A Review of the Development of Research on Fiscal Issues in the Application of Information Technology in Education: A Visual Analysis Based on CSSCI Source Journals (2000-2024)

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Abstract. The application of information technology in education and its fiscal investment have become an important issue in educational research, but the existing achievements are mostly at the macro level, lacking a systematic review of China's local research. Based on 311 papers published in CSSCI from 2000 to 2024, this paper uses bibliometric and visual analysis methods to comprehensively analyze the application of information technology supported by education finance. The results show that the research topics mainly focus on three directions: information technology in schools, education equity and regional development, and policy research. The research frontier migrates with the policy adjustment. The important research directions include application of information technology and fiscal support in education; efficiency, cost, and construction effect of fiscal investment and fiscal policy implementation and countermeasures. This paper reveals the evolution logic and trend of China's education informatization finance research, points out its shortcomings in macro and timeliness, and provides a reference for the optimization of fiscal investment and the formulation of education policy.

Keywords: Education Informatization; Fiscal Investment; Policy Orientation; Bibliometrics.

1. Introduction

Educational informatization refers to the process of comprehensively and deeply using modern information technology to promote educational reform and development in the field of education. With the rapid development of information technology, education informatization has become an important development trend to improve the quality of education, promote education equity, and promote education modernization. The Ministry of Education issued a separate chapter on education informatization and listed it as one of the major projects. China's education informatization has entered a stage of rapid development. Smart classroom, online learning platform, big data analysis, artificial intelligence-assisted teaching, and other new forms of education continue to emerge, promoting the innovation of teaching content, methods and management modes. However, the promotion and deepening of information technology in education not only depend on the maturity of technology itself, but also are closely related to fiscal investment and resource allocation efficiency. The construction of educational informatization usually involves the purchase of hardware equipment, the construction of network infrastructure, the development and maintenance of a software platform, teacher training, and other links, which all need stable and sufficient financial support.

In view of this, this paper intends to use the methods of bibliometrics and visual analysis to systematically sort out the fiscal-related research on the application of information technology in education. Considering that the development of educational fiscal investment and information technology application highly depends on the national policy guidance and institutional background, this paper will focus on the local research in China. By analyzing the changing trend of the number of literature, research hotspots, and their evolution laws, this paper aims to reveal the overall research status and development direction of this field, and provide a reference for future policy-making and fiscal investment optimization.

2. Literature Sources and Research Methods

In this study, the CNKI full-text database of Chinese academic journals was selected as the literature source, and the key words were "education informatization", "educational technology", "information technology" and "funding", "funds", "finance", "appropriation", "special funds", "investment" and other words and cross combinations. The retrieval time range was set from January 1st, 2000 to December 31st, 2024. In the literature retrieved initially, 311 valid sample literatures were finally obtained, excluding non-academic literatures such as meeting notices, news reports, policy interpretation, and research that have no direct relationship with educational informatization.

This study refers to the experience of several studies, with the help of tools such as CiteSpace and Excel, visualizes and statistically analyzes the annual number of papers, keywords co-occurrence, clustering, and prominent words of the literature, to explore the research trends and development trends of the financial application of information technology in Education.

In the specific analysis link, the data processing parameters and conditions of this study are set as follows: the time range is 2000-2024, and the year per slice is set to 1, a total of 24 time zones; Node types is set to keyword, because the keywords of journal literature can better reveal its research theme and core content; In network clustering, TF-IDF algorithm is selected for clustering label naming, and the naming terms of clustering come from literature keywords. In order to better analyze the situation, this study uses a variety of maps, such as keyword co-occurrence map, keyword clustering map, keyword time zone map and so on.

3. Results of the Fiscal Expenditure on the Use of IT in Education

3.1. Analysis of Research Topics

The keyword co-occurrence map visualizes the clustering and relationships of high-frequency words, intuitively presenting the core categories of the research field and the interactive relationships between research topics. The higher the frequency of a keyword's occurrence, the larger the node area shown in the co-occurrence map, indicating a higher research popularity and influence. This study uses the keyword co-occurrence function of Citespace software to obtain the development trends and hot topics of information technology in China's education sector.

