The Research Status and Hotspots in the Domain of Smart Learning in China from 2012-2019

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Abstract. To explore the research status and hotspots in the domain of Smart learning in China, 118 related articles form the China National Knowledge Infrastructure (CKNI) were analyzed by the software of CiteSpace. The results showed that: (1) the area of smart learning in China began in 2012 and shows an upward trend year by year from 2012 to 2017, and the number of articles reached the historical peak in 2017 with 30 articles, but it showed a downward trend after 2017. Zhiting Zhu, Beijing Normal University and E-education Research topped the lists of contributing authors, organizations and publications respectively. (2) “smart learning”, “strategy”, “smart learning environment” and “smart education” were the top four largest clusters on the area of smart learning in China from 2012-2019.

1. Introduction
With the development of information technology, the current infiltration of educational technology into the education field faces many problems. How to effectively use educational technology has always been an important issue in the application of educational technology [1]. “Smart Learning” is a new learning paradigm that learners are self-directed, learner-centered, and have a complete learning experience [2-3]. In September 2010, the e-LearningWeek2010 conference held in South Korea used “Smart Learning” as its key issue. Relevant literature has initially shown that South Korea, Malaysia, Australia, Japan, and global enterprises IBM have paid more attention to “smart learning”, especially in South Korea [4-5]. Only a few scholars in China payed attention to the “smart learning environment” and “smart classroom”, but the research on “smart learning” was rare [6-7]. Until 2012, Chinese researchers first thought that the future classroom needed the smart learning environment [8], and then it showed an upward trend year by year since 2012. Chinese researchers from various disciplines started the study of smart learning, and obtained important achievements, including the Learning analytical techniques and MOOCs, the reform of teaching methods and method under technical support, the applications of mobile and ubiquitous learning, the flipping classroom and micro-course teaching, the gamification learning, and so on [9-10]. As mentioned above, in the past eight years, Chinese researchers have achieved fruitful achievements in the domain of smart education, however, a thorough quantitative analysis to objectively identify influential authors and organizations, as well as the emergent research trends and topics, has not been completed. In order to better promote the development of smart education in China, this paper presents a quantitative review of the research of smart education with the help of the CiteSpace.
2. Methodology

2.1. data sources
118 articles were yielded by the search conducted in the China National Knowledge Infrastructure (CKNI) under the heading of “smart learning”. Among them, there were 96 journal articles and 22 Dissertation.

2.2. data processing
The RIS format of the 118 articles was carried out by the bibliometric analysis and visual analysis by the visualization software CiteSpace.5.5. R2 [11].

3. Results

3.1. Bibliometric analysis

3.1.1. Publishing trend. Fig. 1 demonstrates the publishing trend of studies on smart learning in China. The earliest research on smart learning in China began in 2012, and then it showed an upward trend year by year from 2012 to 2017, and it appeared at a historical peak in 2017 with 30 articles. But after 2017, smart learning research showed a downward trend.

![Fig. 1 Publishing trend.](image)

3.1.2. Author statistics. As seen in Tab.1, all of the top 10 contributing authors had published more than two articles. Zhiting Zhu topped the list with eight articles, followed by Shusheng Shen and Lin Chen, each of them published more than five articles.

| Rank | Authors             | Frequency |
|------|---------------------|-----------|
| 1    | Zhiting Zhu         | 8         |
| 2    | Shusheng Shen       | 5         |
| 3    | Lin Chen            | 5         |
| 4    | Ronghuai Huang       | 4         |
| 5    | Youru Xie           | 3         |
| 6    | Dongdai Zhou        | 3         |
| 7    | Yongbin Hu          | 2         |
| 8    | Linke Guo           | 2         |
| 9    | Yang Yang           | 2         |
| 10   | Zhen Zhao           | 2         |
3.1.3. Affiliation statistics. As seen in Tab.2, all of the top 10 organizations had contributed more than two articles on the studies of smart learning in China. Beijing Normal University was the best performer among the list with seventeen articles, followed by Jiangsu Normal University and East China Normal University, each of them contributed more than ten articles in the domain of smart learning in China.

| Rank | Organizations                               | Frequency |
|------|--------------------------------------------|-----------|
| 1    | Beijing Normal University                  | 17        |
| 2    | East China Normal University               | 11        |
| 3    | Jiangsu Normal University                  | 11        |
| 4    | Northeast Normal University                | 7         |
| 5    | South China Normal University              | 6         |
| 6    | Nanjing Normal University                  | 6         |
| 7    | Guangdong Polytechnic Normal University    | 3         |
| 8    | Southwest University                       | 2         |
| 9    | Shanghai International Studies University  | 2         |
| 10   | Tianjin University of Technology           | 2         |

