Research Status and Prospect of Teaching Evaluation in the Context of Big Data

-- CiteSpace-based visual analysis

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Abstract. In order to investigate the research status and future development trend of teaching evaluation in the context of big data, this paper takes 325 papers in the Chinese database of China Knowledge Network from 2013 to 2022 as the research samples, and analyzes the co-citation network and keyword co-occurrence network of the collected literature with the help of CiteSpace software to explore the development trend, research overview and current research hotspots in this field. The study found that (1) in terms of the annual number of papers issued, the research on teaching evaluation in the context of big data is in an upward trend from 2013 to 2020, and reaches the climax of papers issued in 2020. (2) From the analysis results of core authors as well as author institution networks, there are connections among relevant authors that can promote the development of the field, but in general, communication and cooperation among scholars need to be further strengthened to lead to the emergence of more cohesive research teams. And there are few institutions studying teaching evaluation in the context of big data, but there is no cooperative relationship among various institutions. (3) From the analysis results of research hotspots, the research hotspots of teaching evaluation in the context of big data are mainly focused on big data, teaching evaluation, teaching mode, artificial intelligence, smart classroom, precise teaching and so on. (4) The frontier research on teaching evaluation in the context of big data mainly focuses on big data, information technology, smart classroom, mooc, and evaluation system.

Keywords: Big Data; Teaching Evaluation; Visual Analytics.

1. Introduction

For a long time, teaching evaluation has suffered from outdated models, single indicators, lack of data and inflexible algorithms, and the educational application of artificial intelligence offers the possibility to solve these problems[1].2 In October 020, the Central Committee of the Communist Party of China (CPC) and the State Council clearly proposed in the General Plan for Deepening Educational Evaluation Reform in the New Era to "adhere to scientific and effective, improve the evaluation of results, strengthen the process evaluation, explore value-added evaluation, and improve comprehensive evaluation"[2].Strengthen process evaluation, explore value-added evaluation, and improve comprehensive evaluation, and make use of modern information technology such as artificial intelligence and big data to innovate evaluation tools and improve the scientific, professional, and objective nature of educational evaluation" [2].The National Medium and Long-term Education Reform and Development Plan (2010-2020) raises education quality evaluation to a new strategic level and clearly proposes to reform education quality evaluation and improve education teaching evaluation in order to improve education quality[3].Thus, it can be seen that the change of teaching evaluation mode has also become a major hot spot given to education research in the era.

Big data, as a new trend in the development of information technology, has penetrated into all walks of life, becoming an important driving factor and setting off huge waves of change in the industry [4]. With the continuous improvement of China's education informatization level, how to use big data technology for objective, comprehensive, timely, and accurate teaching evaluation has become an important link to promote teachers' teaching development [5]. The emergence of artificial intelligence, big data, Internet of things and other technologies also provides the possibility of

changing the teaching evaluation mode to a certain extent, and the era of education big data has quietly come. In view of this, this paper adopts a visual analysis party based on CiteSpace software, bibliometric and visual analysis of key words, authors, and institutions, explores the basic research status of teaching evaluation in the context of big data, presents the development changes within the field of big data and teaching evaluation research, and finally, this paper combines literature combing to make a summary and outlook.

2. Research Design

2.1 Research tools

The research tool of this paper is CiteSpace software, an information visualization tool developed by Professor Chaomei Chen of Drexel University, USA, specifically for analyzing academic literature. The software measures domain-specific literature and is able to explore the key paths and knowledge turning points in the evolution of subject areas, and to form an analysis of potential force mechanisms of disciplinary evolution and detection of disciplinary development frontiers through a series of visual mapping [6]. Based on this, this study uses CiteSpace visual analysis software to organize and analyze the research on teaching evaluation in the context of big data, and the analysis elements include authors, issuing institutions, keywords, and time, so as to analyze and summarize the hotspots and frontier research in the field.

