Research Status and Prospects of Artificial Intelligence Technology Applied to Education and Teaching

-- Based on CiteSpace visual analysis

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Abstract. Education is moving towards the era of intelligence, and the integration of AI technology and education has become an important trend for future educational changes. In order to effectively promote the application of AI technology in education teaching, we need to correctly grasp the development of AI technology. The article uses CiteSpace software to visualize and analyze the sample data, and uses subject search to analyze the journals related to AI technology and education teaching from 2010 to 2022 included in China Knowledge Network. Based on the analysis of the number of literature publications, research hotspots and research institutions, conclusions are given, corresponding reflections are proposed, and the research themes and trends of AI technology applied to education and teaching in China are summarized. It is found that the overall trend of the number of publications is on the rise, and the research on the combination of AI technology and education teaching is influenced by various technological developments and policies.

Keywords: Artificial intelligence technology; Education teaching; Application.

1. Introduction

Since the birth of artificial intelligence with big data as the core, the theory and technology have continued to mature and develop, and the scope of application has been expanding. Applying artificial intelligence technology to education teaching and promoting deep change and innovation in education teaching is a common research topic in the education sector at present. Artificial intelligence technology builds a new system of intelligent interactive learning by creating an intelligent educational environment and conducting intelligent educational evaluation.

With the leapfrog development of computer computing speed, artificial intelligence technology has also ushered in a new wave under its impetus, leading the era from traditional informatization to modern artificial intelligence [1]. The combination of AI technology and education not only caters to the inevitable needs of social development, but also meets the development needs of educational reform. The importance of AI technology in education teaching has been emphasized in several national policies and regulations, and in the "Thirteenth Five-Year Plan for National Education Development" promulgated by the State Council in 2017, it was pointed out that intelligent technology is used to explore new models of future teaching[2], and in the "Education Informatization 2.0" released by the Ministry of Education in 2018, the importance of AI technology in education teaching has been emphasized. The application of AI in teaching is emphasized in the Action Plan of Education Informatization 2.0 released by the Ministry of Education in 2018[3]. Currently, the combination of AI technology with the field of education allows for better development of education and teaching, and the use of AI technology enables better implementation of teaching according to the needs of the students and promotes their overall development. The combination of artificial intelligence technology and education teaching is gradually promoted to arise with the development of social economy and the progress of scientific and technological information [4].

The application of AI technology in the field of education can adopt advanced education and teaching methods in the education process, create a good learning environment, improve the quality and efficiency of teachers' teaching and students' learning, and have far-reaching significance in promoting education reform and development and education modernization [5]. Therefore, in order

to further clarify the research status, research hotspots and possible future development directions of AI technology applied to education teaching, this paper uses Citespace and visualizes and analyzes 379 articles downloaded from China Knowledge Network to show the research situation of AI technology applied to education teaching, so as to provide reference and reference for researchers to understand AI technology applied to education teaching This paper provides a reference for researchers to understand the application of AI technology in education teaching.

2. Research tools and data sources

2.1 Research Tools

In this paper, we use CiteSpace software for the analysis of literature related to intelligent teaching systems.CiteSpace software is able to present the structure, laws and distribution of scientific knowledge by visualization [6].CiteSpace can detect the hot topics and their evolution in a discipline or field [7]. Compared with the traditional literature review, scientific knowledge mapping enables researchers to see the knowledge and research hotspots of the field under study more clearly and intuitively, making it easier to understand the field and to have a better grasp on the future direction of the field.

2.2 Data source

In this paper, the research object is "artificial intelligence technology" and "education teaching" as the search theme, and the whole literature was selected from January 2010 to June 2022. 379 articles were analyzed. This study mainly analyzes the keywords, authors and issuing institutions of the literature related to the application of artificial intelligence technology in education teaching.

3. Spatio-temporal knowledge mapping and analysis of domestic artificial intelligence technology applied to education teaching

3.1 Temporal distribution mapping of domestic AI technologies applied to education and teaching

By analyzing the number of publications in a certain research area, the development trend and the level of research enthusiasm of that research in each time period can be clearly derived [8]. In this study, we analyzed the number of publications in journals related to the research content in China Knowledge Network for thirteen years from 2010 to 2022, and the analysis of Figure 1 revealed that the number of publications generally showed an upward trend after 2017.

