Frontiers and Trends of Blended Learning Research in China Based on Visualization Analysis of CNKI Database

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ABSTRACT

In this paper, CiteSpace is used to conduct metrological and visual analysis of the core journals of blended learning research (2003-2021) collected by the China National Knowledge Infrastructure (CNKI). The results show that the number of studies on blended learning in China is increasing year by year, which indicates that the research on blended learning continues to attract attention and that blended learning is not yet mature. The research hotspots include the basic theory research of blended learning, teaching design research, learning resources and platform construction, and application practice research. The research frontiers include analysis and application research based on a specific learning platform, application research of blended learning in a certain field, and instructional design research. The development trend is changing from basic theory research to teaching application practice from focusing on teachers' teaching to students' learning.

KEYWORDS

Blended Learning, Development Trend, Journal Source, Literature Quantity Distribution, Research Author, Research Frontiers, Research Hotspot, Visual Analysis

INTRODUCTION

Blended learning (BL) is the product of e-learning. In 1996, the first paper about e-learning was published in the well-known American journal *Training*. Since then, e-learning has gradually become a research hotspot for educational technology researchers and corporate trainers (Tian & Fu, 2004). However, with the phenomenon of low efficiency, low participation, and inadequate learning in e-learning, research on e-learning has reached a low point. *Blended learning*, as a new learning method combining online and offline learning, has gradually attracted the attention of researchers and has been rapidly developed and applied worldwide. *The Horizon Report* (Higher Education Edition) mentioned BL for eight consecutive years from 2012 to 2019, affirming the advantages of BL in integrating traditional classroom learning and online learning and identifying BL as an important

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trend to accelerate the application of technology in higher education. This paper takes Chinese core journals as samples and uses the co-occurrence analysis, cluster analysis, and burst detection of CiteSpace visual analysis software. To explore the research hotspots, frontiers, and trends in the field of BL, this study involves quantitative and visual analysis from the aspects of literature quantity distribution, journal sources, research authors, research institutions, and keywords.

Data Sources and Research Methods

The database of the China National Knowledge Infrastructure (CNKI) served as the data source for analysis. The journal type was set as the Chinese core journal criterion of PKU and CSSCI, and the retrieval term was "article abstracts" with the search words "blended learning" or "hybrid learning" or "blended teaching" or "hybrid teaching." Since Zhiting Zhu first introduced the concept of BL in China in 2003 (Zhu & Meng, 2003), the chosen retrieval time span was from 2003 to 2021. A total of 2,163 papers were retrieved, and 2,088 valid papers were obtained after CiteSpace screening and rechecking. Because the translation of the term *blended learning* varies in China, this paper uses *blended learning* or *BL* to express it uniformly. In this paper, based on the visualization analysis technology of the scientific knowledge atlas, CiteSpace 5.7. R2 served as an analysis tool to analyze the keyword co-occurrence, keyword clustering, and keyword burst of the literature, combined with the bibliometric method and content analysis method. This paper presents an in-depth analysis of the literature quantity distribution, journal sources, research authors, research institutions, research hotspots, frontiers, and trends of BL in China.

ANALYSES

Number of the Literature Analyses

Studies related to BL were statistically analyzed in core journals according to the publication date of the literature, as shown in Figure 1. According to the statistics, the number of studies on BL has been on the rise from 2003 to 2021. In particular, the number of articles published since 2015 has shown explosive growth, which is closely related to the concept of "Internet plus" put forward in 2015. Through bibliometric analysis, it is found that Chinese teachers and scholars are paying increasing attention to BL, and BL is still a research hotspot. At the same time, the number of studies is increasing year by year, which also indicates that BL is not mature and still needs in-depth research.