2.2 Data sources

In order to ensure a more comprehensive possession of key literature, this paper mainly uses China Knowledge Network (CNKI) as the search database. In this paper, we used "big data" and "teaching evaluation" as the subject terms in CNKI database, and selected SCI and Peking University core CSSCI as the journal sources, and searched the literature in the time period of 2013-2022. The search criteria were "precise", including master's and doctoral degree theses, and 325 pieces of relevant literature were obtained by manually eliminating conference announcements, reports, etc. The data were finally exported and saved in CNKI's Refworks format.

2.3 Data Processing

In this study, CiteSpace software was used to detect the frequency of recurrence of keywords in the field of "big data, teaching evaluation" and to conduct co-occurrence analysis to understand the research hotspots and development trends in this field. In the setting of threshold parameters, the Time Slicing was set from 2013 to 2022, the values of "Node Types" were set as Keyword, Author, Institution, "Top N The value of "Node Types" is set to Keyword, Author, Institution, "Top N" is set to 50, and the pruning strategy is selected as Pruning sliced networks and Pruning Sliced Networks.

3. Data Analysis Results

The literature data obtained from CNKI were guided to CiteSpace software, and a total of 325 valid and non-duplicate datasets were identified. The following results were obtained by statistically analyzing the indicators of literature time, author, publication institution, and keyword co-occurrence:

3.1 Analysis of the temporal distribution of the number of articles issued in a year

The annual distribution of research volume of literature in a particular field can reflect the level of research development and overall results of the field to a certain extent [7].This study counted the articles related to teaching evaluation research in the context of big data published in SCI, PKU core, CSSCI core journals and dissertations from July 10, 2013 to June 15, 2022, and obtained the annual literature volume trend graph of teaching evaluation research in the context of big data, as shown in Figure 1.

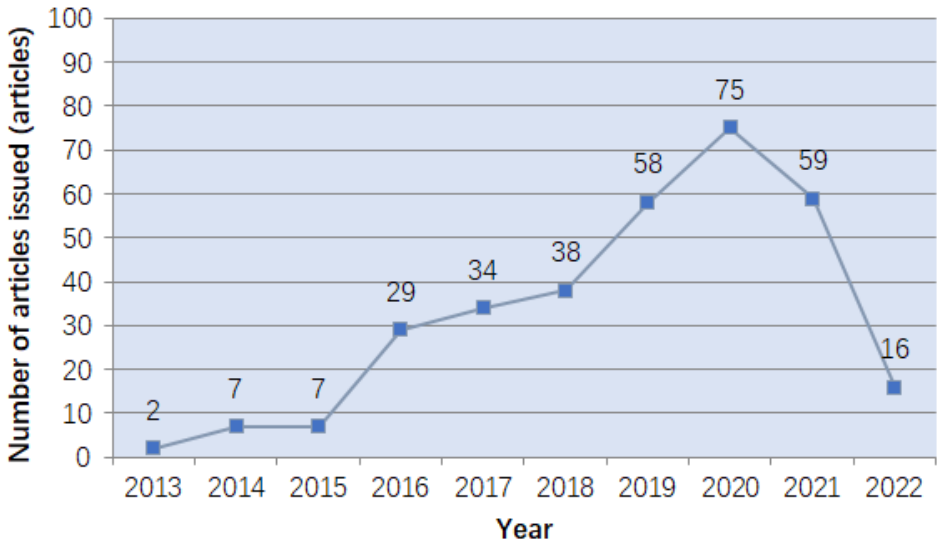


Figure 1. Mapping the number of annual publications of educational evaluation research in the context of big data (2013-2022)

As can be seen in Figure 1, educational evaluation in the context of big data showed a growing trend from 2013 to 2020 and reached a peak in 2020, indicating that the heat and importance attached to teaching evaluation research was rising and attention was gradually increasing during that period, which is also partly due to the widespread use of artificial intelligence-related technologies such as the Internet of Things, big data, and learning analytics in the field of education. And teaching evaluation as an important part of the education field, using big data technology can promote the realization of data-driven decision making in education evaluation [8]. Also, at this stage, the introduction of education informatization 2.0 has prompted educational reform and innovation based on artificial intelligence technologies such as big data and IoT.