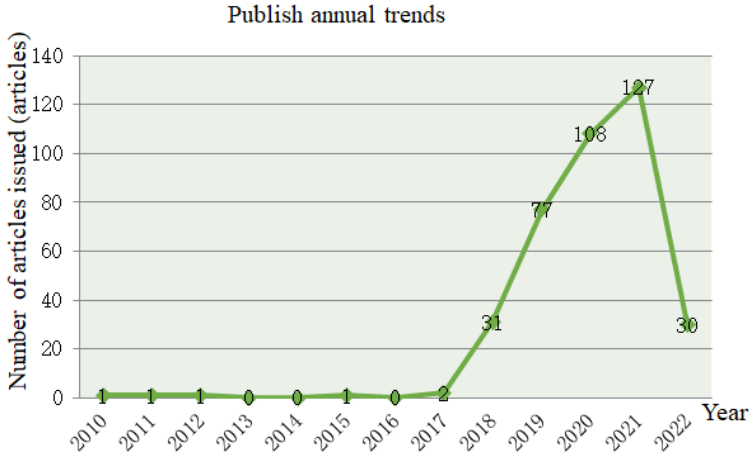


Figure 1. Statistics of literature issuance

As can be observed from Figure 1, the development of domestic research on the integration of AI technology into education teaching was slow during 2010-2017, and the development of research on

the combination of AI technology and education teaching was faster after 2017, which indicates that the application of AI technology in education teaching research has gradually attracted the attention of the majority of scholars. With the development of AI technology, the combination of AI technology and education teaching has gradually become a trend due to the wide application of AI-related technologies such as the Internet of Things, big data, learning and analysis in the field of education. On the other hand, it is also due to the support and guidance of national policies and regulations that the application of AI technology to education teaching is also developing faster.

3.2 Spatial distribution of artificial intelligence technologies applied to education teaching in China

The integration of artificial intelligence technology into education teaching has been a trend, and in order to understand the cooperation between different research institutions in this research area, the distribution of this research content in different research institutions can be obtained by using the analysis of literature. From the literature analysis, it can be concluded that the number of articles issued by the School of Educational Information Technology of South China Normal University, Jitang College of North China University of Technology, the Department of Educational Information Technology of East China Normal University, Shanghai Normal University, and the Academy of Educational Sciences of Huazhong University of Science and Technology are more, and these institutions belong to more developed regions, which indicates that the development of a certain research field has a great relationship with the local economic development and policy support. It can also be concluded that these schools have more in-depth research on the application of AI technology to education teaching and have contributed to the research on the application of AI technology to education teaching.

3.3 Analysis of core authors of literature

The Citespace software analyzes the authors of the selected multiple papers, which can be intuitively derived from which scholars are leading in that research area, and the size of the author name node represents the number of published papers by the author, and the larger the number of published authors, the larger the name is displayed [9]. The author collaboration network graph analyzed by Citespace software is shown in Figure 2.

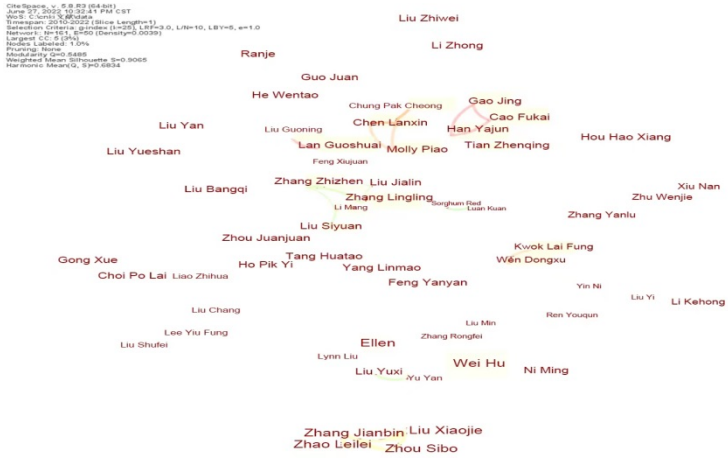


Figure 2. Author cooperation network diagram

From the figure, we can see that the authors with more publications are: Wei Hu, Lingling Zhang, Zhizhen Zhang, Jing Gao, Fukai Cao, Yajun Han, Guoshuai Lan, Guoning Liu, Mang Li, Yanlu Zhang, etc. From the connection between the nodes of the authors' names, it can be seen that only a relatively small number of domestic scholars have conducted collaborative research in this field, indicating that China has not formed a core research group in the study of AI technology applied to education teaching, indicating that AI technology applied to education teaching still needs to be studied by scholars at a deeper level.

