The Current Situation and Frontier Evolution of Information Technology Education Evaluation Research at Home and Abroad

Visual Analysis Based on Citespace and Vosviewer Knowledge Graphs

Guozhu Jin[1(✉)] and Yan Ma[2]

[1] School of Computer and Information Science, Chongqing Normal University, Shapingba, Chongqing, China
1364471267@qq.com

[2] Institute of Wisdom, Chongqing Normal University, Shapingba, Chongqing, China

Abstract. In order to explore the current situation and frontier evolution of education evaluation research on information technology at home and abroad, the paper uses the bibliometric analysis method, combined with CiteSpace and VOSviewer analysis software, to sort out the year, number of citations, distribution of publishing institutions, distribution of research topics, etc. of the relevant core journals included in the web of science and CNKI, and finds that the current education evaluation of information technology is from "teaching evaluation", "teaching evaluation", "information technology" and so on to "big data". Transitions such as "artificial intelligence", and the evaluation object expands from primary and secondary schools to higher education. Future research should focus on combining modern information technology means, focusing on multi-subject evaluation, establishing a modern education evaluation system, and accelerating the digital transformation of education evaluation.

Keywords: Educational evaluation · Information Technology · Knowledge Graph · Bibliometrics

1 Introduction

Deepening the reform of the education system is an organic part of building a strong country in education and a strong country in talent, and its core is to establish and improve the mechanism of cultivating people with virtue (Ministry of Education 2020). Today, however, there is a phenomenon of "involution" in education, which brings about disorder and irrational competition, which is largely due to the failure of educational evaluation to play its due role [7]. Networking is the main feature of the new era, and information technology as an advanced and novel technical means in the context of the network, contains a very diverse amount of information and the carrying of information [1]. On the whole, the reform of education evaluation is related to multiple subjects, multiple links and multiple tasks, and has a strong systematic orientation, so it is necessary

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to actively explore a new teaching model and its evaluation method supported by information technology. In the process of education and teaching, educational evaluation as an organic part of the education system, should be combined with various factors, which plays its functional benefits and advantages effectively. This study uses the bibliometric analysis method and combines the two software of VOSviewer and CiteSpace to sort out the progress of educational evaluation research by constructing the knowledge graph of educational evaluation research, refine the main characteristics of the research, and further put forward relevant research implications, which has certain reference significance for the follow-up research of educational evaluation.

2 Data Sources and Research Methods

2.1 Data Sources

In order to ensure the reliability and authority of experimental data, this study searched foreign language academic literature through the Web of Science core Collection (https://access.clarivate.com/), in the advanced search box, the search conditions are "subject", and "information technology education" and "evaluation" are retrieved. The time span is from January 2013 to June 2022, and a total of 4003 related articles were retrieved.

Searched CNKI (https://www.cnki.net/) for Chinese Social Science Citation Index Source Journals (CSSCI) and national Chinese core journals. In the advanced search box, enter after the subject search items: "information technology + education evaluation", and we can retrieve a total of 78 literature with the theme of "information technology" and "education evaluation".

2.2 Data Inclusion and Screening

The data of the retrieved results were cleaned, and the master's and doctoral dissertations, popular science papers, conference abstracts, call for papers, newspaper brief reviews, industry guidelines and repeated publications were excluded. The retrieved papers were sorted by relevance, and finally 3746 foreign language literatures and 66 Chinese literatures were obtained.

2.3 Research Methodology

This study used bibliometric analysis. Bibliometric analysis method is a research method that disassembles the literature into several analysis units and constituent elements according to the established structure, uses mathematics, statistics and other means to summarize the quantitative characteristics of the inductive analysis units and constituent elements, and excavates the essential essence and deep connotation to be expressed in the literature.

