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Analysis of Research Hotspots and Future Trends in Digitalization of Early Childhood Education in China

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Abstract

With the continuous advancement of the digitalization process in education, research on digitalization in the field of early childhood education has gradually become a research hotspot in the academic community. To comprehensively explore the current research status and development trends of digitalization in early childhood education in China, this paper uses 618 related documents included in China National Knowledge Infrastructure (CNKI) from 2004 to 2024 as the data source. Through the CiteSpace6.4.R1 visualization analysis tool, it constructs the publication volume trend chart, keyword co-occurrence chart, keyword clustering chart, keyword burst chart, and keyword time zone chart, aiming to provide in-depth analysis and references for the academic development in this field. The research results show that the research in this field is generally on the rise, with research hotspots mainly focusing on the application of information technology, digital literacy of early childhood teachers, artificial intelligence, and educational informatization. Based on the current research status, future researchers should deepen the theoretical research on digitalization in early childhood education, expand the application of digital technologies, promote the digital transformation of home-school co-education, and build a scientific evaluation system. At the same time, they should strive to explore localized implementation strategies that suit China's actual conditions, thereby promoting the overall improvement of preschool education quality.

Keywords

Early childhood education; Digitalization; Visualization analysis; CiteSpace

Introduction

In 2018, the release of the *Education Informatization 2.0 Action Plan* by the Ministry of Education signaled China's shift from education informatization 1.0 to 2.0. The "Three Fulls, Two Highs, and One Large" goal covered preschool education, promoting digital resource construction in kindergartens. In 2021, the *Action Plan for Preschool Education Development during the 14th Five-Year Plan Period* aimed to enhance kindergarten informatization, popularize quality digital resources, especially in rural areas. It was the first to include preschool education digitalization in the national plan. In 2023, the *Teacher Digital Literacy standard* was issued, laying a foundation for practical exploration. These policies highlight digitalization's importance in high-quality preschool education. Against this backdrop, this paper uses CiteSpace 6.4.R1 to analyze research on preschool education digitalization, understand the current status, and offer references for future academic research.

1. Research Object and Tools

This study uses China National Knowledge Infrastructure (CNKI) as the data source, covering the period from January 1, 2004, to December 31, 2024. The search keywords are "preschool education" or "early childhood education" and "digitalization", "informatization", "digital intelligence", "artificial intelligence", etc. 618 valid documents were finally selected. Parameters were set within the CiteSpace 6.4.R1 software, with the time period from 2004 to 2024. Based on these parameters, many maps were generated to explore the research hotspots and future research trends of digitalization in preschool education in China over the past two decades.

2. Analysis of Research Hotspots Results

2.1 Publication Volume Analysis

The number of research articles and their time distribution indicate a field's development trend (Yu Xingman & Li Deming, 2023). As shown in Figure 1, from 2004-2010 was the exploration stage with 2-4 annual publications. From 2011-2019, it was a rapid-growth period with fluctuating growth in the number of documents. Since 2020, it is the deepening stage, maintaining growth despite some fluctuations. This is due to national-level informatization policies like the *14th Five-Year Plan for National Informatization*. These policies support preschool education digitalization, promoting the continuous development of China's educational digitalization and in-depth research.

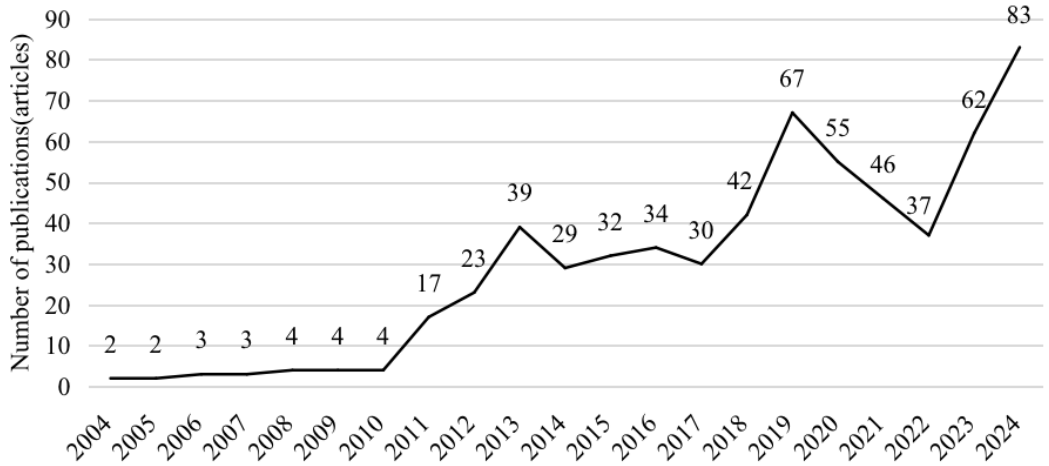

Figure 1. Line chart of publications from 2004 to 2024.