4. Analysis of research hotspots and research frontiers

4.1 Keyword-based analysis of research hotspots

The keywords in a paper are of practical importance in addressing the central content of the paper. In many papers, keyword analysis can be performed to obtain the frequency of keyword occurrences in a given field in a specific time interval, and to rank them by frequency, so that the research dynamics and research hotspots in the field can be obtained visually [10]. In this paper, the keyword analysis was performed using CiteSpace software, which resulted in the keyword co-occurrence mapping (Figure 3). A summary of the selected keyword categories with a high number of occurrences in the literature is presented in Table 1 on the basis of the CiteSpace software.

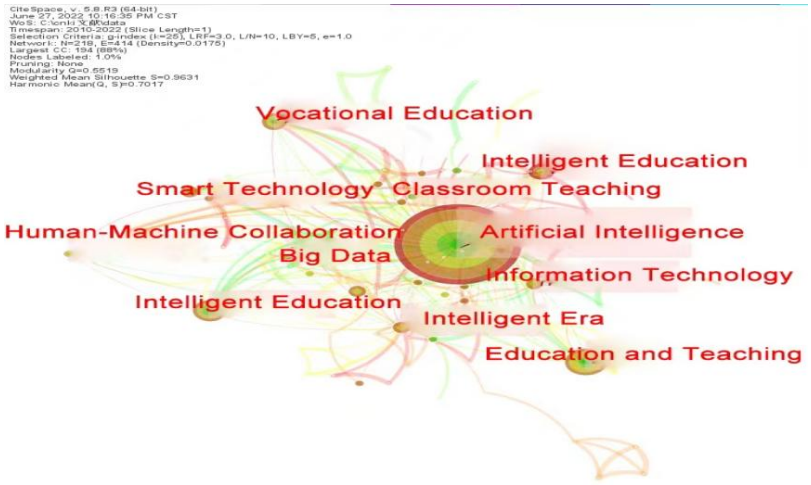


Figure 3. Keyword co-occurrence chart

As shown in Figure 3, the top 11 keywords are "artificial intelligence," "education teaching," "classroom teaching," "big data," "human-computer collaboration," "smart technology," "vocational education," and "professional education. ""human-computer collaboration", "intelligent technology", "smart education", "vocational education ""Information Technology" "Smart Age". From this figure, it can be seen that artificial intelligence technology and education teaching are the most frequent keywords among the 379 selected documents. With the progress of science and technology, the development of artificial intelligence has become faster and faster, and the use of artificial intelligence technology in education is conducive to improving teaching efficiency. The use of AI in teaching allows teachers to improve teaching and better impart knowledge to students. From the figure, we can see that the keyword network density is 0.0175, and the structure of the keyword co-occurrence network is tight and loose. This indicates that in the future research institutions need to cooperate closely and the research content needs to be deep and focused.

From the figure, it can be seen that the current education teaching and classroom teaching are closely related to artificial intelligence. The close combination of artificial intelligence technology and big data resources with the field of education and teaching can bring a lot of convenient benefits to teachers and students, and pay more attention to the development of comprehensive quality and individualized potential of students [11].

According to the keyword frequency and centrality summary table, the keywords with high frequency in the related research literature are mainly artificial intelligence, education teaching, intelligent education, vocational education, information technology, intelligent education, and intelligent era. It can be seen that the integration of artificial intelligence technology in education teaching is a hot spot for research. With the progress of science and technology, the development of artificial intelligence is also getting faster and faster. Applying artificial intelligence to education and teaching can enable teachers to improve teaching, better impart knowledge to students, enable students to learn better, stimulate students' enthusiasm for learning, make students more interested in learning, and thus improve their grades and abilities in various aspects.

Table 1. Summary of keyword frequency and centrality

No	Keyword	frequency	centrality	No	Keyword	frequency	centrality
1	Artificial Intelligence	214	1.40	11	Smart Technology	7	0.04
2	Education and Teaching	25	0.02	12	Big Data	6	0.07
3	Intelligent Education	18	0.10	13	Teaching and Learning Transformation	6	0.05
4	Vocational Education	16	0.04	14	Strategies	5	0.01
5	Information Technology	15	0.08	15	Primary and Secondary Schools	5	0.02
6	Intelligent Education	14	0.05	16	Teaching Strategies	5	0.05
7	Smart Era	11	0.17	17	Smart Classroom	4	0.01
8	Applications	9	0.02	18	Smart Campus	4	0.02
9	Human-Machine Collaboration	9	0.04	19	Response Strategies	3	0.02
10	Classroom Teaching	7	0.01	20	Teaching Practice	3	0.01

4.2 Analysis of Research Hotspots Based on Keyword Clustering

The keyword clustering function of CiteSpace can clarify the hotspots and trends in some research areas [12]. CiteSpace software is used to cluster and analyze the keywords of literature data, and the keyword clustering mapping can be obtained as shown in Figure 4.