This study used two literature analysis software, VOSviewer and CiteSpace. VOSviewer is a bibliometric analysis software that is widely used in the academic community. The software can process a large number of structured literature data, and extract the main indicators such as researchers, keywords, and citations from it, and

visualize the research topics and research trends, so that other scholars can quickly and comprehensively understand the research progress of a certain research field. CiteSpace is a literature analysis tool developed by Chaomei Chen's team for the visual analysis of Chinese and English literature in specific fields [2].

Combined with VOSviewer and CiteSpace6.1R2 software performs visual analysis of knowledge graphs of literature acquired by Web Of Science (WOS) and CNKI; From the visualization maps of co-existing networks, clustering networks, keyword emergences, etc., the overall analysis of research related research on information technology education evaluation at home and abroad is analyzed, and the interrelationship of various theme units is clarified through the co-existing network, which provides direction for subsequent in-depth research and transformation of innovative achievements in this field.

3 Knowledge Graph Analysis of Information Technology Education Evaluation Research in China

3.1 Distribution of Literature Years

To a certain extent, the total number of journal literature in a certain field can show the degree of activity and theoretical level of the academic research field [4]. After a total of 4003 articles were searched in the WOS database, a total of 3746 papers were included after screening The United States, Spain, South Korea, the United Kingdom, Taiwan, Japan, Australia, Brazil, and India are the top 10 countries or regions in the past decade. A total of 78 articles were retrieved through the CNKI database, and a total of 66 articles were included after screening. After analysing the years of keywords, it is found that China's research on information technology education evaluation has gradually shifted from focusing on information technology education to focusing on big data, artificial intelligence and evaluation reform.

In the foreign literature, due to the relatively low number of educational evaluations on information technology before 2013, so, the analysis period was defined as nearly ten years (2013–2022), and finally, WOS included 3746 valid documents and drew a trend chart of publications as shown in Fig. 1. From Fig. 1, it can be seen that from 2013 to 2016, the number of articles issued was small, and the average control was about 170 articles per year; The number of articles published in 2017–2019 gradually increased, about 1.1 times; from 2020 to 2021, the number of articles published was 758, reaching a peak; Since 2022 is not yet halfway through, the data has not yet been completely counted, so the comparison of the number of posts will not be made. In recent years, the number of articles published in this field has increased rapidly, which may be due to the global outbreak of the new crown pneumonia pandemic (COVID-19) since 2019, and the great changes in education methods have taken place, and exploring new ways of education evaluation has naturally become a research hotspot in the field of education today.

Figure 2 is the relevant publication status of education evaluation in the field of information technology in China from 2000 to 2022, from the perspective of the trend of paper publication, China's research on information technology education evaluation

Fig. 1. Analysis of WOS publication status and citation frequency

Fig. 2. CNKI publications from 2000 to 2022

has been in a state of ups and downs since 2000, but after 2019, the number of articles continued to rise, reaching a peak in 2021, 13, and it is expected that the number of articles will end in 2022 with 12.

3.2 Distribution of Literature Publishers

The analysis of the institutions that publish relevant academic papers can understand the platform for researchers in the field to communicate. Figure 3 shows the map of WOS issuing agencies in the past decade, in which the size of nodes reflects the number of documents issued by institutions, the colour of nodes indicates the degree of attention to the field, and the connection between nodes indicates the cooperation between institutions. The results show that the Ministry of Education is the main publishing agency, with a total of 93 articles published in the past ten years, accounting for 2.48%; It was followed by the Chinese Academy of Sciences, with 73 articles published, accounting for 1.95%; In addition, Jilin University, Tongji University, Tsinghua University, Wuhan University, Nanjing University and other institutions have published more than 40 articles.