Figure 1. Time Distribution of BL Research Papers From 2003 to 2021
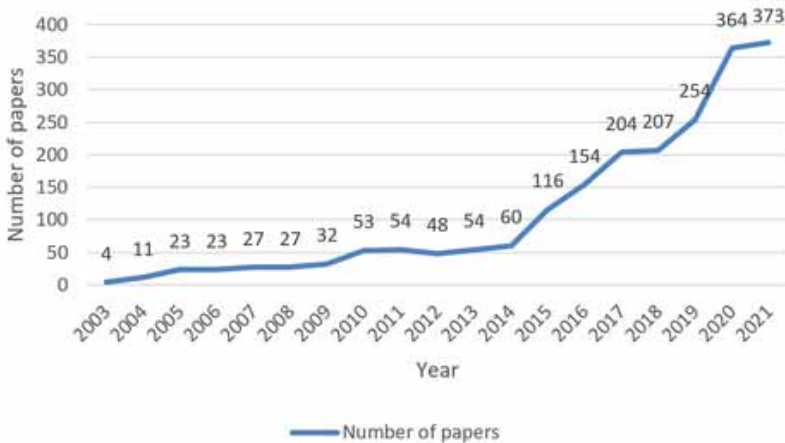
Journal Source Analysis

According to the statistics of the journals to which the literature belongs, the journals containing no fewer than 10 articles are shown in Figure 2. These journals contain 1,226 articles in total, accounting for more than 70% of the total papers in the core journals of BL research. The top four journals are all educational technology journals, indicating that educational technicians are the key force in the research of BL. In addition, BL is widely used in higher education, vocational education, continuing education, experimental, medical, chemistry, and other subjects.

Author Analysis

CiteSpace was used to calculate statistics on the number of papers published by the authors. Results showed that there were 571 authors studying BL, and 40 authors published at least three papers, accounting for 7% of the total number of authors, indicating that the number of papers published by the authors studying BL was low. Table 1 lists the authors with at least five articles, for a total of 20 authors. The citation frequency of each paper published by each author was counted, and the average citation frequency of each paper was calculated, which can indicate the influence of the author in the research field of BL to a certain extent (Ai & Chen, 2019). Ronghuai Huang, Xiaoying Feng, Xiaohong Su, Zhiting Zhu, Fang Yang, Guodong Zhao, Jiangang Cheng, and Guoshuai Lan are all BL researchers who had a citation frequency of more than 60 per paper by 2021. To understand the research progress of BL, researchers whose papers are cited frequently were tracked. For example, Ronghuai Huang has focused mainly on the study of the course design and learning intention of BL. Xiaoying Feng has focused mainly on the design of BL activities and research on blended teaching abilities.

Research Institution Analysis

The statistical distribution of research institutions can reflect the strength of BL research institutions. A total of 13 research institutions have published more than 20 studies on BL, as shown in Figure 3. It shows that universities with a strong comprehensive strength are the main research institutions using

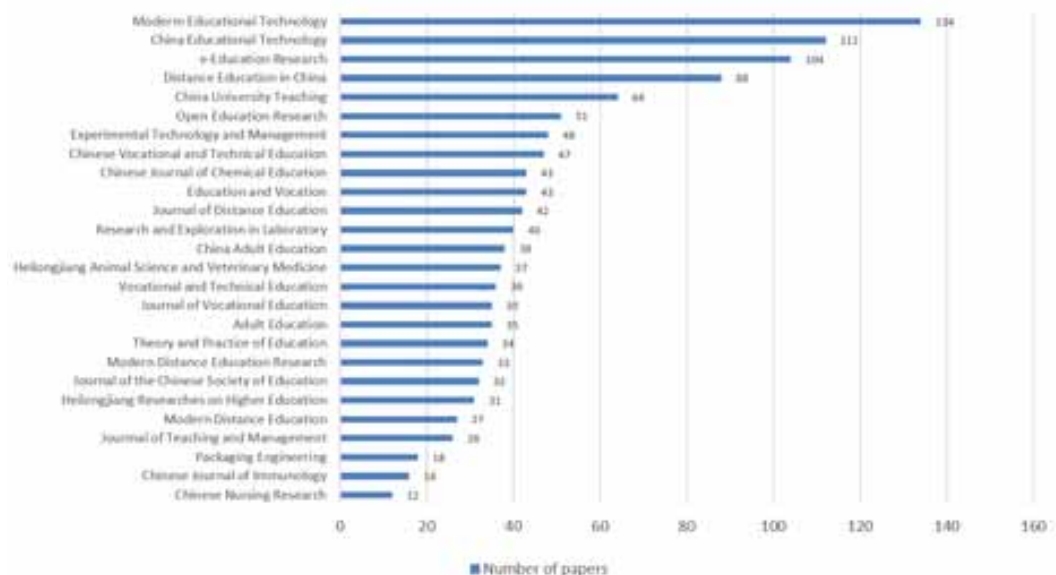**Figure 2. Statistical Chart of Journal Volumes of BL**