3.2 Core authorship mapping analysis

To understand the key researchers in this field, a core authorship map was generated. In the creation interface of CiteSpace software, we set the network node type as "Author" and analyzed the CNKI author collaboration network, and the results are shown in Figure 2. The tightness is 0.0021. The connecting lines represent the roommate cooperation relationship between these authors, for example, there is a network connection between Wang Jun and Bi Jing, and there is a network connection between Wang Hongguang, Wang Yanxin and Liu Haimei, etc. The figure shows that Zhang Juan, Wan Liyong and Zhu Ke scholars have paid more attention in this field, and some of the authors have published more individual articles and have achieved fruitful results around teaching evaluation in the context of big data, which is worthy of academic attention and reference. In general, the exchange and cooperation among scholars should be further strengthened to lead to the emergence of more cohesive research teams.



Figure 2. Mapping of author collaborations in teaching evaluation research in the context of big data

3.3 Author Institutional Network Analysis

In order to understand the highly productive academic groups and institutions studying teaching evaluation in the context of big data and the cooperation among different research institutions in China, we used Citespace software and selected "Institution" as a keyword in the Node type box to generate The network map of institutional cooperation in teaching evaluation in the context of big data was generated by using Citespace software and selecting "Institution" as the keyword in the Node type box. According to the analysis results, there are 202 nodes, 0 lines, and 0 tightness in the network structure, which indicates that the academic groups of teaching evaluation research in the context of big data are scattered, and there is little cooperation among different research institutions, and a strong cohesive research institution has not been formed. The figure shows that the two institutions that have studied the most teaching evaluation in the context of big data are the College of Teacher Education of Huzhou Normal University and the Department of Education of Southwest University, and there are not a few institutions studying this field, but there is no cooperation formed among various institutions.

3.4 Analysis of research hotspots and research frontiers

3.4.1 Research Hotspot Analysis

(1) Analysis of keyword-based research hotspots

Keywords are the author's summary and refinement of the content of the article, and can reflect the core content of the literature. Therefore, analyzing the aggregation of keywords in a certain academic field can reveal the overall characteristics of its content and the inner connection between research contents, etc., and can grasp the development pulse and direction of academic research in the field[9]. The hotness of research topics can be reflected by word frequency, and the higher the word frequency, the higher the research hotness[10]. Using CiteSpace for keyword analysis, the top 20 keywords in terms of frequency of occurrence are shown in Table 1, and the top 20 keywords in terms of centrality are shown in Table 2, and the keywords with higher frequency and greater centrality can represent the common research issues of scholars over a period of time.

Table 1. Top 20 keywords in terms of frequency of occurrence

Number	Frequency	Keywords
1	70	Big Data
2	20	Teaching Evaluation
3	19	Smart Classroom
4	17	Teaching Model
5	14	Artificial Intelligence
6	13	Precise Teaching
7	10	Instructional Design
8	9	Information Technology
9	7	mooc
10	7	Learning Analytics
11	6	Teaching Reform
12	5	Teaching Decision
13	5	Teaching Quality
14	5	Evaluation System
15	5	Catechism
16	5	Internet+
17	4	Educational Change
18	4	Classroom Teaching
19	4	Online Teaching
20	4	High School

As can be seen from Table 1, the key words that appear more frequently (>7) are "big data", "teaching evaluation", "smart classroom", " teaching mode", "artificial intelligence", "precise teaching", "teaching design", "information technology " and so on. The top three are "big data", "teaching evaluation" and "smart classroom", which shows that the scholars' research hotspots for these three keywords are relatively high, especially for big data. This shows that the scholars' research on these three keywords is relatively high, especially on big data.

