



Research on the Teaching Strategies for Implementing Core Literacy in Mathematics in Domestic Primary and Secondary Schools: A Visual Analysis Based on CiteSpace

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Abstract

This paper aims to explore the current research status and hotspots of teaching strategies for the implementation of core mathematical literacy in primary and secondary schools, and predict future academic frontiers. By using CiteSpace 6.2.R6 to search for 833 valid documents with the title of “mathematics & core literacy & teaching” in CNKI from 2015 to 2024, this paper analyzes the publication volume, keyword co-occurrence, and so on to reveal the development trend and research hotspots in this field. The research shows that the number of publications has been steadily increasing. The research hotspots can be classified into three categories: the core mathematical literacy and educational concepts focus on the understanding of the concept itself; the school stages and teaching contents emphasize student-centeredness, adapting teaching contents; teaching methods and strategies stress the innovation of various teaching models. Finally, three suggestions are proposed: strengthening the research on the connection between different school stages and subject integration; increasing guidance for teachers in implementing teaching models; and strengthening the practical verification and effect evaluation of teaching strategies.

Keywords

Core Literacy; Mathematics; Primary and Secondary Schools; Teaching Strategies

Introduction

China’s basic education reform has made core literacy the focus of mathematics curriculum reform. In 2014, the “Opinions of the Ministry of Education on Comprehensively Deepening Curriculum Reform and Implementing the Fundamental Task of Moral Education” first proposed the concept of “core literacy”, clarifying the core literacy system for students at all levels. In 2017, the “General High School Mathematics Curriculum Standards” further condensed the core competencies of mathematics into six key elements, providing clear target guidance for mathematics teaching. In 2022, the “Compulsory Education Mathematics Curriculum Standards” once again emphasized the orientation of core literacy, advocating the promotion of the all-round development of students’ mathematics literacy through structured teaching, situation creation, and cross-disciplinary practice etc.

However, in practice, there are still problems such as more theoretical discussions, less systematic research, and

the dominance of traditional teaching. Therefore, this study uses CiteSpace to deeply analyze the current research status of domestic mathematics core literacy teaching strategies, aiming to provide guidance for teaching practice and promote the effective implementation of core literacy.

1. Research Subjects and Tools

The data for this study were obtained from the CNKI database. An advanced search was conducted using the keywords “core literacy”, “mathematics”, “teaching”, “teaching methods”, “teaching models”, etc. The search period was from January 1, 2015, to December 31, 2024, resulting in a total of 4,188 documents. After manual screening, 833 valid documents were selected as the research samples. Using the CiteSpace 6.2.R2 tool, a visual analysis of the teaching strategies for mathematics core literacy was conducted from the perspectives of publication trends, keyword co-occurrence, and clustering.

2. Analysis of Research Results

2.1 Analysis of publication volume

Analyzing the number of publications in this field can help determine the level of academic attention to this topic and provide an understanding of the overall research status of the field. As shown in Figure 1, from 2015 to 2024, the number of publications related to this research has increased year by year, indicating a strong academic interest. It can be divided into three stages. From 2015 to 2018, the annual number of publications increased rapidly, responding to the promulgation of the “General High School Mathematics Curriculum Standards (2017 Edition)”. From 2019 to 2022, the research on this topic showed a slow upward trend. From 2023 to 2024, the growth rate was the highest, which was after the release of the 2022 version of the new curriculum standards, and the research has become increasingly mature and diversified. This indicates that policy guidance and the value of subject literacy have jointly promoted the continuous deepening of research in this field.

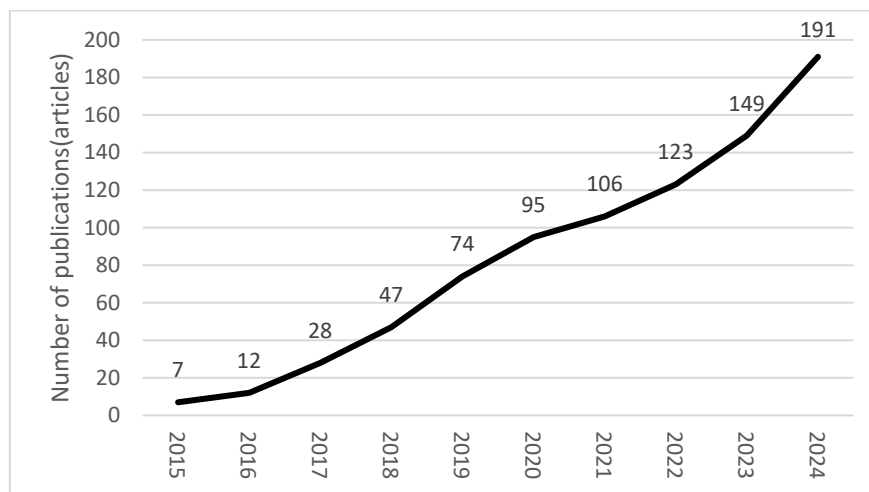


Figure 1. Trend Chart of Publication Volume.