Figure 4 shows the distribution of CNKI's major research institutions, and the top ten institutions are: Beijing Normal University (total number of articles is 8, accounting for 12.1%), Southwest University (total number of articles is 7, accounting for

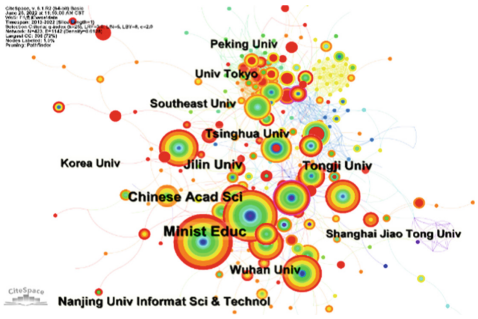

Fig. 3. 2013–2022 WOS publishing agencies present a map

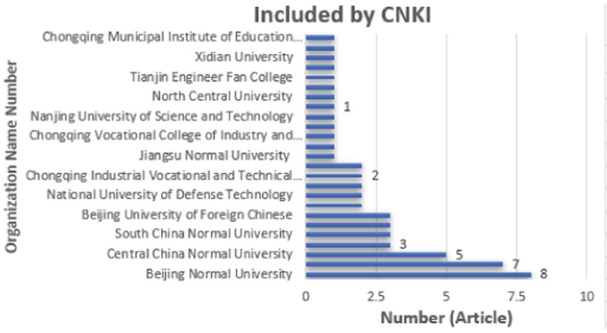

Fig. 4. Distribution of CNKI's major research institutions from 2000 to 2022

10.6%), Central China Normal University (5 articles), East China Normal University (3 articles), South China Normal University (3 articles), Qufu Normal University (3 articles), Beijing University of Foreign Chinese (3 articles), Northwest Normal University (2 articles), National University of Defense Technology (2 articles) and Peking University (2 articles). It can be seen that Normal University pays more attention to the educational evaluation of information technology, attaches importance to academic and applied research in this field, and with the popularization of networked teaching, in recent years, China has a more in-depth study of the new teaching model supported by information technology and its evaluation methods.

The status of documents issued by domestic and foreign institutions is shown in Table 1.

3.3 Keyword Analysis

The distribution of research literature topics helps to understand the hot spots and priorities of research in this field [5]. After analysing the co-occurrence atlas of keywords in information technology education evaluation at home and abroad, it is found that the research enthusiasm of keywords such as "information technology", "education evaluation", "teaching evaluation, "evaluation system", "teaching quality", "diversified evaluation" and "artificial intelligence" is relatively high, which shows that the existing

Table 1. Distribution of relevant literature journals in the evaluation section of information technology education

VOS has been included in the past decade			Included by CNKI		
Serial Number	Organization Name Number	Number (Article)	Serial Number	Organization Name Number	Number (Article)
1	Ministry of Education	93	1	Beijing Normal University	8
2	Chinese Academy of Sciences	73	2	Southwest University	7
3	Jilin University	58	3	Central China Normal University	5
4	Tongji University	48	4	East China Normal University	3
5	Tsinghua University	46	5	South China Normal University	3
6	Wuhan University	43	6	Qufu Normal University	3
7	Nanjing University Information Sci & Technology	42	7	Beijing University of Foreign Chinese	3
8	Southeast University	39	8	Northwest Normal University	2
9	University Tokyo	36	9	National University of Defense Technology	2
10	Peking University	34	10	Peking university	2

research focuses on the quality dimension of information technology education evaluation, pays attention to the analysis of the boundary of rights and responsibilities, interaction relationship and participation path between multiple evaluation subjects, and makes many explorations in the construction of evaluation index system. In addition, with the continuous development of information technology, the use of artificial intelligence, big data, cloud computing and other advanced technical means for educational evaluation has also received more and more attention.