As shown in Fig. 1, overall, the nodes corresponding to "basic education", "informatization", and "information technology" have relatively larger areas, indicating that educational informatization has been a hot topic in educational research from 2000 to 2023. In 2001, China's Ministry of Education issued the Tenth Five-Year Plan for National Education and proposed the "Science and Education Revitalize the Country" policy, encouraging the increase of "modernization and informatization in education methods", which aligns with the initial appearance of related research [1].



Fig. 1 Keyword co-occurrence map for IT applied in researching fiscal expenditure on education-based.

Other nodes with relatively large areas, such as "educational equity", "rural education", and "ethnic regions", indicate that educational equity is one of the main research themes in this field. The differences in educational access between urban and rural areas, as well as the digital divide caused by uneven fiscal investment, have become important factors affecting educational equity [2]. The node for "basic education" is larger than that for "higher education", suggesting that China's educational finance investment in information technology is focused on the primary, middle, and high school levels. At the same time, "basic education", "primary and secondary schools", and "higher education" are directly connected to keywords like "digital divide", "imbalance", and "western universities", indicating that the issue of educational equity spans across the entire education phase for students in China. Nodes like "information literacy", "digital campus", and "smart education" reflect the evolution of educational informatization methods, with the development of educational informatization having become a key area of focus for educational finance. "Development strategy", "countermeasures", and "implementation strategies" discuss misconceptions about educational investment and the current situation, along with possible countermeasures.

In conclusion, research on educational informatization in China is focused on three main directions: the integration of information technology into schools, educational equity and regional development, and policy research.

3.2. Analysis of Research Frontiers

Keyword burst highlights the frequency of keyword occurrences at specific time points, known as "sudden growth." The keyword prominence rate is used to measure the speed of frequency growth, helping researchers track the dynamics of the research field and predict research frontiers [3]. Based on the characteristics of keywords, the data presented in Fig. 2 roughly reflect the four stages of the frontier of educational informatization in China.

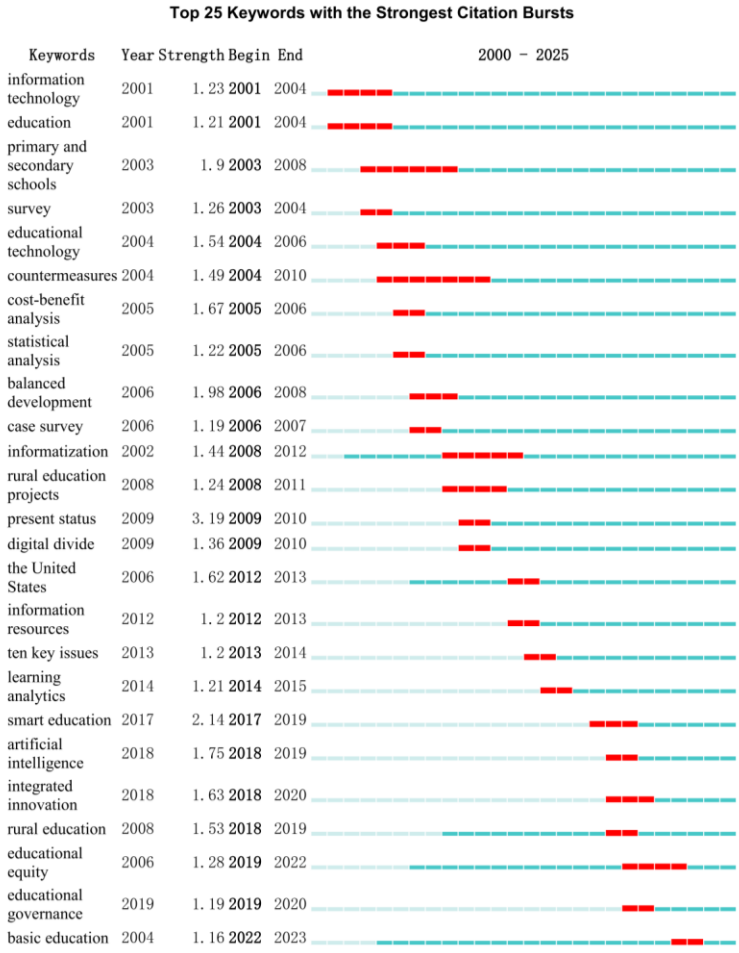


Fig. 2 Keyword burst map for IT applied in researching fiscal expenditure on education-based.