2.2 Co-occurrence analysis of keywords

The co-occurrence map of keywords can visually and clearly present the research hotspots and future development trends in this field. As shown in Table 1, the research map in this study contains 273 nodes and 449 connections. The high-frequency keywords include “core literacy”, “mathematics teaching”, “teaching strategies”, etc., indicating that the research focus is on how to innovate teaching strategies, giving rise to models such as stratified teaching and situational teaching. Artificial intelligence technology diversifies and makes teaching methods novel. Future research will continue to explore the application of intelligent technology to achieve core literacy in primary and secondary school mathematics and promote the improvement of basic education quality.

Table 1. Co-occurrence of keywords in the field

Importance	Keywords
Main keywords	Core Literacy, Primary Mathematics, Junior Middle School Maths, Senior High School Mathematics, Instructional Strategy, Teaching Design, Information Technology, Classroom Teaching
Secondary keywords	Deep Learning, Teaching by Units, Big concept, mathematical thinking, teaching practice, stratified teaching, situational teaching, mathematical modeling, Smart Classroom, interdisciplinary, job design

2.3 Key words clustering analysis

The keyword clustering map can categorize keywords. As shown in Figure 2, $Q = 0.6388 > 0.3$, indicating that the clustering effect is at a significant level; $S = 0.8995$, indicating that the clustering reliability is high.

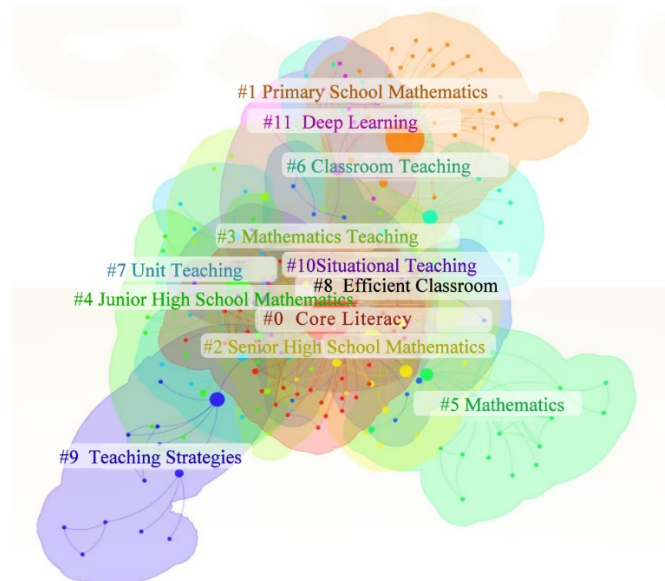


Figure 2. Cluster Map of Keywords.

Based on the 12 generated clusters, this paper classifies the research in this field into three categories: research on mathematical core competencies and educational concepts, research on core competencies in different grades and contents, and research on teaching methods and strategies based on core competencies, as shown in Table 2 below:

2.3.1 Core competencies in mathematics and educational philosophy

In this regard, #0 core competencies, #5 mathematics reflect scholars' understanding and research on the concept and components of core competencies in mathematics. #3 Mathematics teaching reflects researchers' attention to mathematics teaching practice, proposing from a macro perspective the concepts of mathematical literacy, effective strategies, and practical paths (Ren, 2024). Therefore, educators should design effective teaching strategies to promote students' active participation and in-depth thinking in mathematics learning.

2.3.2 Educational stages and teaching content

This clustering reflects the different needs and focuses of mathematics teaching content in different educational stages. #1 Primary school mathematics emphasizes practice and homework design, cultivating basic abilities. #4 junior high school mathematics focuses on differentiated teaching and variant teaching to develop thinking character (Dong, 2023), to adapt to the learning needs and ability levels of different students. #2 high school mathematics highlights context creation and mathematical modeling, emphasizing the combination of core competencies and the demands of the times. Therefore, the design of teaching content should match the cognitive development stage of students.

