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REVIEW

Research Progress and Trends of Domestic Smart Learning Environment

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ABSTRACT

In order to explore the main progress and current status of domestic research on smart learning environment, this paper takes 260 core and CSSCI journal papers included in the CNKI database as the research objects, and uses CiteSpace visual analysis software and uses bibliometrics and knowledge graph analysis as the main research methods, summarizes and analyzes the time distribution of the literature, the distribution of institutions and authors, co-occurrence and clustering of keywords, and research hotspots, etc.

1. Research Program

1.1 Research Tools

Use CiteSpace software developed by Professor Chen Chaomei, CiteSpace is a multi-dimensional, time-sharing and dynamic citation visualization analysis software,[1] which has been widely used in various fields. In this research, the time span is set from 2012 to 2018, and Years PerSlice is set to 1 year. Node Types selects authors, institutions, keywords, and threshold selection TOP 50, using static clustering and visualizing the entire network, the corresponding knowledge graph is obtained.

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1.2 Data Sources

Use CNKI as a data source, the words "smart learning environment", "smart classroom", and "smart teaching environment" are used as the key words, the time was set from 2012 to 2018. A total of 290 papers of Chinese core and CSSCI level were searched (as of December 7th, 2018), and meeting notices, papers, reports, etc. were removed, and 260 valid papers were obtained after screening.

2. Space-time Knowledge Graph Analysis

2.1 Time Distribution Map of Research on Smart Learning Environment

The change in the amount of papers published in the same topic is an important indicator for the development of research, which to some extent reflects the changes in the amount of scientific knowledge and the speed of research in this field. The statistical results of the literature published from 2012 to 2018 are shown in Figure 1. The Chinese scholars' research on the smart learning environment is generally on the rise. In 2012, as the first year of the domestic smart learning environment, it will grow steadily with little growth in 2015, and there will be rapid growth in 2016, which should be due to the influence of national policies. With the introduction of the "Internet+" Education and Education Informatization 13th Five-Year Plan, the smart learning environment has received extensive attention. The growth of 2017 and 2018 slowed down. CNKI predicted that there will be more than 70 papers in 2018.

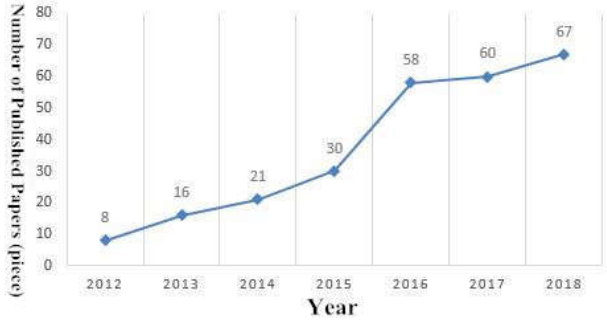

Figure 1. Literature volume statistics

2.2 Space Distribution Map of Research on Smart Learning Environment

Explore the core research institutions of China's smart learning environment through statistics on the amount of documents issued by various agencies. As shown in Figure 2, the organization that publishes 3 or more articles is listed, among them, the School of Smart Learning of Beijing Normal University, the School of Education and Information Technology of South China Normal University, the School of Education and Information Technology of Huazhong Normal University and the School of Smart Education of Jiangsu Normal University have the largest number of published papers, which indicates that it has strong research potential in the direction of smart learning environment. There is little difference in the number of published papers issued by other institutions, mostly in normal schools.

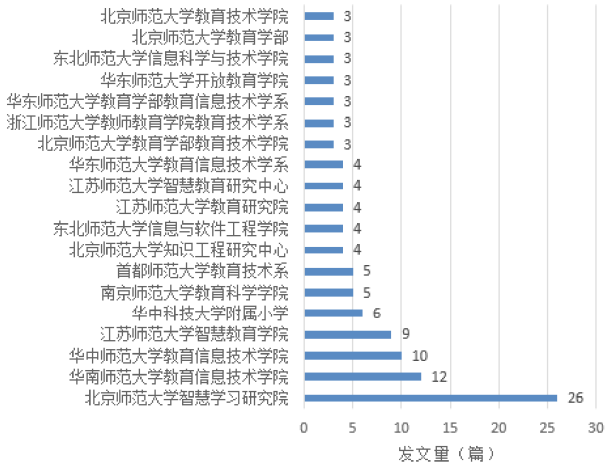

Figure 2. High-yield institutions (in Chinese)