2.2 Co-occurrence Analysis of Keywords

By analyzing the co-occurrence graph of keywords, the main research directions and hotspots in a certain field during a corresponding period can be better reflected. The co-occurrence graph of keywords has 318 nodes and 474 connections. Every node in the graph represents a keyword, and the size of the node is proportionally related to the frequency with which the word appears in the literature. Keywords with high frequencies are closely arranged in the graph's central area, reflecting the focus of research hotspots within this domain (Song Yafang et al., 2024). The primary and secondary keywords in the realm of early childhood education digitalization are presented in Table 1.

Table 1. Co-occurrence of keywords in the field

Importance	Keywords
Main keywords	Information Technology, Preschool Education, Artificial Intelligence, Early Childhood Teacher, Information Literacy, Educational Informatization, Early Childhood Education, Preschool Education Major
Secondary keywords	Digital literacy, Modern information technology, Digitalization of education, Information age, Digital transformation, High-quality development, Information technology capabilities, Information technology application capabilities, Internet+, Internet-based teaching, Digital educational resources, Artificial intelligence technology

The top 13 keywords were selected for frequency and centrality analysis. As Table 2 shows, "Information Technology" has the highest frequency, at 160 times, with a centrality of 0.41. This means it's often mentioned in early childhood education digitalization research and plays a key connecting role. Other high-frequency keywords like "Information Literacy", "Early Childhood Teachers", "Artificial Intelligence", and "Educational Informatization" suggest that research focuses on IT application in education, improving educators' quality, and emerging technologies' impact on early childhood education. The report of the 20th National Congress of the Communist Party of China emphasized educational digitalization. With the digital China drive, the education system is implementing educational digitalization strategies. This has increased attention on early childhood education, digitalization research, and practice. As technology advances, future research needs to focus on integrating emerging technologies into early childhood education for high-quality development and solving the digital divide problem.

Table 2. Frequency Statistics of Keywords

Serial Number	Keywords	Frequency	Centrality
1	Information Technology	160	0.41
2	Preschool Education	127	0.49
3	Early Childhood Education	69	0.29
4	Information Literacy	61	0.91
5	Early Childhood Teachers	54	0.23
6	Artificial Intelligence	49	0.13
7	Young Children	36	0.24
8	Preschool Education Major	31	0.26
9	Kindergarten	29	0.08
10	Educational Informatization	19	0.09
11	Preschool Children	15	0.22
12	Application	13	0.04
13	Modern Information Technology	10	0.06

2.3 Keyword Clustering Analysis

The keyword clustering map groups similar keywords to identify research themes and hotspots, promote academic exchanges, further analyze the development trajectory of the research field, uncover latent research orientations and interdisciplinary domains, and enhance the depth and scope of literature research. Therefore, to understand the research hotspots of digitalization in early childhood education in China, CiteSpace6.4.R1 software was used for keyword clustering, generating the keyword clustering map of this field, as shown in Figure 2. Q = 0.8664 (> 0.3), indicating that a high clustering reliability has reached a significant level, and S = 0.9747 (> 0.7), suggesting a high clustering reliability.

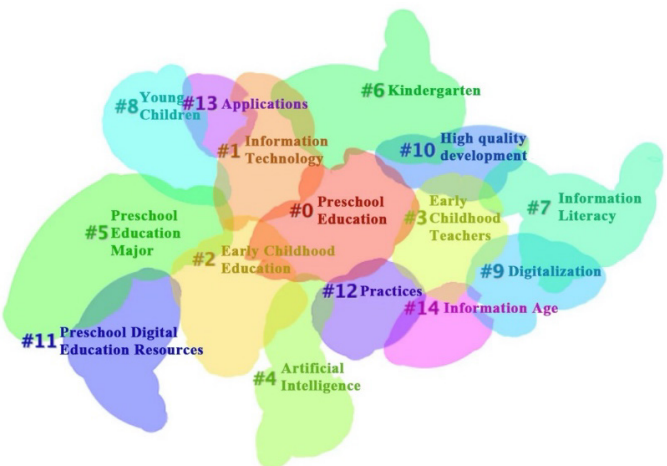

Figure 2. Keyword Clustering Map.

Based on the 15 clusters generated, as shown in Table 3, it can be concluded that the related research in this field can mainly be divided into three aspects: early childhood education and teacher development, digital technology and information literacy, and educational practice and development application.