2.3.3 Teaching methods and strategies

The research on teaching methods and strategies focuses on innovative teaching models. High centrality #7 unit teaching, #10 situational teaching, and #11 deep learning are key methods for promoting the implementation of core competencies. Scholars emphasize structured design (Ma, 2023) and mathematical culture cultivation (Zhang, 2023). “Blended teaching” reflects the teaching procedure of the CTI model (Yu, 2023). In addition, the “Education Informatization 2.0 Action Plan” promotes the deep integration of information technology and mathematics teaching, and keywords such as “micro-lesson” and “informationization” indicate that scholars are striving to create a fully visual intelligent classroom. In conclusion, current teaching strategy research is shifting from single knowledge transmission to competency-oriented teaching design, emphasizing context creation, interdisciplinary integration, and technology empowerment, providing multiple paths for the implementation of core competencies.

Table 2. Keyword Clustering Statistics

Clustering	Sub-clustering Number	Size	Centrality	Keywords
Mathematical Core Competencies and Educational Philosophy	#0Core Literacy	42	0.957	Cultivation path, Practice research, Inferential capability
	#5Mathematics	18	0.884	Strategy, the ability of thinking, calculate mathematical literacy, effective strategy, interdisciplinary, implement approach
	#3Mathematical Education	24	0.925	teaching practice, job design, inferential capability
	#1Primary Mathematics	41	0.959	
Educational Stage and Teaching Content	#4Junior Middle School Maths	20	0.699	stratified teaching, Variation Teaching
	#2Senior High School Mathematics	29	0.874	training strategy, informatization, mathematical modeling, situation
	#6Classroom Teaching	16	0.958	mathematical thinking, new curriculum standard, apply
	#7Teaching By Units	15	0.904	teaching design, Micro-lesson, key elements
Teaching methods and strategies	#8Efficient Classroom	14	0.904	information technology, construction strategy, reading ability, mathematics reading
	#9Instructional Strategy	13	0.905	Big concept, reversal design, Experimental characteristics
	#10Situational Teaching	13	0.793	mathematical culture, systematic thinking, curriculum standards, situated cognition
	#11Deep Learning	11	0.882	Structuralization, Blended learning

2.4 Keyword salience analysis

The time sequence of the CiteSpace software was used to construct the time when the high-frequency keywords appeared in this field and the periods of their sudden changes, presenting the sequence of the appearance of 20 thematic words and their intensity change characteristics over the past ten years. The boldness of the keyword font indicates the research heat and attention intensity in a specific year. Figure 3, from the perspective of the emergence intensity, the emergence intensity of “layered teaching” is the highest, at 4.61, indicating that layered teaching is conducive to the implementation of core mathematical literacy in primary and secondary schools. “Smart classroom”, “teaching strategies”, etc., have the second-highest intensity, reflecting the trend of integrating intelligent technology and exploring diverse teaching methods.

By organizing according to the time sequence of keyword emergence, it was found that from 2015 to 2018, the research was in the initial exploration stage, focusing on training approaches and practical paths, which were requirements for the implementation of mathematical literacy from a macro perspective. From 2019 to 2020, scholars explored different teaching methods based on students' physical and mental development and differences. There is no fixed teaching method. The key is to focus on the students and consider their development patterns. Gradually develop the core competencies of mathematics in a step-by-step manner (Shi, 2017). From 2021 to 2024, this stage focused on systematicness, subjectivity, and depth. Scholars relied on AI technology to deepen systematic research and formed diversified teaching strategy systems, such as variant teaching and mathematical modeling.

Top 20 Keywords with the Strongest Citation Bursts

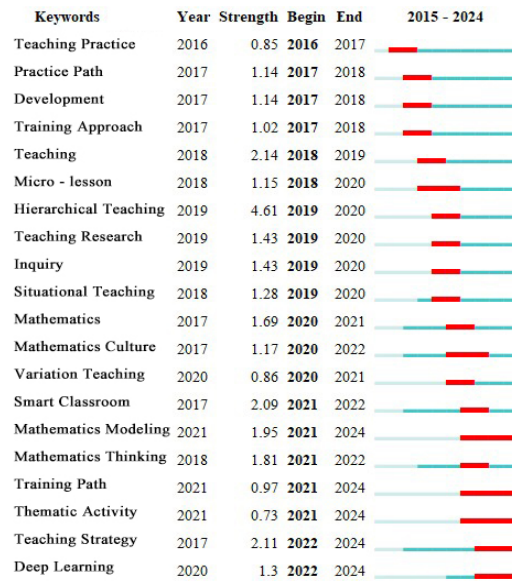


Figure 3. Key Words Emergence.