The first stage is the "initial integration of information technology into schools", with frontier keywords concentrated between 2001 and 2006, including "information technology", "education", "primary and secondary schools", "survey", and "educational technology." The "Education Informatization 10th Five-Year Plan" proposed that "the popularization of computers should start from an early age" [4]. This stage marks the early phase of educational informatization, with the focus on popularizing the concept of educational informatization.

The second stage is the "discussion of equity issues", with frontier keywords concentrated between 2004 and 2010. The burst keywords include "countermeasures", "cost-benefit analysis", "statistical analysis", "balanced development", and "rural education projects" (e.g., the "Rural Education Project"). During the development and implementation of educational informatization, an imbalance in information resources emerged. This situation arose from China's dual education policy system, where "local governments are responsible, with hierarchical management and counties as the main units" [5]. Due to limited fiscal investment from the central government, regions had to rely on their own finances to run schools, leading to remote counties being unable to follow national policies to promote educational informatization. Therefore, the research in the second stage focused on identifying problems and proposing strategies to address them.

The third stage is the "evolution of educational methods", with frontier keywords concentrated between 2012 and 2020, including "smart education", "artificial intelligence", and "integrated innovation." The strategic goals and themes outlined in the "National Medium- and Long-Term Education Reform and Development Plan (2010-2020)" mentioned that China aimed to basically achieve educational modernization by 2020 [6]. In 2018, China proposed eight specific implementation plans for the "Internet + Education" initiative, signaling that educational informatization was gradually entering the application stage, laying the foundation for the strategy of becoming a strong education nation.

The fourth stage is the "return to the discussion of equity issues", with frontier keywords concentrated between 2018 and 2023. Keywords like "rural education", "educational equity", "basic education", and "educational governance" indicate that China has once again shifted its educational finance investment towards narrowing the regional education gap. This shift involves efforts such as targeted poverty alleviation, increasing school autonomy to encourage balanced educational development, and gradually redirecting campus infrastructure funding towards human resources, particularly teachers. Additionally, comprehensive supervision, evaluation, and third-party assessments have been initiated [7].

As can be seen, research dynamics and frontiers change in response to adjustments in national policies. However, related nodes such as "balanced development", "rural education", and "educational equity" have appeared repeatedly in both the second and fourth stages, indicating that educational equity has always been an important issue in the development of education in China and may continue to be a focus in future research.

3.3. Historical Evolution and Development Trends of Educational Informatization Research

Fig. 3 is the keyword timeline map of educational informatization research in China. In this study, time is represented on the horizontal axis, recording the first occurrence year of nodes under each cluster. If keywords from different periods appear in the same research cluster, they are connected by arcs, making it easier for researchers to track the evolution and development of the field's hotspots. There are 11 clusters in total in Fig. 3. Due to significant differences in the number of nodes under different clusters, this study will focus on analyzing the top five clusters with the most nodes.