Table 2. Top 20 keywords for centrality

Number	Centrality	Keywords
1	0.72	Big Data
2	0.23	Teaching Evaluation
3	0.11	Teaching Model
4	0.11	Artificial Intelligence
5	0.07	Intelligent Classroom
6	0.05	Precise Teaching
7	0.05	Information Technology
8	0.05	Teaching Quality
9	0.05	Informatization
10	0.04	mooc
11	0.03	Teaching Design
12	0.03	Teaching Reform
13	0.03	Internet+
14	0.03	Teaching Ability
15	0.03	Data Mining
16	0.03	Data Analysis
17	0.02	Learning Analysis
18	0.02	Evaluation System
19	0.02	Online Teaching
20	0.02	High School

Modern education is necessarily data-driven rather than a purely empirical practice [11]. Evaluation based on big data in education is an important symbol of education modernization, whose

external expression is to show the external behavior of individuals and depict their internal values and knowledge structures by means of data, with the fundamental purpose of awakening the self-awareness of subjects, indicating the direction of development, and promoting value generation through data-based evaluation [12]. At present, big data is increasingly used in the field of education, and the implementation of the smart classroom under the modern education concept needs to be supported by big data, which makes education big data better serve for classroom teaching, better teaching evaluation, and finally promote the reform of education and the overall development of students.

Table 2 shows that the key words with high centrality are "big data", "teaching evaluation", "teaching mode", "artificial intelligence " "smart classroom" "precision teaching" "information technology" "teaching quality ""informatization". The two keywords with the highest degree of centrality are "big data" and "teaching evaluation". As an important part of the teaching process, how to implement scientific, reasonable and effective teaching evaluation to reflect students' learning status comprehensively and objectively, a single data is far from meeting this requirement, but the intervention of big data technology can achieve this goal to a large extent.



Figure 3. Keyword co-occurrence mapping of teaching evaluation research in the context of big data

As shown in Figure 3, there are 249 network nodes with 416 lines in the co-occurrence map of teaching evaluation research in the context of big data, and the network density is 0.0135. Since the keyword nodes can reflect the frequency of relevant keywords in the research papers in this field and also represent the research hotspots in this field, and "big data" is the largest node in this map in Figure 3. "intelligent classroom", "artificial intelligence", "instructional design", "precision teaching "information technology" is the second largest node after "big data", which indicates that these are also the hotspots of scholars' research, and the connection between these nodes also indicates their correlation.

(2) Analysis of research hotspots based on keyword clustering

Using the keyword clustering analysis function of CiteSpace can help explore the research frontiers and hotspots in related fields [13]. In the study of teaching evaluation in the context of big data, using the spectral clustering algorithm, a total of 10 clusters were generated, as shown in Figure 4, with the labels of #0 for big data, cluster #1 for smart classroom, cluster #2 for artificial intelligence, cluster #3 for teaching evaluation, cluster #4 for learning analysis, cluster #5 for teaching competency, cluster #6 for mooc cluster #7 is labeled performance analysis, cluster #8 is labeled academic assessment, and cluster #9 is labeled data-driven.