Table 1. Statistics of Author Publications

Author	Institution	Number of papers	Cited	Citations per paper
Xibin Han	Tsinghua University	13	602	46
Guoshuai Lan	Henan University	10	642	64
Xiaoying Feng	Beijing Normal University	9	1,287	143
Hongliang Ma	Shaanxi Normal University	8	216	27
Jiangang Cheng	Tsinghua University	7	526	75
Jing Ma	Zhengzhou University	7	178	25
Ronghuai Huang	Beijing Normal University	6	1,110	185
Zhiting Zhu	East China Normal University	6	727	121
Fang Yang	Tsinghua University	6	702	117
Qian Guo	Henan University	6	237	40
Qiong Wang	Peking University	6	187	31
Liyong Wan	Central South University for Nationalities	6	162	27
Xuemei Bai	Shaanxi Normal University	6	146	24
Xiaohong Su	Harbin Institute of Technology	5	625	125
Guodong Zhao	Peking University	5	452	90
Yongping Tan	Guangxi Electric Power Vocational and Technical College	5	252	50
Hongjian Liao	Guangzhou University	5	231	46
Shusheng Shen	Nanjing Normal University	5	131	26
Zhong Sun	Capital Normal University	5	128	26
Yonghai Zhu	Capital Normal University	5	60	12

Figure 3. Statistical Chart of Publications of BL Research Institutions
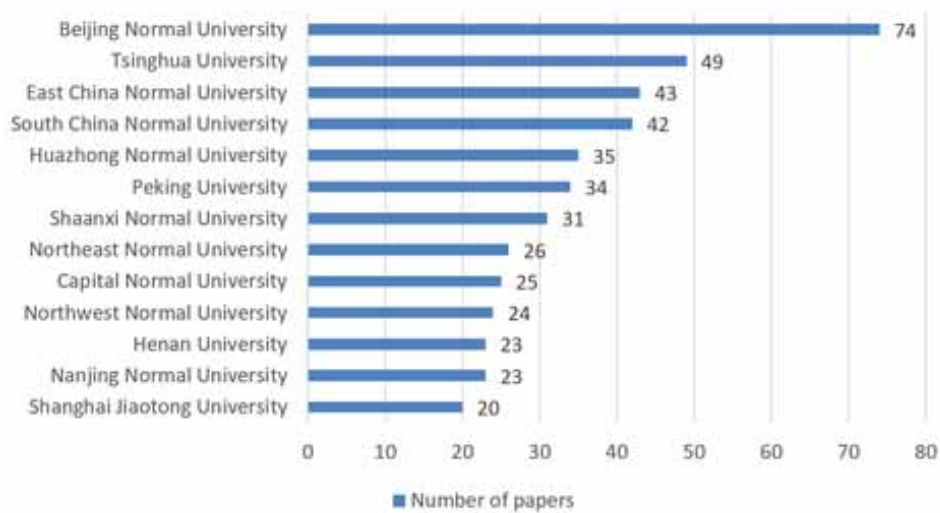
BL research and applications: Beijing Normal University, Tsinghua University, East China Normal University, and South China Normal University all published more than 40 articles.

Research Hotspot Analysis

Research hotspots refer to the scientific issues or topics discussed by a relatively large number of intrinsically related papers or groups of papers in a certain period of time (Chen, 2006). Keywords and their betweenness centrality can reveal the research topics of academic papers to some extent and reflect the research hotspots and development trends in this field (Liang et al., 2020). In this paper, CiteSpace was used to conduct a co-occurrence analysis of keywords, and the top 20 keywords with the highest frequency and betweenness centrality were extracted from the literature, as shown in Tables 2–3. By combining keywords such as *MOOC* and *Mu Ke* (Chinese, the same meaning as *MOOC*), "blended teaching model" and "hybrid teaching model," and removing keywords such as "blended learning," "blended teaching," " hybrid learning," and "hybrid teaching." The research and application of BL in China mainly focus on education, especially higher education and vocational education. The research content includes the teaching model, instructional design, learning platform, and learning method.