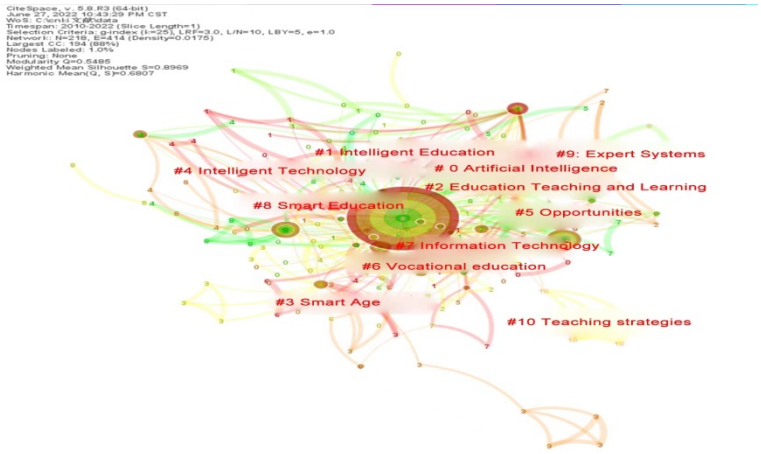


Figure 4. Keyword co-occurrence clustering mapping

From Figure 4, we can see that the frequency of artificial intelligence, intelligent education, education teaching, and intelligent technology is high. The development of artificial intelligence technology has brought great influence to the aspect of education and teaching, and the application of artificial intelligence technology to the field of education and teaching is of great help to education and teaching. The state has issued some policies and regulations for integrating AI technology and education teaching, and strongly supports the development of AI. It shows that it is very important to integrate AI technology into education teaching, which is of great help to the improvement of education teaching quality and can bring convenience to teachers' teaching work, make students more interested in learning and better personalized education.

4.3 Analysis of research frontiers based on keyword emergence

Research frontier refers to "a set of emergent dynamic concepts and potential research problems", while emergent words refer to words that are frequently cited or appear frequently in the relevant literature [13]. In a certain period of time, emergent words can be used as one of the criteria for judging and predicting research frontiers [14].

In this study, CiteSpace was used to analyze and explore the emergent words in the sample data of relevant literature in the field of AI education research, and 11 emergent words were obtained (as shown in Figure 5), namely "educational technology," "intelligent agent," "expert system," "smart campus," "coping strategy," "teaching and learning," and so on. "higher education" and so on.

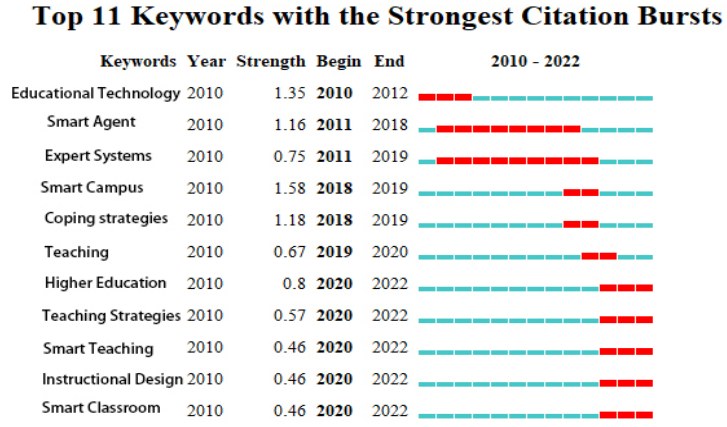


Figure 5. Mapping of emergent words

In the study sample data, the research on educational technology gradually developed from 2010; intelligent agents and expert systems gradually developed from 2011; smart campus also began to develop in 2018; smart teaching and smart classroom began to appear in 2020. From the intensity of keyword emergence, it can be seen that "smart campus" is the most emerged keyword, followed by "educational technology" and "intelligent agent".