2.3.1 Early Childhood Education and Teacher Development

With the introduction of digital technology, preschool education courses have become more flexible and can better adapt to the learning needs of different children. Zhang Tao et al. believe that digital education, with its immersion and interactivity, enables children to transcend time and space limitations, making knowledge acquisition more interesting and vivid (Zhang Tao, Zhang Lihong, & Wu Ruolan, 2024). At the same time, research shows that teachers' digital literacy and ability are key factors in achieving high-quality early childhood education.

2.3.2 Digital Technology and Information Literacy

The development of children in the digital age has gradually become an important topic for current scholars to explore, mainly focusing on the following four aspects: First, focus on the influence that digital technology exerts on the physical and mental growth of children. Second, a detailed description of the current application status of digital technology in children's growth. Third, the introduction of foreign digital technology and children's development projects. Fourthly, conduct an analysis of the difficulties encountered by children's education during the digital era (Li Jing & Yu Yao, 2023). It can be seen that in the context of the digital age, children's development is facing some practical difficulties. Effectively resolving these difficulties has become a key task for preschool education to adapt to the changes of the times and achieve innovative development.

2.3.3 Educational Practice and Development Application

Digital resources for preschool education include digital picture books, courseware, animations, electronic textbooks, etc. In the past, teachers mainly relied on traditional methods to teach children knowledge, but now they can use information technology to immerse children in real scenarios and help them form an intuitive understanding. At the same time, in recent years, with the development of the information age, the role of digitalization in the high-quality development of preschool education has become increasingly prominent. Researchers hold the view that the high standard development of preschool education entails more fairness, greater inclusivity, and higher efficiency (Hong Xiumin & Zhu Wenting, 2024).

Table 3. Keyword Clustering Statistics

Clustering	Sub-clustering Number	Size	Centrality	Keywords
Early Childhood Education and Teacher Development	#0Preschool Education	48	0.981	Big data, Data mining,Study,Early childhood education
	#2Early Childhood Education	34	0.997	Internet-based teaching, Preschool education, Teaching mode, Integration
	#3Early Childhood Teachers	33	0.997	Visual analysis, Information technology literacy, Information technology capability, Digital resource library
	#6Kindergarten	27	0.892	Educational informatization, Students majoring in preschool education, Information technology application, Informatization of preschool education
	#5Preschool Education Major	30	0.959	Digital literacy, Digital transformation, The era of 5G, Higher vocational education
	#8Young Children	25	0.988	Developmental psychology, Digital game, Preschool education
Digital Technology and Information Literacy	#1Information Technology	38	0.964	Physical education teaching, Information literacy, Artificial intelligence, Children's life
	#4Artificial Intelligence	31	0.997	Preschool children, Metaverse, Enlightenment education, Online learning
	#7Information Literacy	26	0.981	Information technology application ability, Training mode Children, Investigation and research
	#9Digitalization	15	0.953	Vocational colleges, Internet+, Talent cultivation, Informatization
	#14Information Age	6	1	Urban and rural areas, The development of preschool education Reflection, Information technology
Educational Practice and Development Application	#10High quality development	11	0.995	Path, Value, Artificial intelligence technology, Vocational education
	#11Preschool digital educational resources	11	0.984	Public service, Kindergarten teachers, Digital resources, Kindergarten cases
	#12Practices	10	0.967	Modern information technology, Theory, Early childhood art teaching, Professional perspective
	#13Applications	7	0.985	Development, Computer information technology, Research, Reform

2.4 Keyword Burst Analysis

Using CiteSpace software, the temporal sequence of high-frequency keywords in this research field was constructed, showing the emergence timing and intensity changes of various thematic terms over the past two decades. The boldness of the keywords visually reflects their research popularity and attention intensity in specific years. As shown in Figure 3, taking the high-frequency term "Artificial Intelligence" as an example, its intensity reached 5.33 from 2021 to 2024, indicating a high research interest in the application of AI technology in promoting digital development in early childhood education during this period. From 2013 to 2021, an increasing number of keywords gained attention, signifying a shift from simple digital applications to multifaceted collaboration and literacy enhancement, with research perspectives gradually becoming more diverse.