To deeply explore the affinity relationship between high-frequency keywords and reveal the BL research hotspots, clustering analysis was conducted on keywords, and the results are presented in a timeline, as shown in Figure 4. The clustering results showed that "blended learning," "online teaching," "hybrid learning" and "flipped class," "MOOC," "Internet+," "instructional design,"

Table 2. Statistics of the First 20 Keywords in Frequency

Rank	Frequency	Betweenness centrality	Keyword
1	281	0.12	blended teaching model
2	195	0.08	mooc
3	147	0.09	flipped classroom
4	88	0.04	online teaching
5	80	0.04	spoc
6	79	0.02	teaching reform
7	66	0.05	instructional design
8	58	0.02	online and offline
9	49	0.04	e-learning
10	48	0.02	vocational education
11	38	0.02	deep learning
12	38	0.02	university English
13	34	0.03	Rain Classroom
14	27	0.01	course ideology and politics
15	26	0.03	self-learning
16	25	0.01	experimental teaching
17	24	0.01	Micro Lesson
18	24	0.01	Internet+
19	23	0.01	mobile learning
20	21	0.02	influencing factors

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8	34	0.03	Rain Classroom
9	26	0.03	self-learning
10	79	0.02	teaching reform
11	58	0.02	online and offline
12	48	0.02	vocational education
13	38	0.02	deep learning
14	38	0.02	university English
15	21	0.02	influencing factors
16	17	0.02	higher education
17	16	0.02	education informatization
18	7	0.02	collaborative learning
19	27	0.01	course ideology and politics
20	25	0.01	experimental teaching

"teaching model," and "e-learning" are the current Chinese research focuses in BL. By merging repeated or similar topics, such as #0 and #2, #1 and #8, four research hotspots were finally identified: research on BL basic theory (#0, blended learning); research on the instructional design of BL (#3, flipped class; #6, instructional design; and #7, teaching model); BL resources and platform construction (#4 MOOC); and application and practice research of BL (#1, online teaching and #5, Internet+).

Research on Blended Learning Basic Theory

The research on the basic theory of BL mainly focuses on the basic theory of concept, connotation, principle, essence, and value, which has become the basic theory of subsequent related research. For example, Zhu and Meng (2003) introduced the background, connotation, and classification of BL for the first time in China in 2003. They believed that BL greatly expanded the practicability of distance education and could concentrate the advantages of various media and learning modes to provide adaptive learning content for learners. Tian and Fu (2004) systematically discussed the basic concept, connotation, curriculum design method of BL, and the reflection it brought to educational technology. Li and Zhao (2004) discussed the theoretical basis, basic principles, process design, and application mode of BL. Huang et al. (2009) discussed the essence, basic characteristics, and basic BL principles and constructed the design theory of BL courses. Chen et al. (2010) analyzed the nature of BL from four dimensions: people, technology, environment, and method. Hu and Zhang (2016) positioned technology as an important means to change the teaching structure and used technology to strengthen the teaching structure to guide BL design. As a diversified and systematic learning

Figure 4. BL Research Keyword Co-Occurrence Network Timeline

method, BL should be interdisciplinary based on its theoretical basis. However, through reading the literature, it is found that most researchers are based on related theories of pedagogy, and few studied BL from other perspectives. For example, Chen (2012) explained the connotation of BL and analyzed the characteristics and operating mechanism of a BL system from the perspective of dissipative structure theory. From the perspective of the subject's knowledge intake, Zheng (2013) composed a personalized organic BL theory by combining learning subjects' own learning characteristics, learning target needs, learning condition permission, and organically mixing existing learning theories. In general, researchers have performed many basic theoretical studies on the concept, connotation, essence, principle, and development trend of BL, which is conducive to clarifying the basic concepts and promoting the research and development of BL to a certain extent.