With the increasing maturity of AI technology, AI technology has developed rapidly with its powerful data processing and analysis capabilities and learning abilities. Combining AI technology with intelligent campus construction and exploring its wider and deeper application in campus informatization construction will be the future development trend [15].

With the rapid development of China's modernization process, the application of AI technology has become more widespread, and the popularization of AI technology in the field of education and teaching can not only solve many problems that exist in the traditional teaching process, but also comprehensively innovate the teaching mode and teaching concept, and promote better development of education and teaching [16].

5. Research Conclusions and Reflections

5.1 Research Conclusion

In this paper, we analyzed the relevant literature in China Knowledge Network by using Citespace with the research purpose of artificial intelligence technology and education teaching. It can be learned that with the in-depth use of artificial intelligence technology in the field of education and the successive introduction of national regulations and policies, the future research combining artificial intelligence technology and the field of education and teaching will continue to flourish. The article conducted a systematic visual analysis of the research on AI technology applied to education and teaching from January 2010 to June 2022 to draw the following conclusions:

First, from the number of articles published, the research on AI technology applied to education and teaching has increased substantially from 2017 and has a significant upward trend year by year,

which is strongly related to the national policies. Second, from the viewpoint of the authors' co-existence network, the volume of publications and the issuing institutions, there are still more leading scholars and core key institutions in the field of AI technology applied to education and teaching research in China, and the influence and contribution in the field are also high, but the research in the field of AI technology applied to education and teaching has not yet formed a core research group. Among the issued literature, those with higher number of articles are some universities. Third, from the analysis of the keyword mapping, China's research in the field of artificial intelligence technology applied to education and teaching research is relatively deep, basically associated with the intelligent era, intelligent agents and intelligent education, and artificial intelligence technology applied to education and teaching research content is more extensive and more comprehensive application areas.

At present, the development of artificial intelligence technology has a greater impact on the field of education and teaching, promoting the change of talent training in higher education, vocational education and basic education, innovating talent training mode and accelerating the cultivation of talents urgently needed by society.

5.2 Research Reflections

At present, artificial intelligence technology continues to attract the attention of scholars, and research groups and research institutions are working closely with each other, and scholars are jointly exploring the application of artificial intelligence technology in education teaching and promoting the development of education informatization. With the development and application of 5G technology, it will further give rise to the development and application of artificial intelligence technology and education integration innovation. Now the application of artificial intelligence technology is more widespread, and the popularization of artificial intelligence technology in the field of education and teaching can not only solve many problems that exist in the traditional teaching process, but also comprehensively innovate the teaching mode and teaching concept, so that education and teaching can develop better.

Artificial intelligence technology has a long history of research, from the 1950s after the introduction of artificial intelligence, many countries and regions began to research, research for so many years, in theoretical research and development and application have made some progress, now artificial intelligence technology used in various areas of teaching, on the basis of artificial intelligence technology has also developed a lot of artificial intelligence teaching application platform, and to improve the It is of great help to improve teaching efficiency. The combination of artificial intelligence technology and education teaching is a promising research field, and the existing teaching model needs to be changed urgently, and the combination of more existing mature technologies is needed, which will definitely promote the rapid development of education teaching. Nowadays, artificial intelligence technology is developing very rapidly, but there are still some problems in the combination with education teaching, so we should continuously improve the combination of artificial intelligence technology and education teaching, and put the improvement of teaching efficiency in the first place when applying artificial intelligence technology to education teaching, and fully consider the personalized development of students.

With the development of AI technology, in the field of education, AI has gone from pure algorithms to applications, grown from entrants to participants, and from achieving functions in a piecemeal manner to closely integrating with education. Artificial intelligence technology has contributed to making education more intelligent and more in line with the characteristics of the current era. The effective combination between artificial intelligence technology and education teaching is also an important guarantee to promote the continuous progress of education. With the advent of the era of artificial intelligence, it also provides new innovative ideas and change paths for the development of education and teaching, and its application in the teaching process will effectively enhance students' learning interests and learning adaptability, thus continuously improving students' comprehensive literacy and comprehensive ability. And the development of artificial intelligence technology and educational applications make researchers pay more attention to the technology itself,

and the future development of artificial intelligence technology should be more for emotional intelligence. The application of artificial intelligence technology in education teaching should pay more attention to the students' emotional experience.

Acknowledgment

I am very grateful to my supervisor for her guidance during the writing process. Her valuable suggestions and ideas have helped me a lot, and it is because of her guidance that I was able to finish the article successfully.

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