2.5 Key words: Time zone analysis

The hotspot time zone map can effectively present the spatiotemporal distribution characteristics and dynamic evolution patterns of the research topic. As shown in Table 3, from 2015 to 2024, “core literacy” has been consistently present throughout the research on mathematics teaching in primary and secondary schools. From 2015 to 2018, Based on “Primary and secondary school mathematics”, focusing on mathematics teaching and teaching practice to cultivate students' core mathematical literacy, this approach aligns with the characteristics of the initial stage of core literacy proposal, when the academic community was exploring the implementation paths of core literacy in mathematics teaching at different educational stages. The implementation of core literacy should start from teaching practice and establish the connection between grades and literacy (Cui, 2017). From 2019 to 2021, the integration of information technology became a hot topic, and “informationization”, “deep learning”, and “smart classrooms” were important research topics in the academic community. Promoting students’ deep thinking through teaching and technology can optimize teaching strategies (Zhong, 2020). From 2022 to 2024, the “Compulsory Education Mathematics Curriculum Standards (2022 Edition)” emphasized promoting “unit teaching” research and emphasizing the connection between knowledge, logic, and literacy. Then, “big concepts” and “big units” became an advanced direction, focusing on holistic teaching. At the same time, hot words such as “interdisciplinary learning” and “problem situations” emerged, indicating that the cultivation of core literacy is trending towards practicality and life-orientedness. In the future, these directions will continue to deepen to respond to the practical needs of literacy cultivation.

Table 3. Research hotspot trend

2015-2018	This stage focuses on core literacy, mathematics, mathematical literacy, and job design
2019-2021	This stage focuses on classroom teaching, information technology, teaching design, instructional strategy, life teaching, stratified teaching, deep learning, teaching by units
2022-2024	This stage focuses on the new curriculum standard, teaching method, mathematical modeling, interdisciplinary, large-unit teaching, smart classroom, mathematical culture

3. Conclusion and Prospect

3.1 Conclusion

The visualization analysis based on CiteSpace shows that the research on teaching strategies for core mathematics literacy in primary and secondary schools in China has been on a continuous growth trajectory, mainly focusing on three major directions: theoretical construction of core literacy, teaching practice by grade, and innovation in teaching models. The research process has three distinct progressive stages. In the initial stage (2015-2018), the emphasis was on theoretical exploration; in the middle stage (2019-2021), it shifted towards the integration of technology and teaching; and in the recent stage (2022-2024), it has been concentrating on unit-based integrated teaching and cross-disciplinary practices, providing a systematic theoretical framework and practical path for the future implementation of core literacy.

3.2 Prospect

Based on the above conclusions, this paper proposes the following areas for further exploration.

3.2.1 Strengthen the research on cross-grade transition and subject integration

The current research lacks in terms of stage transition and interdisciplinary integration. In the future, it is necessary to explore the establishment of a progressive cultivation system for the core competencies of mathematics in primary, junior high and senior high schools, emphasizing the consistency of teaching strategies between different stages; promote interdisciplinary teaching practices, and facilitate students' comprehensive application of knowledge through thematic and project-based learning; strengthen collaborative innovation among teachers, and integrate resources to develop effective interdisciplinary teaching strategies.

3.2.2 Strengthen the guidance for teachers on implementing teaching methods

Although the academic community has proposed innovative strategies such as tiered teaching, unit teaching, and smart classrooms, front-line teachers are still in a state of "learning from books but understanding superficially" when it comes to practical application. We can enhance teacher training to improve their understanding of core concepts and their ability to use information technology, ensuring that teaching strategies can truly be implemented and achieve results.

3.2.3 Practical verification and effect evaluation of strengthened teaching strategies

The current teaching strategies need to enhance empirical research. This can be verified through educational experiments in multiple regions and of various types of schools. Furthermore, a scientific core literacy evaluation system should be established, and methods such as process assessment should be adopted to track the development of core literacy, providing a basis for strategy optimization and promoting the transformation of achievements.

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