Research on Instructional Design of Blended Learning

The research on the instructional design of BL mainly focuses on the construction of a BL model, learning activity design, and teaching implementation based on a certain learning platform or a certain theory. For example, Zhou (2011) constructed a BL model based on the Blackboard learning platform; Mou and Dong (2014) constructed a BL model based on the Coursera teaching platform; Yin (2015) constructed a BL model based on the Fanya SPOC platform; Xu et al. (2015) constructed a BL model based on the WeChat public platform; Li (2016) constructed the ADDIE teaching design model and provided an in-depth discussion of the teaching design and teacher–student activities in the teaching implementation process of BL courses; and Feng and Wang (2019) constructed a set of core-goal-oriented BL modes, asserting that the fundamental purpose of BL is to promote student learning and that it should be transformed from teaching design to learning design. In recent years, the instructional design of BL has gradually drawn attention to being *student-centered*, emphasizing that students are the subjects of cognitive processes and the active builders of knowledge meaning. Zhao and Bao (2017) proposed the BL model in a flipped classroom, which breaks the process and order of traditional classroom teaching, reconstructs the learning process, and promotes students'

independent, cooperative, and inquiry learning abilities. Cao et al. (2021) proposed a four-stage, ten-step course design model of BL in colleges and universities based on a student-centered approach and the principle of "consistency of objectives, teaching, and assessment." However, most of the instructional design constructs the BL model or designs the learning activities theoretically and carries on a small amount of empirical research, which lacks the verification of the proposed BL model and learning activities. On the basis of a large number of empirical studies, research on the instructional design of BL needs to construct a BL model and design learning activities from the actual and specific problems of teaching and verify the models and activities.

Blended Learning Resources and Platform Construction

Learning resources and platform construction can effectively promote the development and application of BL. At present, there is no special learning resource or platform for BL. The fundamental reason is that there are a wide variety of online learning resources and platforms. Moodle, Blackboard, Rain Classroom, and other platforms are highly adaptable and can be directly used as a BL course platform to maximize the use of existing learning resources (Wang et al., 2015). The research includes the characteristic analysis of the BL platform, the construction and application research of the BL platform, the design and construction of online learning resources, and the transformation of a learning platform to meet the needs of BL. Especially in recent years, research on the new learning platform and the BL environment has gradually attracted attention. For example, Zhang and Wang (2010) designed a mobile BL system using context and pulse perception technology; Jiang et al. (2012) used Windows Live Group as a course platform for BL; Han and Han (2014) designed a microlesson network teaching platform by combining BL with micro-lessons; and Wang et al. (2016) designed the process and evaluation of BL resources based on the WeChat public platform. In general, there are abundant resources and platforms for BL, but there is a lack of general research on learning resources and platforms. The lack of studies on the standardization of learning resources means that the utilization rate of learning resources is low, and the phenomenon of repeated construction is serious. Studies on the standardization and portability of BL resources need to be further strengthened.

