



A Review of Research on Information Technology Teaching Problems and Countermeasures in Basic Education in The Past Ten Years——Knowledge Graph Analysis based on Cite Space

Qianxue Zhang^{1a}, Wenjin Shen^{2b}

¹College of Computer and Information Science, Chongqing Normal University, Chongqing, China

²College of Vocational Education Teaching, Chongqing Normal University, Chongqing, China

^a2390614996@qq.com; ^b11319490@qq.com

Abstract. As China's basic education has entered the information age, the importance and necessity of information technology teaching in the basic education stage have become more prominent. The deep integration of informatization, digitalization and education and teaching has pointed out the direction for the teaching reform of information technology. In the past ten years, the results of basic education information technology teaching and research have continued to emerge, which has effectively promoted the rapid development of information technology education practice. In this study, academic papers in the field of information technology teaching in basic education in China in the past ten years were selected as research samples, Cite Space knowledge graph software is used to visually analyze paper information, etc., and summarize the current hot spots of information technology teaching development, in addition, the problems and optimization strategies in the four aspects of information technology teaching objectives, teaching content, teaching methods and teaching resources were sorted out, in order to provide a theoretical reference for the development of basic education information technology teaching.

Keywords: Basic education; Information technology; Research hotspot; Questions; Countermeasures

1 Introduction

In recent years, emerging information technologies such as cloud computing, Internet of Things, virtual reality and big data have had a profound impact on economic development and social life, and have also been widely used in the field of education. In the report of the 20th National Congress of the Communist Party of China, General Secretary Xi Jinping proposed to promote the digitalization of education and build a learning society and a learning country with lifelong learning for all,¹ and strengthening information technology education in primary and secondary schools is the basic requirement

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to achieve this goal. The successive release of China's "Information Technology Curriculum Standards for General High Schools (2017 Edition)" and "Information Technology Curriculum Standards for Compulsory Education (2022 Edition)" is a timely response to the changes in the information age in the construction of basic education disciplines. At present, with the joint efforts of domestic scholars and front-line educators, information technology teaching in basic education has made progress in the field of research and practice, but there are still many problems. Therefore, the analysis of the problems and countermeasures in the teaching of information technology in basic education is helpful to promote the further reform and development of information technology teaching in basic education.

2 Data sources and methodology

A total of 1085 relevant literature was retrieved as the sample data of the research by searching the academic papers published in China from 2012 to 2023 with the keywords of "information technology", "primary and secondary schools" and "basic education" in CNKI. In this study, the Cite Space knowledge graph analysis technology was used, combined with bibliometric, content analysis and citation analysis, to visualize the literature and obtain the knowledge graph of information technology teaching and research in basic education. On this basis, the teaching practice problems and solutions found in the research of information technology teaching in basic education are summarized.

3 The basic situation of information technology teaching and research in basic education in the past ten years

3.1 The distribution of the number of literature

To a certain extent, the number of published papers reflects the attention of the academic community to the teaching and research of information technology in basic education. By analyzing the statistical chart of the number of papers published in the literature of China's basic education information technology teaching research from 2012 to 2023 (as shown in Figure 1), it can be found that the annual number of papers published is closely related to the promulgation of basic education information technology curriculum policies. In 2012, the Ministry of Education issued the "Ten-Year Development Plan for Education Informatization (2011-2020)", and 91 articles were published that year. In 2017, the Ministry of Education issued the "Curriculum Guidelines for Comprehensive Practical Activities in Primary and Secondary Schools", which systematically designed 25 learning themes such as "Introduction to Interesting Programming", "Into the World of Programming" and "First Experience of Open Source Robots" to guide schools to organize students to learn.²In the same year, the Ministry of Education issued the "Information Technology Curriculum Standards for General High Schools (2017 Edition)", and in 2018, the Ministry of Education formulated and implemented the "Education Informatization 2.0 Action Plan".