Table 2. High-frequency keywords in the evaluation of information technology education

Keywords	Frequency	Centrality	First Appearance Year
model	223	0.03	2013
technology	207	0.04	2013
system	200	0.02	2013
information	183	0.05	2013
education	158	0.04	2013
impact	143	0.02	2013
performance	140	0.06	2013
student	131	0.03	2013
higher education	114	0.01	2016
information technology	113	0.01	2013

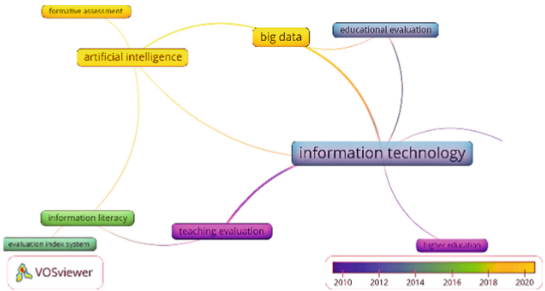

Fig. 5. CNKI Core Journal Keyword Contribution Map 2000–2022

3.3.1 High-Frequency Keywords

High-frequency keywords can reflect research hotspots in this field. Set the node type to "Keywords" and the network crop select "Pathfinder" and "Pruning sliced networks". There are 488 nodes in the English literature high-frequency keyword atlas, 1591 connections, and a density of 0.0134. Keywords with a frequency of more than 1,00 are shown in Table 2.

The high-frequency keywords in the Chinese literature are shown in Fig. 5, of which the top 5 high-frequency keywords are "information technology (20 times) and "education evaluation" (9). Times), "big data" (5 times), "artificial intelligence" (5 times), "information literacy" (3 times).

3.3.2 Keywords Emerge

Keyword prominence can predict the development trend and research frontier of the research field. In the past two years, the prominent words in the English literature include Deep learning, feature extraction, competence, convolutional neural network and so on;

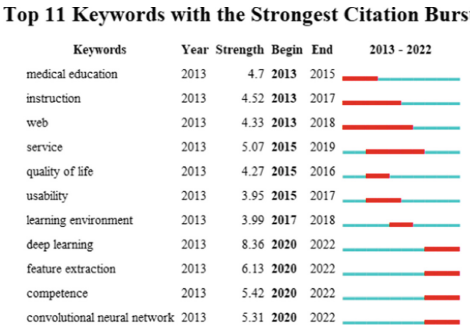

Fig. 6. WOS literature nearly 2013–2022 emerging word atlas

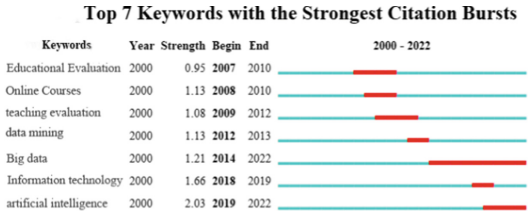

Fig. 7. Chinese Literature 2000–2022 Emerging Word Atlas

Keywords such as instruction, web, and service that appeared in 2013–2015 ended in 2018–2019, as shown in Fig. 6.

Figure 7 is some of the prominent words that have appeared in the literature of Chinese in recent years, from the figure, it can be seen that keywords such as "teaching evaluation", "online course", "teaching evaluation", "data mining", "information technology" and other keywords are gradually weakening with the passage of time, and new technologies such as "big data (started in 2014)" and "artificial intelligence (started in 2019)" are hot spots in current research and may continue to play their role in the future.

3.3.3 Keyword Clustering Analysis

Keyword clustering reflects the composition of various research topics in the field. Module value (Q) and average profile value (S) are the basis for judging the effect of map drawing [6], and the network module index $Q = 0.4703$ and the network homogeneity $S = 0.7468$ of the English keyword cluster in this study show that the network structure of the map is reasonable and can represent the research hotspots in the field of information technology education evaluation.

The clustering results of the English literature are #0 machine learning, #1 virtual reality, #2 deep learning, #3 higher education, #4 medical education, #5 performance evaluation, and #6 digital. The specific results of competence are shown in Fig. 8. And Chinese literature clustering results are only "information technology", "educational evaluation" and "artificial intelligence".