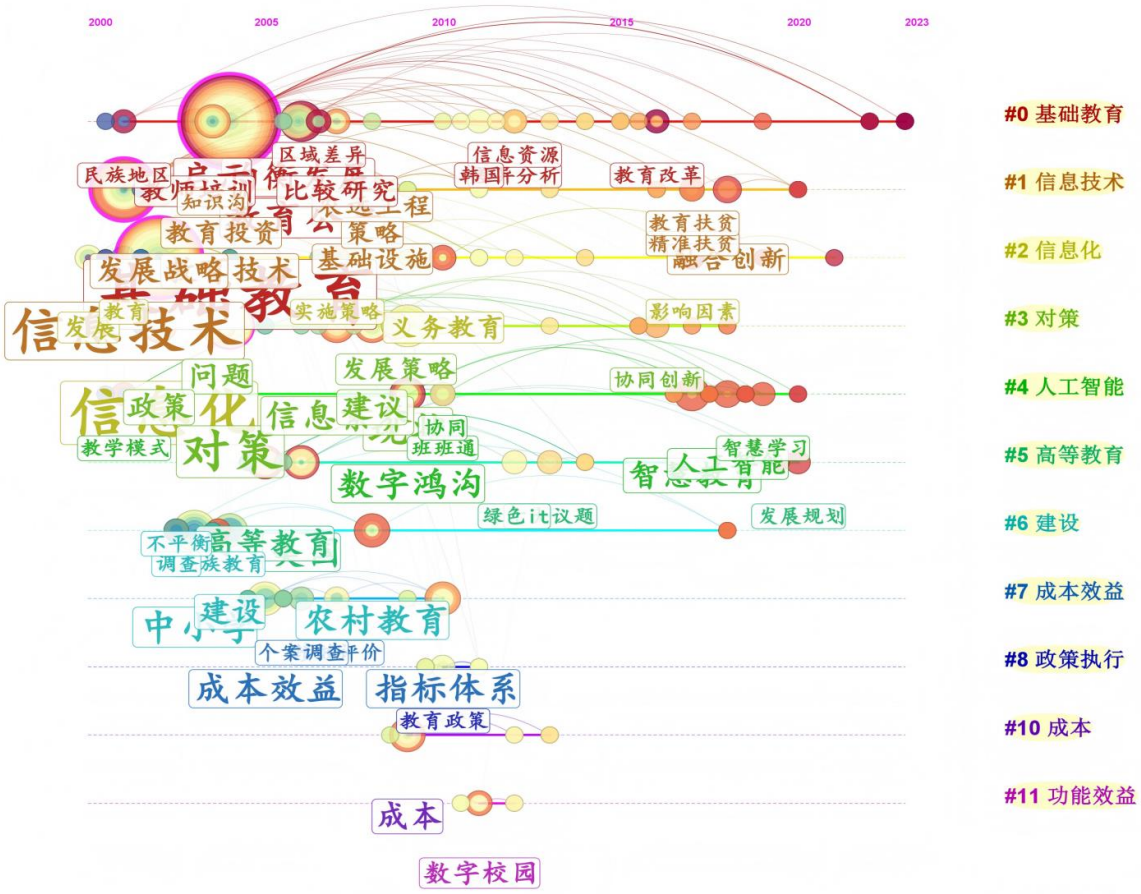


Fig. 3 Keyword timeline map for IT applied in researching fiscal expenditure on education-based.

As shown in Fig. 3, between 2000 and 2001, with the development of digital technology in China, a small number of scholars began researching the investment and development of information technology in education. From 2004, basic education became a hot topic in the field, and it continued to be frequently mentioned in research until 2023. This indicates that most researchers have focused on compulsory education and general high school education. Between 2004 and 2007, the volume of research in China's educational informatization field increased sharply, with a diversification of research types. Some researchers began comparing the educational informatization differences between China and Western countries--since Western countries developed information technology earlier, these studies aimed to provide references for China regarding funding investments, research topics, and implementation strategies in educational informatization. From 2007 to 2016, the number of studies in China's educational informatization field fluctuated, with the focus shifting to educational equity, such as "regional differences", "urban-rural disparities", "information resources", and "infrastructure." This suggests that national educational funding was primarily allocated to building information technology infrastructure. Between 2016 and 2019, with the improvement of campus internet access and the national strategy of becoming a strong education nation, research focused on areas such as targeted poverty alleviation and educational poverty alleviation. Some literature offered opinions and countermeasures based on policy research. In addition, a significant amount of literature began studying the application of artificial intelligence in education, marking a reform and innovation in educational methods. However, while the rapid development of information technology has brought conveniences to education, it also presents numerous issues. From 2022 to 2023, ethical issues related to educational informatization began to emerge, such as the negative impact of artificial intelligence on students in the basic education stage.

4. Overview of Important Research Directions

In order to promote the accuracy of the analysis, based on the clustering information provided by CiteSpace software, this study uses keywords to trace back to the target literature, and recombines the similar clusters according to the similarity of literature content. The result is shown in Fig. 4. Through the above steps, the research on the application of information technology in education and its financial problems presents three main directions: the application of information technology and fiscal support in education, the efficiency and cost and construction effect of fiscal investment, and the fiscal policy implementation and countermeasures.