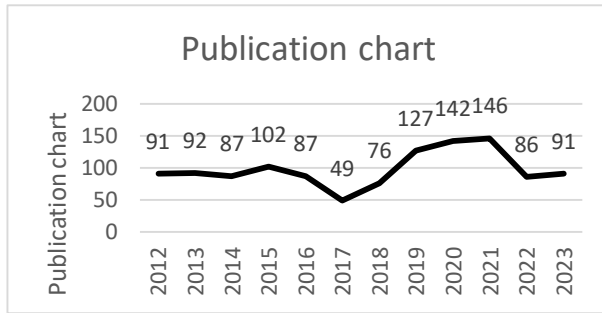


Fig. 1. Trend of the number of published literature on information technology teaching and research in basic education from 2012 to 2023

3.2 Authors distribution of the literature

The author co-occurrence map with the number of nodes of 85 and the number of connections of 13 was finally obtained by using Cite Space software to draw the author co-occurrence map (see Fig. 2). The number of connections represents the connection between nodes, the more connections represent the closer the connection between nodes, and the fewer connections represent the less connections between nodes. It can be seen that there is little cooperation among authors in the field of information technology teaching and research in basic education in China, and most of the authors are mainly independent researchers, and academic exchanges and cooperation among scholars need to be improved.

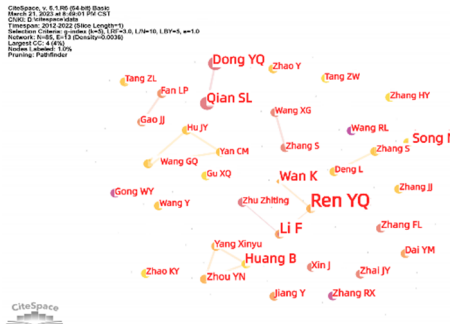


Fig. 2. Co-occurrence map of information technology teaching research in basic education from 2012 to 2023

3.3 Distribution of research institutions

Academic institutions are the main force in carrying out information technology teaching and research in basic education. Using Cite Space software to visualize the co-occurrence map of research institutions (as shown in Figure 3), it was found that in the past ten years, the distribution of academic institutions in China's basic education

information technology teaching and research has the following characteristics: first, higher normal colleges are the main force of research, but there is a lack of connection between research institutions, indicating that there is a lack of cooperation between research institutions, and independent research is the mainstay; Second, compared with universities and specialized research institutions, the proportion of front-line teachers in primary and secondary schools participating in the teaching and research of information technology in basic education is relatively small.



Fig. 3. Co-occurrence map of information technology teaching and research institutions in basic education from 2012 to 2023

3.4 Keyword analysis of information technology in basic education

Statistical analysis of keyword frequency.

Centrality refers to the fact that the word is heavily quoted in a short period of time. From the frequency and intermediary centrality of Table 1, it can be seen that the keywords closely related to the teaching and research of information technology in basic education in the past ten years are information literacy, computational thinking, maker education, artificial intelligence, teaching mode, teaching objectives, etc. The top 20 high-frequency keywords are shown in Table 1.

Table 1. Keyword centrality statistics of information technology teaching in basic education from 2012 to 2023 (Top 20)

| Serial number | Frequency | Centrality | year | keyword |
|---------------|-----------|------------|------|-------------------------|
| 1 | 297 | 0.33 | 2012 | Information technology |
| 2 | 164 | 0.09 | 2012 | Schools |
| 3 | 52 | 0.48 | 2012 | Information literacy |
| 4 | 34 | 0.63 | 2013 | Computational thinking |
| 5 | 30 | 0.2 | 2016 | Maker education |
| 6 | 29 | 0.03 | 2018 | Artificial intelligence |
| 7 | 25 | 0.53 | 2012 | Teaching mode |
| 8 | 24 | 0.05 | 2012 | Teaching objective |
| 9 | 19 | 0.17 | 2015 | Microlecture |
| 10 | 19 | 0.09 | 2013 | Basic education |
| 11 | 17 | 0.03 | 2015 | Flipped Classroom |

| | | | | |
|----|----|------|------|-----------------------|
| 12 | 17 | 0.06 | 2017 | Core competencies |
| 13 | 16 | 0.14 | 2012 | Teaching |
| 14 | 15 | 0.2 | 2012 | Informatization |
| 15 | 15 | 0.43 | 2012 | Classroom teaching |
| 16 | 14 | 0.03 | 2020 | Online teaching |
| 17 | 14 | 0.53 | 2012 | Course integration |
| 18 | 13 | 0.17 | 2012 | Teaching strategies |
| 19 | 11 | 0.12 | 2015 | Teacher |
| 20 | 11 | 0.06 | 2018 | Programming education |

Keyword clustering map analysis.

In the keyword clustering analysis map, the module value Q is 0.7924, indicating that the cluster structure is significant. The S value is a parameter to measure the homogeneity of the clustering network, and the average S of clustering in the study is 0.947, indicating that the clustering credibility is high. Table 2 shows the specific situation of keyword clustering, a total of 10 cluster labels are formed, and it can be seen from the table that the research topics in this field are concentrated in four aspects: teaching objectives, teaching content, teaching methods, and teaching resources.