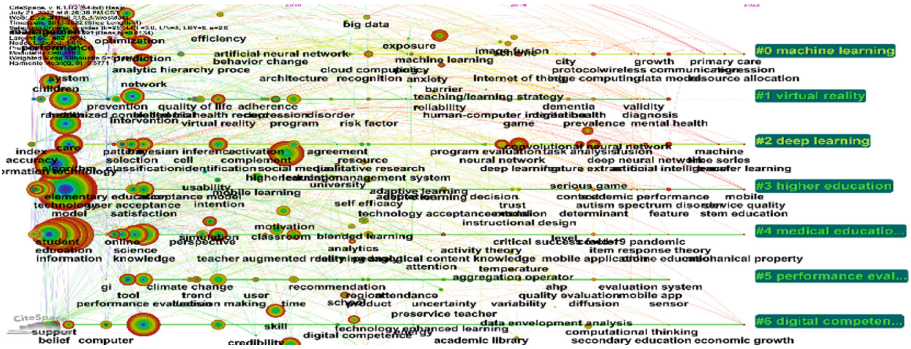

Fig. 8. Timeline distribution of Keywords in English literature on information technology education evaluation

4 Conclusion

In order to better review the research context of Information Technology Education Evaluation in China, this paper conducts bibliometric analysis of relevant papers on information technology education evaluation research at home and abroad, and uses CiteSpace to conduct data mining, statistics and knowledge graph visualization analysis of related research progress, research hotspots, and evolution of hot topics, and obtains the following main conclusions.

First, the number of education evaluation articles published by information technology shows the overall trend of "stable development in the early stage and sudden increase in the number in the later stage", while the cooperation between authors and institutions shows the characteristics of "partial concentration and overall dispersion". Especially in 2021, the education evaluation of information technology at home and abroad has been greatly improved, the most likely reason is that in the post-epidemic background, both at home and abroad are in urgent need of an evaluation model suitable for the current social development, information technology as an advanced and novel technical means in the network background, the amount of information it contains, And the bearer of information is very diverse, therefore, looking for an information technology education evaluation model suitable for the current social development, combining with various factors in the process of education and teaching, fully, reasonably and effectively playing its functional benefits and advantages has become a hot topic in the current education evaluation.

Second, the Ministry of Education is the institution that publishes the most articles in this field, and China's normal universities are relatively more concerned about the evaluation of information technology education in China, attaching importance to academic and applied research in this field, but the amount of texts published in foreign language literature is small. Keywords such as "information technology", "education evaluation", "teaching evaluation", "evaluation system", "teaching quality" and "diversified evaluation" are highly popular. This shows that the existing research focuses on the quality dimension of information technology education evaluation, focuses on

analyzing the boundaries of rights and responsibilities, interaction relationships and participation paths between multiple evaluation subjects, and makes many explorations in the construction of evaluation index system.

Third, with the continuous development of information technology, the hot spots of information technology education evaluation and research present the characteristics of the evolution of emerging themes with advanced technical means such as "deep learning, virtual reality, feature extraction, machine learning, and convolutional neural networks" as the core. With the evolution of hot topics, information technology education evaluation has been given multi-dimensional and deep connotations. Topics such as "artificial intelligence", "big data", "cloud computing", "information technology", and "education evaluation" basically revolve around these research hotspots It is not only embodied in high efficiency, but also endowed with multi-dimensional deep connotations such as modernization, high quality and sustainability.

This paper conducts a visual study of the literature chronological distribution, author co-emergence, research institution co-emergence, keyword co-emergence, keyword clustering and other aspects of information technology education evaluation research, comprehensively shows the current situation and frontier evolution of information technology education evaluation research in China, and draws on further research by scholars in the field of education evaluation. In the future, information technology education evaluation research should pay more attention to the education evaluation problems of big data, higher education, artificial intelligence, etc., strengthen the evaluation of the main body of research, relying on various advanced technical means, according to the different positioning and needs of multiple evaluation subjects, reasonably define the focus of evaluation, and promote the research on the construction of an education classification evaluation index system.

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