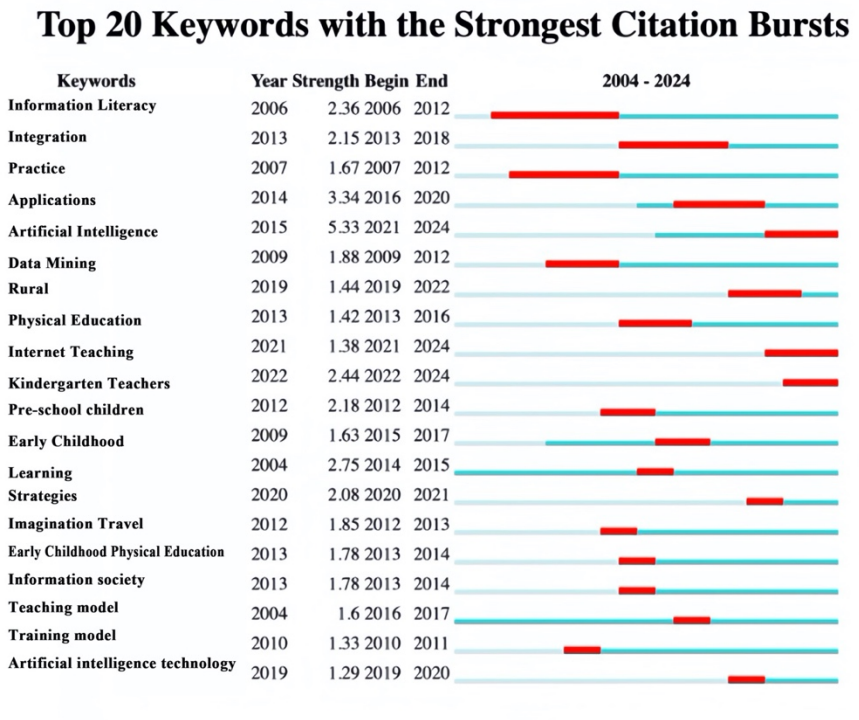

Figure 3. Keyword Burst Map.

2.5 Keyword Time Zone Analysis

The hot spot time zone map, as an important visualization form of scientific knowledge maps, can effectively present the spatio-temporal distribution characteristics. This analytical method, by uncovering the temporal distribution patterns of keywords and the relevant networks of research topics, provides researchers with an important tool to grasp the development context of the field, and also offers data support for predicting future research directions. Table 4 shows the changes of key focuses and trends in digitalization research of preschool education at different stages.

Table 4. Research hotspot trend

2004-2007	This stage focuses on information technology, information literacy, modern information technology, informationization practices, and preschool education.
2008-2013	This stage focuses on education informatization, information technology application ability, preschool education informatization and information age.
2014-2017	This stage focuses on artificial intelligence, information technology literacy, Internet+, and big data.
2018-2024	This stage focuses on digitization of education, digital literacy, quality development, artificial intelligence technologies, and digital educational resources.

In the future, the focus of attention on the digitalization of early childhood education will shift from the simple application of information technology and the development of digital resources to in-depth exploration of the deep integration of emerging technologies and early childhood education in the digital background, improving teachers' digital literacy and capabilities, formulating personalized education plans, and protecting children's data privacy and establishing ethical norms for technology use.

3. Suggestions and Prospects

3.1 Deepening the Application of Digital Technology

In the current era of rapid information development, early childhood education needs to further expand and deepen the application of digital technology. Besides the existing multimedia resources and "Internet +" education, it should also actively explore and innovate, promoting the application of virtual reality, augmented reality, and other technologies in early childhood education (Grodecki, K., Goulding, A., & Suraweera, N., 2024). At the same time, efforts should be made to increase the development and integration of digital resources, build a diverse and high-quality resource library.

3.2 Promoting Digital Home-School Co-education

In the future, the digital transformation of home-school co-education should be promoted to build a more efficient, convenient, and diversified home-school co-education model. Online home-school co-education courses should be established to provide parents with parenting knowledge and guidance, helping them improve their parenting skills. Digital means should be used to enhance the fun and participation of activities, promoting parent-child interaction between parents and children, forging a combined strength in home-school collaborative education, and jointly driving the comprehensive development of children (Vidal-Esteve, M. I. & Martín-Gómez, S., 2023).

3.3 Improving the Digital Evaluation System

In the future, it is essential to establish a rational and scientific digital evaluation system for early childhood education. The evaluation indices should incorporate children's learning achievements, teachers' instructional capabilities, the application effectiveness of digital resources, the quality of home-school cooperation in education, and other relevant aspects. It is crucial to attach importance to both the process and the result, and integrate quantitative and qualitative assessment methods to promote the sound development of digitalization in early childhood education (Lindeman, S., Svensson, M., & Enochsson, A. B., 2021).

3.4 Exploring Localized Practice Paths

In China, diverse regions exhibit marked disparities. For the digitalization of early childhood education, it is imperative to explore localized approaches. Moreover, by integrating traditional cultural features, it is essential to develop digital resources that embody local cultural connotations. This integration of traditional culture and modern technology serves to inherit and promote outstanding traditional culture, as well as to cultivate children's cultural confidence and national pride.

4. Conclusion

In summary, future research and practice should keep pace with the times, make full use of advanced digital technologies and rich digital resources, and strive to create a more high-quality, fair and personalized education service system for children, enabling them to explore confidently and grow happily in the digital wave, laying a solid groundwork for their future comprehensive development.

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