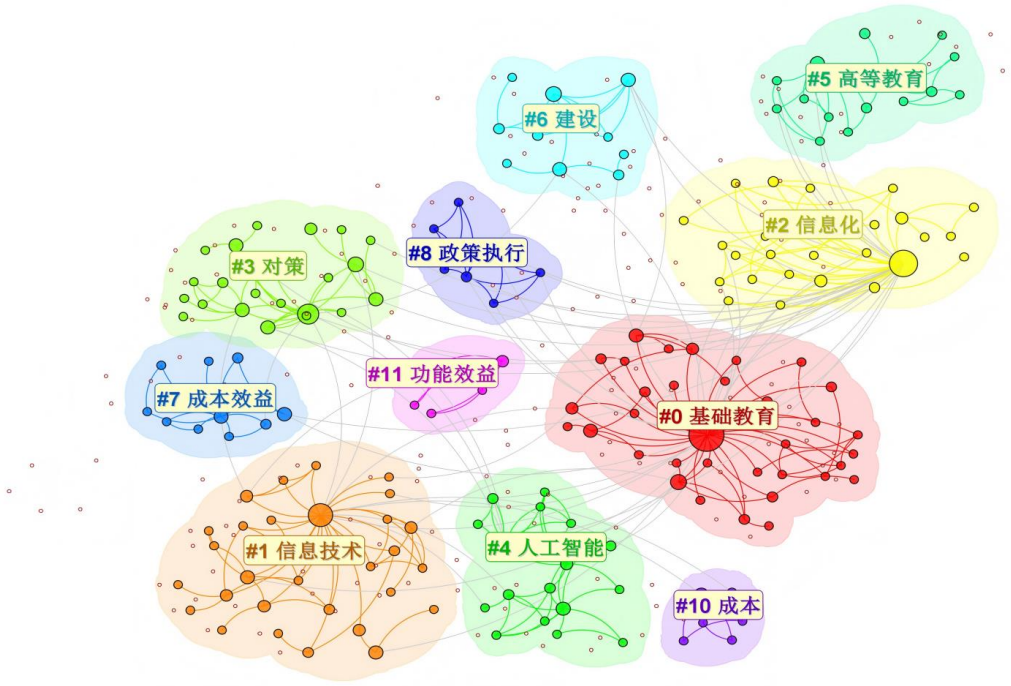


Fig. 4 Keywords clustering map of financial research on the application of information technology in Education.

4.1. Application of Information Technology and Fiscal Support in Education

Finance plays a fundamental and strategic role in the informatization construction of different education stages. It not only provides hardware and resource support but also has a profound impact on the overall pattern of education equity and quality. In terms of basic education, Xiaohong Yang and others found limitations in the selection of current policy tools, and put forward a path to optimize fiscal and policy arrangements [8]. Zhuo Chen revealed that the investment in education informatization has a significant threshold effect on the improvement of the overall level, which means that finance can not only promote education equity, but also lead to the re differentiation of education resources due to distribution differences [9]. In terms of higher education, Mingzhuo Liu and others pointed out that fiscal investment is a necessary condition for the informatization construction of colleges and universities, but it also revealed the institutional constraints beyond finance [10]. It shows that it is difficult to comprehensively deepen informatization by relying on finance alone.

4.2. Efficiency, Cost and Construction Effect of Fiscal Investment

The efficiency of fiscal investment in the development of education informatization is a core issue discussed by the academic community in recent years.

Eryong Xue and others proposed that no less than 8% of the education funds should be disbursed as the basic guarantee standard. They stressed that the investment should take into account the scale and efficiency. They advocated the construction of a diversified investment system for the

government, society, schools and families, the establishment of an investment benefit evaluation system, the monitoring and evaluation throughout the whole process of the project, and the optimization of the cost structure by expanding the autonomy of funds and purchasing services, indicating that the innovation of investment mode and performance supervision are crucial to improving cost efficiency [11]. Shimei Han found that although 97.6% of primary and secondary schools have network access, there is a significant gap between urban and rural areas and regions, and only basic equipment is available in rural areas [12]. The fiscal investment has "tried again and played down the balance", but the short-term effect has exacerbated the gap, suggesting the need to balance fairness and efficiency, and optimize the structure through preferential policies.