3.1.4. Source publication statistics. As seen in Tab.3, all of the top 10 source publications contributed more than three articles in the domain of smart learning in China. E-education Research topped the list with nineteen articles, followed by Modern Educational Technology and China Educational Technology, each of them contributed more than fifteen articles in the domain of smart learning in China.

| Rank | Source Publication                                      | Frequency |
|------|--------------------------------------------------------|-----------|
| 1    | e-Education Research                                   | 19        |
| 2    | Modern Educational Technology                          | 17        |
| 3    | China Educational Technology                           | 15        |
| 4    | Journal of Distance Education                          | 10        |
| 5    | Open Education Research                                | 8         |
| 6    | Distance Education in China                            | 4         |
| 7    | Modern Distance Education Research                     | 4         |
| 8    | Journal of Teaching and Management                     | 3         |
| 9    | Journal of Educational Studies                         | 3         |
| 10   | Adult Education                                        | 3         |

3.2. Knowledge mapping results

3.2.1. High-frequency keywords. The top 10 high-frequency keywords in the domain of smart learning in China, as well as their frequencies on the studies of smart education were shown in Tab.4 and Fig.2. “smart learning” was the most frequent keywords, and “smart learning environment”, “smart education”, “smart learning space” and “learning analysis” were positioned in the 2nd, 3rd, 4th and 5th places on the list. It is indicated that the smart learning environment, smart learning space, and learning analysis attracted researchers’ attention.
| Rank | Keywords                        | Frequency |
|------|---------------------------------|-----------|
| 1    | smart learning                  | 49        |
| 2    | smart learning environment      | 46        |
| 3    | smart education                 | 8         |
| 4    | smart learning space            | 6         |
| 5    | learning analysis               | 4         |
| 6    | strategy                        | 3         |
| 7    | learning structure              | 2         |
| 8    | smart classroom                 | 2         |
| 9    | flipping classroom              | 2         |
| 10   | technology                      | 2         |

3.2.2. Popular research topics. Fig 3 outlines the top four largest clusters on the studies of smart learning in China, which were “smart learning”, “strategy”, “smart learning environment” and “smart education” and the Modularity Q value is 0.66, the Mean Silhouette value is 0.54. As shown, the largest cluster is “smart learning (#0)”, which contains 7 articles and its silhouette value is 0.93. The high-frequency keywords of this cluster contain “smart learning”, “learning analysis” and “learning space”. The second-largest cluster is “strategy (#1)”, which contains 7 articles and its silhouette value is 0.85. The high-frequency keywords of this cluster contain “smart learning space”, “smart classroom”, “strategy” and “technology”. The third-largest cluster is “smart learning environment” (#2), which contains 5 articles and its silhouette value is 1.00. The high-frequency keywords of this cluster contain “smart learning environment”, “creativity”, “electronic bookbag” and “generative teaching”. The fourth-largest cluster is “smart education” (#3), which contains 4 articles and its silhouette value is 1.00. The high-frequency keywords of this cluster contain “smart education”, “flipping classroom”, “ubiquitous learning” and “ecosystem”.

Fig. 2 Top 10 keywords
4. Conclusions and further research

In order to better promote the development of smart education in China, a quantitative review the research of smart education was conducted with the help of the CiteSpace. The bibliometric analysis results showed that the studies on smart learning in China began in 2012 and it showed an upward trend year by year from 2012 to 2017, and the number of articles reached the historical peak in 2017 with 30 articles, but it showed a downward trend from 2017 to 2019. Zhiting Zhu topped the list of contributing authors, followed by Shusheng Shen and Lin Chen, each of them published more than five articles. Beijing Normal University topped the list of contributing organizations, followed by Jiangsu Normal University and East China Normal University, each of them contributed more than ten articles. E-education Research topped the list of the contributing source publication, followed by Modern Educational Technology and China Educational Technology, each of them contributed more than fifteen articles. Additionally, most of the top 10 contributing organizations were normal universities, indicating that normal universities were the main research institution on the studies of smart learning in China.

In the section of knowledge mapping analysis, the results of high-frequency keywords showed that the “smart learning” was the most frequent keywords, and “smart learning environment”, “smart education”, “smart learning space” and “learning analysis” were positioned in the 2nd, 3rd, 4th and 5th places on the list. It is indicated that the smart learning environment, smart learning space, and learning analysis attracted researchers’ attention in China. The clusters analysis results showed that “smart learning”, “strategy”, “smart learning environment” and “smart education” were the top four largest clusters on the area of smart learning in China from 2012-2019. Among them, “smart learning (#0)” was the largest cluster and the high-frequency keywords of this cluster contained “smart learning”, “learning analysis” and “learning space”, indicating that smart learning was achieved and completed through learning, smart learning space, etc.

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