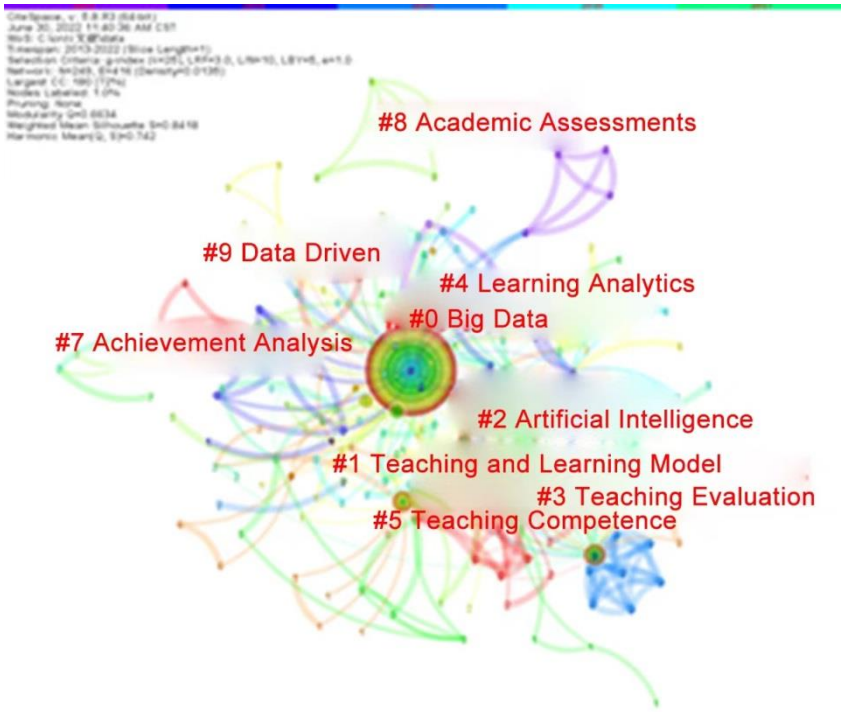


Figure 4. Keyword co-occurrence clustering mapping of teaching evaluation research in the context of big data

(3) Analysis of research hotspots based on keywords and clustering

This study conducts keyword clustering analysis based on keyword path evolution analysis, and obtains a timeline mapping based on keywords and clusters. From the analysis results of citespace, it can be seen that the horizontal axis is the time when the hotspots emerged, the vertical axis is the clustering module automatically calculated by the software, each node is a research topic, the circles and colors represent the richness of the topic, and the connecting lines represent the connection between different topics. In this figure, it can be seen that the circle representing Big Data is the largest and has been emerging during the period from 2013 to 2022, indicating that Big Data has been a research hotspot for relevant researchers during this period and has received wide attention and importance. Moreover, the nodes it connects are all related to education and teaching, indicating that in the current education field, big data are playing a very important role and have penetrated into all fields of education and teaching.

3.4.2 Analysis of research frontiers based on keyword emergence

It can be used as one of the criteria for judging and predicting the research frontier [14]. In this paper, CiteSpace software was used to explore and analyze the emergent keywords in the field of teaching evaluation research in the context of big data, and a total of 10 emergent keywords were analyzed, and the table of emergent keywords is shown in Figure 5, which are "data mining", "mooc "big data", "spoc", "classroom teaching", "information technology ""teaching evaluation" "smart classroom" "evaluation system" "teaching quality ".