Therefore, optimizing the allocation structure of financial funds and improving the efficiency of input and output has become an important direction of current research. Relevant research has gradually promoted the focus of academic discussion to the comprehensive analysis of input structure, use efficiency and long-term results. This change shows that the focus of fiscal policy is moving from "quantitative expansion" to "qualitative improvement".

4.3. Fiscal Policy Implementation and Countermeasures

The implementation effect of fiscal policy is directly related to the implementation degree of education informatization strategy. The allocation, supervision and use mechanism of financial funds not only affects the progress of informatization construction, but also determines the construction effect to a large extent.

Some scholars discussed the implementation effect of fiscal policy from multi-dimensional factors. For example, Wenping Li's research points out that local government demands, education informatization market demands, general public budget education funds and the richness of the resumes of the main leaders of local governments are all important factors to promote the performance of education informatization [13]. The study shows that the implementation of fiscal policy depends not only on the scale of funds, but also on the intention and governance structure of local governments. In order to further stimulate vitality, the researchers suggest that local governments should pay more attention to people's demands, improve institutional security and economic support, and give full play to the role of the market in resource allocation.

Xiaomeng Wu and other scholars stressed that the cooperation of multiple subjects is the premise of the steady progress of educational informatization. She believes that only when the government, schools, parents and enterprises form full cooperation, clear responsibilities and rights, and actively negotiate, and ensure that schools have a certain degree of autonomy, can the construction of educational informatization develop healthily [14]. This view suggests that fiscal policy needs not only financial support, but also multi-party participation and institutional improvement in its implementation.

To sum up, the implementation and improvement of fiscal policy plays a key role in the development of education informatization. Strengthening the implementation of policies, broadening the participants and improving the supervision mechanism are important paths to promote the in-depth development of education informatization.

5. Conclusion

This paper systematically reviews 311 studies on the application of information technology in education and its financial aspects from 2000 to 2024, published in CSSCI core journals, using bibliometric methods. The study reveals the development trajectory, research hotspots, and frontier trends in this field. The research findings are as follows: First, the evolution of China's information technology education finance research is closely related to national policy direction, major projects, and social events, exhibiting a phased characteristic of "initial exploration--steady development --rapid growth--phase retreat." Second, "Basic education", "informatization", and "information technology" have consistently been core topics, reflecting the foundational role of educational

informatization in China's education system. At the same time, it highlights the crucial role of fiscal investment in balancing the urban-rural and regional disparities in educational informatization and confirms that educational equity has been a core issue throughout the research. Furthermore, technological iteration has driven the research direction, with fiscal investment gradually extending from hardware construction to quality-enhancing areas such as technology integration and teacher training. Third, the phased evolution of research frontiers further shows that the focus of research in this field dynamically shifts in response to policy adjustments. In this process, the role of fiscal investment has gradually shifted from "ensuring infrastructure" to "driving quality improvement and sustainable development." However, the funding allocation structure of "emphasizing construction and neglecting application" has not yet been fully improved, and differences in investment efficiency between regions remain a prominent issue.

In conclusion, research on information technology education finance in China has formed a pattern characterized by clear policy-driven initiatives and a focus on specific topics. However, existing studies primarily concentrate on informatization resource allocation, educational equity issues, and investment performance evaluation. There remain concerns, such as the lack of timeliness in some studies, which remain at a macro level and offer generalized discussions on the current situation, policies, and recommendations. Future research should further break through the generalized analysis at the macro level and strengthen empirical exploration in more specific areas, such as precise financial allocation for different educational stages, the long-term funding mechanism for reducing the digital divide, and cost-benefit evaluations of new technology integration. Additionally, tracking studies on the effectiveness of policy implementation should be strengthened, promoting the transformation of fiscal investment from "scale expansion" to "quality and efficiency", and providing more targeted theoretical support and practical guidance for balanced and high-quality development in the era of educational informatization 2.0.

Authors Contribution

All the authors contributed equally, and their names were listed in alphabetical order.

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