Application and Practice Research of Blended Learning

The application and practice research of BL involves basic education, higher education, continuing education, vocational education, and enterprise training, among which the applied practice research in college curriculum teaching is more extensive. For example, Wu (2010) designed the course "Educational Electroacoustic System" based on BL; Wang et al. (2016) carried out large-scale practice in the teaching of the "College Computer Foundation" course based on the new blended "MOOC+SPOC+flipped class" teaching concept; Yang et al. (2017) carried out blended teaching practice for college English classes; Han (2018) carried out blended teaching practice based on MOOCs and Rain Classroom for ideological and political courses in colleges and universities; comparatively, there are few studies on the application of BL in the field of basic education. It can be considered that this is because compared with basic education, the students in basic education mainly study in the classroom, and there is less online autonomous learning. However, in higher education, the physical and mental development of college students has become mature, and the traditional classroom teaching method can no longer meet the needs of students. Students mainly study independently, which is more suitable for the research and development of BL. However, with the increasing attention to STEM education in basic education in China, the application and practice research of BL in basic education should be further strengthened.
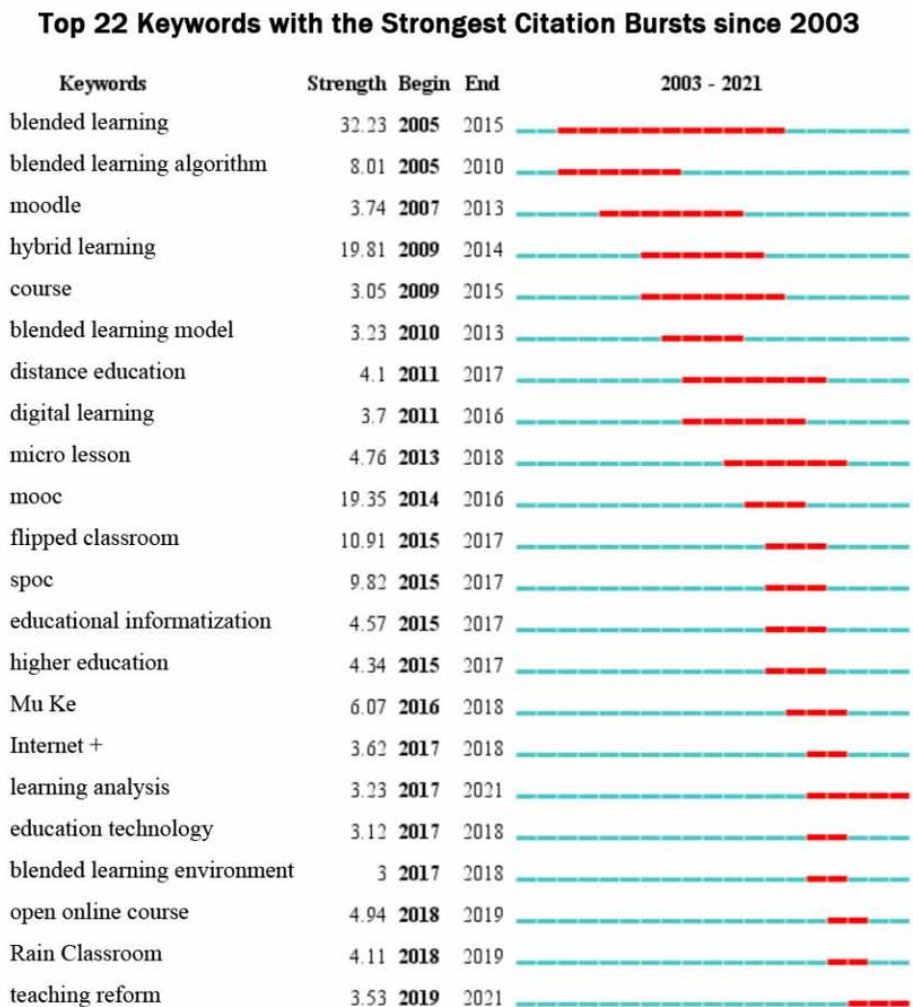
Research Frontier and Trend Analysis

The research frontier refers to the most promising research topic in a certain field of scientific research, which can represent the future development trend (Ma & Zhou, 2019). *Burst keywords* represent words that attract more attention in a short period of time and can reflect the research frontier in this field

to some extent. The higher the burst strength is, the more attention is given to it (Chai & Li, 2015). Burst keywords were analyzed through CiteSpace, and the time interval was two years; 22 keywords were obtained through the operation, as shown in Figure 5.

Figure 5 shows that there were no burst keywords in 2003–2004, when the concept of BL was just introduced in China. Researchers have mainly focused on the concept, basic theories, and principles of BL, with few practical applications. Since 2005, BL research has gradually changed from basic theoretical research to teaching application practice. There are three main research frontiers of BL: first, analysis and application research based on Moodle, MOOC, SPOC, Micro Lesson, Rain Classroom, and other learning platforms. Second, the application of BL in distance education, higher education, educational technology, open online courses, and other fields. Third, instructional design research, including BL models, flipped classrooms, and BL environments.