Table 2. Network clustering table of key words co-occurrence in information technology teaching in basic education from 2012 to 2023

| Cluster labels | S | Top Terms (LSS) |
|---------------------------------|-------|---|
| 0# Information technology | 1 | Cooperative learning ; Wisdom classroom |
| 1# Computational thinking | 0.984 | Programming education ; Core quality |
| 2# Information literacy | 0.886 | Cultivate ; Promotion |
| 3# Teaching objectives | 0.984 | Educational reform ; Informatization |
| 4# Task-driven | 0.907 | Interest ; Teaching process |
| 5# Flipped classroom | 0.979 | Micro lesson ; Digital campus |
| 6# Maker education | 0.878 | Robot teaching ; Innovation ability |
| 7# Primary and secondary school | 1 | Teaching strategy ; Curriculum construction |
| 8# Internet+ | 0.848 | Teaching mode ; Teaching reform |
| 9# Classroom teaching | 0.987 | Problem ; Conformity |

4 Analysis of problems existing in information technology teaching practice in basic education

According to the results of cluster analysis, it is found that the research on information technology teaching in basic education in recent 10 years mainly focuses on four aspects: teaching objectives, teaching content, teaching methods and teaching resources. In these four areas, researchers focus on analyzing the problems existing in teaching practice and propose solutions.

4.1 The design of teaching objectives is not scientific

In 2000, the Ministry of Education issued the "Information Technology Curriculum Guidelines for Primary and Secondary schools", and for the first time took information literacy as the curriculum goal of cultivating students.³ In April 2022, the Ministry of Education officially promulgated the Information Technology Curriculum Standards for Compulsory Education, which pointed out that the core literacy to be cultivated in information technology courses mainly includes information awareness, computational thinking, digital learning and innovation, and information social responsibility, and these four aspects support and penetrate each other to jointly promote the improvement of students' digital literacy and skills.⁴ The education goal of information technology curriculum has changed from the original cultivation of information literacy to the cultivation of digital literacy, which indicates that the training goal of information technology curriculum in our country has changed with the changes of The Times.

There is a lack of scientificity in the design of information technology teaching objectives in basic education. When designing specific teaching objectives, there may be some lack of curriculum content and core literacy elements of the subject.⁵ At present, the design of teaching objectives still has some problems, such as focusing on a certain dimension, splitting teaching objectives, unclear expression and too much description.⁶

4.2 The teaching content arrangement is not reasonable

In the content of information technology teaching in basic education, there are some problems such as slow updating of knowledge and lack of ethical education. The traditional teaching of information technology in primary and secondary schools mainly focuses on the content of textbooks, pays attention to the basic systematic operation and learning, and the knowledge update is slow, lack of challenges, and has limitations.⁷ The practical operation teaching of Office software is still the main content of the current information technology curriculum, but the curriculum content of different schools in different regions has not formed a unified standard and process.

In general, most scholars focus on the content of knowledge learning, and few scholars realize the significance of information ethics issues for students' development. Although individual studies have discussed information ethics education, they still lack theoretical height and practical depth.

4.3 The teaching method is simple

Scientific teaching methods are helpful to realize the high efficiency of information technology classroom in primary and secondary schools, but the research on teaching methods mostly stays at the theoretical level and is not strong in practice. At present, the teaching methods of information technology teaching are relatively simple, and some information technology teachers still use relatively old information teaching methods, which lack flexibility and scientific design. The teaching methods are detached from the teaching content and float on the surface, which hinders the improvement of students' information technology literacy and information level.⁸ The particularity of the subject of information technology requires scholars to constantly explore the teaching methods suitable for this subject.

4.4 The construction of teaching resources is not perfect

There are two main problems in the practice of information technology teaching resources in basic education. The first is the problem of offline resources, teaching materials are not unified, lack of systematic, over-emphasis on technical and operational. At present, there is no unified information technology teaching material in China. Most of the current writing concepts of information technology teaching materials take knowledge training as the main teaching goal and computer operation as the design orientation.⁹ At present, the content of technical aspects in textbooks at all levels is far more than the explanation of guiding ideology and values of information acquisition, transmission, processing, analysis and application. The second is the problem of online resources, teaching resources are not perfect. However, there is no unified platform resource at present, and the development of the platform has limitations.