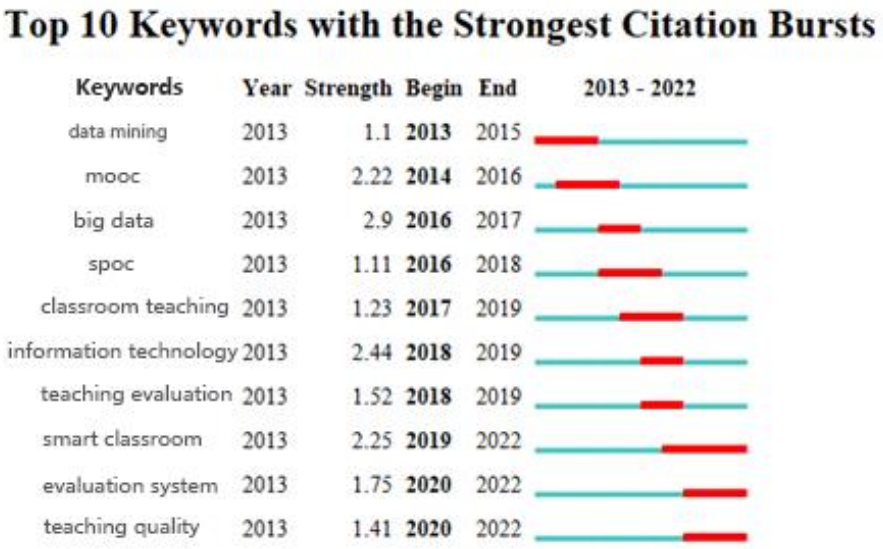


Figure 5. 10 major emergent keywords mapping

From the research sample data, the keyword data mining appeared for the first time in 2013 and lasted until 2015; mooc appeared in 2014, mooc is also known as large-scale online open courses, with the development and progress of information technology, many teaching resources can be obtained from mugshots, which are popular among scholars because of its advantages of access to high-quality resources without regional restrictions and ease of learning. welcome. Big data lasted from 2016 to 2017, during which time the research on big data received extensive attention. spoc lasted from 2016 to 2018, and spoc refers to "small-scale private online courses", hoping to integrate MOOC education ideas, and to combine micro-lessons, niche teaching, integrated [15]. After 2017, classroom teaching, information technology, teaching evaluation, smart classroom, evaluation system, and teaching quality became the keywords. In terms of the intensity of keyword emergence, among them, big data and information technology emerged with the greatest intensity, which also indicates that both big data and information technology play an important role in the research of teaching evaluation.

While big data, due to the characteristics of large amount of data, many types, fast processing speed and authenticity, can greatly expand the content of teaching evaluation by using the massive characteristics of big data to obtain and mine more information of large amount of real and reliable education data in the natural state. The current education teaching needs to overcome the various difficulties arising from traditional teaching, thus the role of information technology becomes particularly important.

4. Research Summary and Outlook

The manuscript should include a conclusion. In this section, summarize what was described in your paper. Future directions may also be included in this section. Authors are strongly encouraged not to reference multiple figures or tables in the conclusion; these should be referenced in the body of the paper.

4.1 Research Summary

Although big data has made great progress in teaching evaluation, there are many pressing issues that need to be addressed.

1. Data sharing mechanism is not perfect

First, the existing education data mining and analysis are often limited to specific systems and platforms, with a single source of data, and have not yet built cross-system and cross-platform "education big data", and all kinds of data are scattered and isolated from each other, forming data islands. Second, the utilization rate of information resources is low. Although there is a large amount

of data, the utilization rate of information is relatively low. In addition, the technology of data collection is not mature, leading to the lack of information, which also restricts the breadth and depth of education big data collection.

2. Data privacy and ethics face challenges

In the process of collecting, storing and using big data, there may be problems such as privacy leakage. In the field of education, most of the collected data comes from students' learning data. Theoretically, the data can be used for analysis only with the consent of the evaluated students, but this is not the case. The reality is that the evaluated students have to sacrifice their personal data in order to get personalized services, which leads to the leakage of data privacy and ethical issues. In addition, data processing can also lead to the lack of data integrity and validity. The collected data is not directly available, it needs to go through a series of operations, such as filtering, classification, etc., which may affect the validity and integrity of the data.

3. Insufficient data coordination and planning

Currently, the data integration planning about the education field is not sufficient. It is mainly reflected in the fact that the thinking of teaching evaluation based on big data or data-driven teaching evaluation has not really been formed [16]. In the process of educational evaluation, many teachers cannot fully understand and give full play to the value of big data thinking in teaching evaluation, and some teachers belittle the role of data or hold the idea that data is above everything. In addition, many teachers do not interpret the data-driven teaching evaluation properly, over-emphasize the results of teaching evaluation or just aim at the results of teaching evaluation, and lack further data mining, which will lead to parents not being able to understand their children's learning status well through data, students not being able to use data well to understand their learning effectiveness, and teachers not being able to see their teaching effectiveness well through data.

4.2 Research Outlook

With the application of various big data technologies in education and the continuous development and progress of modern information technology, we have entered an era of big data in which data drives teaching and learning and analysis transforms education. Big data has been involved in various fields, and after visualizing and analyzing the research on teaching evaluation in the context of big data through this study, we can find that the role of big data in teaching evaluation is also becoming more and more important, and the future research on big data as well as teaching evaluation is still a research hotspot for researchers.

5. Conclusion

At present, teaching evaluation based on big data is pouring into all levels of education teaching and strengthening the change of education, and efficient big data analysis and mining has become a new wave to improve the quality of education and promote the development of education. Therefore, in the era of big data, educators should fully understand and give full play to the value of big data thinking in teaching evaluation, use big data thinking and technology to promote changes and innovations in education teaching, and lead the new direction of education teaching development.

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