the National Social Science Fund, and the National Self-Funded Fund are among the top 3, occupying an absolute dominant position. It can be seen that the support of the National Fund is still the main driving force for new research progress and research results in this field.

3.3.2 Research institutions. The research in this field is mainly concentrated in colleges and universities, and the normal colleges and universities clearly occupy the main position, reflecting the educational research advantages of normal colleges. Among them, the largest number of documents is East China Normal University, a total of 45, followed by Beijing Normal University, a total of 40, Northeast Normal University, 15 ranked third. In addition, there are 468 articles from 331 institutions, and the coverage of the organization is very wide. On the one hand, it reflects the research on the application of AI education, and on the other hand, it reflects the lack of systematic and continuous research of most research institutions.

3.4. Hot Spot Analysis of AI Education Application Research

The key words are the high conciseness of the article, which can reflect the core content of the article, and the degree of relevance between the keywords can reflect the intrinsic relationship between the knowledge in the research field. Therefore, it is possible to explore the research hotspots in this field.
by conducting keyword frequency and central analysis on the research literature of AI education application fields.

Using the keyword frequency analysis function of Citespace software, we can get the keyword frequency table with the highest frequency ranking. It can be seen that apart from the core keyword “AI”, the differences between other major keywords are not significant.

The centrality of Citespace can be used to characterize the research hotspots, and the larger the value, the higher the heat of the study.

Based on the above analysis results, we can see that the display of keywords is hotspot, such as AI, intelligent education, personnel training, robotics, personalized learning, educational informatization 2.0, and human-machine collaboration is more prominent.

3.5. Analysis of the Evolution Trend of AI Education Application Research

In order to further analyze the evolution trend of AI education, the time zone view function of Citespace software can be used to obtain the key time zone information analysis map, as shown in Figure 1.

![Figure 1. AI education application keyword time zone information analysis](image)

From the map, we can see the co-occurrence status and appearance time of each keyword, and then reveal the actual development trend of AI education application. According to the keyword time zone information analysis, the sudden emergence of keywords in each time period can clearly see that the evolution trend of AI research in China in 2009 can be roughly divided into three stages.

The first stage (2009-2013). The hot keywords at this stage mainly include robot and robot education, focusing on the development of robot technology and the application of robots in education. The development of AI technology represented by robots in this period is a new environment facing the education industry. Educators should take the initiative to adapt and guide students to learn the basic knowledge of robots through the learning platform of intelligent robots, and at the same time, strive to improve students’ interest and motivation.

The second stage (2014-2016). Hot keywords mainly include big data, MOOCS, etc. It mainly discusses the development of AI, which promotes the application of big data technology in education and the value and role of big data for education. It shows that big data can not only directly affect the teaching of teachers and students, but also support the decision-making of the entire education system. At the same time, during this period, big data has greatly innovated in the education mode, teaching methods and school management mode at all levels of education, and has achieved considerable research results both in theory and in practice. For example, in terms of education model, many scholars and experts advocate MOOCS, Khan Academy and other educational models, rely on online education platform to collect educational data and provide personalized services for students, and think that MOOCS is the dawn of future education.

The third stage (from 2017 to the present) is a peak period of AI technology development. Key words include personalized learning, wisdom education, deep learning, learning analysis, and precision teaching. 2017 is called the first year of AI. In this period, the research results of AI in the field of education emerge in endlessly, especially in the study of AI on education theory. The
academic circles agree that the ultimate value goal of education is to realize the individualization, accuracy and efficiency of education by using AI technology.

3.6. **AI Education Application Research Cluster Analysis**

In this paper, the keyword network is clustered by log-likelihood algorithm, and the feature words with the highest operator value in the research field are clustered words, and 6 clusters are obtained. They are MOOC, education informatization 2.0, in-depth learning, learning analysis, computational thinking, and personalized education. As shown in Fig.2.

![Figure 2. Key words clustering analysis visualization map](image)

**MOOC.** The characteristic words under the cluster include MOOC, precision teaching, AI technology and so on. As MOOC charges have become a trend, AI technology can free MOOC teachers and other staff from simple, repetitive, and mechanical labor, alleviate capital investment in MOOC operations, reduce operating costs, and contribute to solution for free course content.[6]

**Education.Informationization2.0.** The characteristic words under the cluster include educational informatization 2.0, education ecology, education modernization, and wisdom education. Zheng Xudong believes that the current education ecosystem is based on AI as the core of the wisdom education 2.0 era, which can effectively coordinate the relationship between technology application and wisdom personnel training, education governance, and social needs. This has greatly promoted the steady construction of a harmonious education ecosystem. [7]

**Deep learning.** The feature words under the cluster include deep learning, personalized learning resources, and neural networks. Li Haojun’s personalized learning resource recommendation method using deep neural network design can effectively judge learners' different attention and learning preferences for various learning resources, and recommend personalized learning resources for learners. [8]

**Learning analysis.** The characteristic words under the cluster include learning analysis, personalized learning, educational big data, and adaptive learning. Based on the analysis of domestic research and analysis, Professor Qingtang Liu believes that learning analysis in the context of educational big data includes learner data and learning environment. [9] The collection of educational big data, data analysis and evaluation, and the prediction and intervention of students' learning status on the basis of evaluation, and finally achieve the goal of personalized learning and adaptive learning. Computational thinking. The characteristic words under the cluster include computational thinking, computer, problem solving and so on. American computer educator Papert thinks that computational thinking is a way of clarifying opinions by means of computational representation, and pointed out that students can learn to learn and master learning methods while developing problems through computers, and then develop their own abilities, while emphasizing Programming activities can exercise people's thinking. [10]

**Personalized education.** The characteristic words under the cluster include personalized education, test-related network, test recommendation system, and scientific and technological revolution. With the advent of AI and big data era, a new round of scientific and technological revolution has begun, which has injected vitality into personalized education and is conducive to solving educational problems such as individualized learning and independent learning. For example,
4. Conclusion
This paper uses Citespace metrology visualization analysis software to analyze the research results of AI education in CSSCI database in China, and tries to provide reference for researchers by means of intuitive diagrams, and puts forward the following suggestions:

4.1. Improve the Level and Quality of Research Results.
It can be seen that the articles in the field of AI education are not high in general. Lack of academic influence. it is urgent for educational technology people to combine AI technology on the development of AI in the field of education to achieve a profound and long-term development of education.

4.2. Identify the Point of Convergence Between AI and Education.
Education reform and innovation must fully understand the application of AI technology, explore the laws of education and improve the quality of education through the intelligent processing of education information, realize the purpose of promoting education equity projects such as distance education through the support of intelligent equipment, provide appropriate services for the education process, and promote the realization of many goals. At the same time, the application of AI in the field of education should conform to the law of education, take the improvement of students' ability as the premise, avoid the blind worship of AI, and educational information workers should have continuous control over the intervention of AI in the field of education, meet the internal demand of AI in the field of education, and realize the sustainable development of AI in the field of education.

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