5 Research on countermeasures of information technology teaching in basic education

5.1 Based on the core quality of the subject, design science teaching objectives

When designing specific teaching objectives, we should pay attention to the fact that the four elements of subject core literacy are not parallel in curriculum implementation. In order to better guide teaching, some scholars put forward a design idea dominated by computational thinking, which emphasizes the integration of computational thinking into teaching activities to cultivate students' logical thinking, problem-solving ability and innovative spirit, thus helping to improve students' core literacy of disciplines. More importantly, it should be noted that the cultivation of students' literacy is a dynamic process of continuous improvement. In different classes, students learn different contents of information technology, so they should focus on the cultivation of subject core literacy.¹⁰

5.2 Renew the teaching content and realize the discipline education

The information technology teaching oriented to the core literacy of the subject can be based on the big concept of the subject, develop from the traditional lesson design to unit design, explore the interdisciplinary theme design based on the big unit, and promote the development of information technology teaching from knowledge orientation to discipline education. In the selection of teaching content, we should focus on the general information technology knowledge and skills needed by students in their future life development, and different classes should be connected with each other in content and level.¹¹

5.3 Improve teaching methods and promote integrated development

Teaching methods infiltrate each other and cross continuously, and finally merge into a new teaching method, which is the trend and realistic choice of the steady development of teaching methods. In practical teaching, teachers should constantly sum up experience and gradually improve teaching methods to ensure that they can adapt to the changes of teaching background and teaching objects.

5.4 Enrich teaching resources to make up for resource gaps

The scholars put forward their opinions on the construction of online resources from three aspects: government, school and teachers. The government should strengthen the integration of resources within the region, build a "cloud platform" at the regional level to share high-quality education resources, expand the coverage of high-quality digital education resources in primary and secondary schools, communicate with each school, build a subject curriculum resource library, and promote excellent teachers to share experience. Schools should create a pan-information campus environment, carry out the construction of educational resources, promote the open sharing of resources, provide digital teaching resources, and build digital campuses. Teachers need to improve their professional level, explore innovative teaching, and create demonstration lessons.

6 Conclusions and prospects

6.1 Conclusions of the study

From the perspective of research content, the research results of information technology teaching in basic education in the past ten years are relatively rich, and through the cluster analysis of keywords, it is found that the research on information technology teaching in basic education mainly focuses on five aspects: teaching objectives, teaching content, teaching organization form, teaching methods and teaching resources, but there is a lack of evaluation research on the teaching effect of information technology in basic education.

From the perspective of research paradigm, the research results are mainly theoretical research, and there are few empirical studies. There is a lack of empirical research

closely combined with the practice of information technology teaching, which leads to the lack of practicality of some research results. At present, the most empirical research topics in information technology teaching are pedagogical methods and strategies, but almost all of them only involve a single teaching method and strategy.

6.2 Research Prospects

Transform multiple research perspectives.

The teaching and research of information technology in basic education should change multiple perspectives and enrich the entry points of research. The teaching and research of information technology in basic education should jump out of the discipline itself, absorb the nourishment of different disciplines, and learn from the theories, methods and practical experience of other disciplines, so as to provide new ideas for information technology teaching, so as to promote the diversification of research results. In the future, the research on information technology teaching in basic education should strengthen the integration with related disciplines, conduct interdisciplinary research on the problems existing in the current information technology teaching and research from the perspective of Chinese, mathematics, physics and other disciplines, and find innovative points in the cross-field research of information technology teaching.

Enrich the relevant research content.

At present, the research on information technology teaching in basic education basically runs through the whole process of teaching, but the research content needs to be further enriched and refined. For example, the information technology teaching objectives are hierarchically refined, reconstructed; It can also be combined with the actual teaching to conduct targeted research on the application effect of specific teaching content in teaching. At the same time, in the research of information technology teaching, it is necessary to increase the research content of teaching evaluation, apply new teaching methods and teaching methods to actual teaching, and verify their scientificity and practicability through teaching evaluation.

Optimize the cooperative research of the main structure.

Collaboration between researchers and institutions needs to be strengthened. In view of the current situation that the number of cooperative research nodes in the field of information technology teaching in basic education is small and the correlation between related research institutions is few, relevant researchers and research institutions should increase cooperation in future research in this field, build more and more influential research teams, improve scientific research efficiency, and optimize and promote scientific research results, so as to improve teachers' professional ability and help information technology classrooms.

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