In general, instructional design plays an important role in the research of BL and supports the development and application of BL. The research on the practical application of BL is diversified, and it is widely applied in the teaching of specific courses and learning platforms. In addition, learning

Figure 5. BL Research Burst Keywords

Top 22 Keywords with the Strongest Citation Bursts since 2003

Keywords	Strength	Begin	End	2003 - 2021
blended learning	32.23	2005	2015	
blended learning algorithm	8.01	2005	2010	
moodle	3.74	2007	2013	
hybrid learning	19.81	2009	2014	
course	3.05	2009	2015	
blended learning model	3.23	2010	2013	
distance education	4.1	2011	2017	
digital learning	3.7	2011	2016	
micro lesson	4.76	2013	2018	
mooc	19.35	2014	2016	
flipped classroom	10.91	2015	2017	
spoc	9.82	2015	2017	
educational informatization	4.57	2015	2017	
higher education	4.34	2015	2017	
Mu Ke	6.07	2016	2018	
Internet +	3.62	2017	2018	
learning analysis	3.23	2017	2021	
education technology	3.12	2017	2018	
blended learning environment	3	2017	2018	
open online course	4.94	2018	2019	
Rain Classroom	4.11	2018	2019	
teaching reform	3.53	2019	2021	

analysis technology, as a research field of constructing meaning from data, can be used as an auxiliary tool of BL, providing researchers with new types of data analysis and evaluation methods (Wang & Feng, 2019). In general, the development trend of BL research is as follows: On the one hand, it changes from basic theory research to teaching application practice and from focusing on teaching to focusing on student learning. On the other hand, new technologies such as learning analysis can help teachers better understand and optimize the learning process and learning environment, reform traditional classroom teaching, and bring breakthroughs and innovations to BL research and development.

CONCLUSION

This study used CiteSpace to perform metrological and visual analysis on the core journals of BL research in China from 2003 to 2021 in CNKI. This paper analyzes the literature quantity distribution, journal sources, research authors, research institutions, research hotspots, frontiers, and trends of BL research in China. The research conclusions are as follows.

The number of studies on BL is increasing year by year, which indicates that the research on BL continues to attract attention and that BL is not yet mature and still needs in-depth research. Analyzing the number of articles published in core journals, citations per article, and the number of articles published by research institutions, reveals the journals, authors, and institutions that pay great attention to BL. Subsequent researchers can follow the corresponding core journals, authors, and institutions to timely grasp the research status of BL in order to carry out more in-depth research.

Research Hotspot of Blended Learning

- Analysis of the frequency and centrality of high-frequency keywords and the clustering of keywords revealed that the current research hotspots of BL mainly focus on the basic theory research of BL, teaching design research, learning resources, and platform construction and application research.
- The basic theory of BL needs to be further strengthened. It is not simply a mixture of online learning and face-to-face learning but a combination of diverse learning methods, for example, focusing on learning resources, learning media, learning environments, and learning styles. Therefore, researchers need to clarify the concept, connotation, principle, essence, and value of BL, form a unified understanding and study the basic theory of BL from different perspectives.
- In the teaching design of BL, most of the research is constructed using a theoretical BL model or designing learning activities. Given the lack of a large number of empirical studies, it is difficult to verify the effectiveness of the BL model and learning activities. In addition, BL gradually pays attention to student-centered instructional design.
- There is a lack of generality research on the construction of BL resources and platforms, a low utilization rate of learning resources, and serious repetitive construction. Research on the standardization of learning resources and generality between different platforms needs to be further strengthened.
- The applied and practical research of BL is mainly focused on course teaching in colleges and universities. With the extensive attention given to STEM education in basic education, the application and practice research of BL in basic education needs to be further strengthened.

Frontiers and Trends of Blended Learning Research

Through keyword emergence analysis, it is found that the research frontier of BL focuses on the analysis and application research based on a specific learning platform, BL application research in a certain field, and the research of instructional design. The BL development trend is changing from basic theory research to teaching application practice and from focusing on teaching to focusing on

student learning. Subsequent studies can explore the theoretical design and application practice of BL from the perspective of learners, from the mechanism of learning, and from the concepts and technologies of other research fields.

Discussion

However, this study only focuses on the frontiers and trends of BL research in China, and a comparative study of BL at home and abroad can be conducted in the future. To explore the similarities and differences in theoretical research, teaching design research, learning resources, and platform construction to provide a reference for further in-depth study of BL.

ACKNOWLEDGMENT

COMPETING INTERESTS

The authors of this publication declare there are no competing interests.

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