In order to analyze the cooperation between institutions, the organization cooperation map of smart learning environment research is generated, as shown in Figure 3. The more the number of papers published, the larger the nodes and the connecting lines indicate cooperation between organizations.[2] There are 37 nodes in the organization cooperation network, with 17 connections, and the overall density of the network is 0.0255. A relatively large research group is formed centering on the smart learning research institute of Beijing Normal University, including the Institute of Educational Technology of Beijing Normal University, the Department of Education, the Smart Education Institute of Jiangsu Normal University, the Smart Education Research Center, and the Department of Education and Technology of Capital Normal University. Other cooperative groups are small, and the School of Education and Information Technology of South China Normal University cooperates with the Department of Computer Science of the City University of Hong Kong; The School of Education and Information Technology of Huazhong NormalUniversity has cooperated with the affiliated elementary school of Huazhong University of Science and Technology; The Department of Educational Technology of Zhejiang Normal University Teacher Education Col-

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lege cooperates with the Teacher Education College of Huazhong Normal University and the Education Technology College of Beijing Normal University; There are also a number of collaborations between different academic departments within the school. On the whole, the cooperation is not strong, and the research group with core cohesiveness is still relatively small.

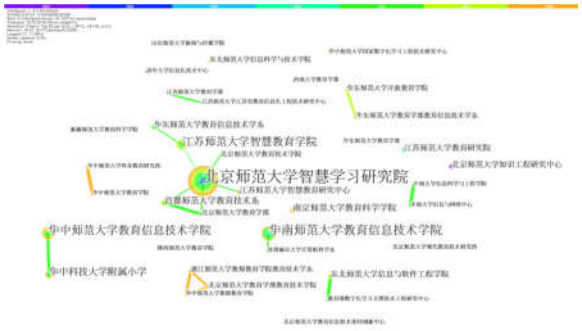

Figure 3. Institutional cooperation map (in Chinese)

2.3 Authors and Their Influence Analysis

An analysis of the author's collaboration can reveal the distribution of important scholars. The author's cooperative network map is shown in Figure 4. There are 48 authors, 64 links, and the network density is 0.0567. The authors published more articles: Ronghuai Huang, Zhiting Zhu, Yi Zhang, Qingyu Bai, Beilei Chen, Shusheng Shen, Xianmin Yang, and Lin Chen. It can be seen from the author's cooperation network that there are some cooperative groups between the current authors. The two larger cooperative groups are the cooperation group centered on Huang Ronghuai of Beijing Normal University and the cooperation group centered on Zhangye of Central China Normal University. Most of the rest of the authors are based on cooperation within the university or within the institute, and a few are inter-school cooperation. On the whole, there is no large-scale cooperation network, especially the close contact between different universities, and the lack of exchanges and cooperation between scholars in different disciplines.

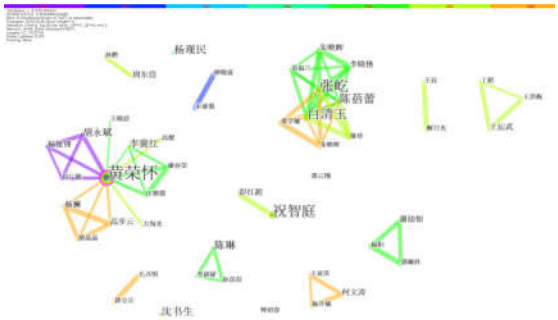

Figure 4. Author cooperation network (in Chinese)

3. Content Knowledge Graph Analysis

3.1 Keywords Co-occurrence Knowledge Graph

As an important component and essence of the thesis, the keyword co-occurrence can reflect the hotspots and frontiers of a certain field.[3] Select the MST algorithm and get a knowledge graph with 61 nodes and 93 connections, as shown in Figure 5. The circle size indicates the co-occurrence frequency of the keyword, and the font size indicates the centrality. From the figure, the hotspots that domestic scholars pay attention to in a certain period can be visually reflected. Specifically, the keywords with higher frequency are: "smart classroom", "smart learning environment", "smart education", "smart learning", "smart teaching", "teaching mode", "smart classroom", "learning environment", "personalized learning", "learning analysis" ", "Big Data", "Internet +", "Artificial Intelligence", "Educational Informationization", etc.

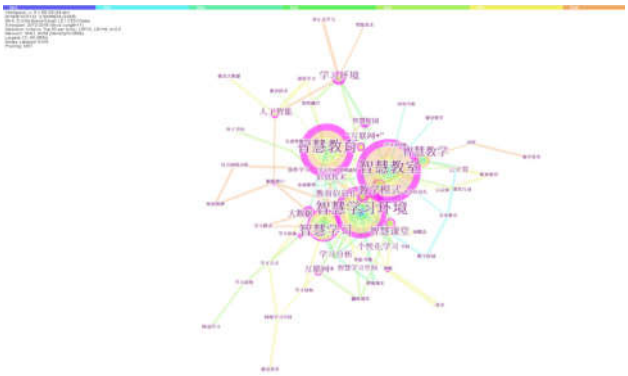

Figure 5. Keywords Co-occurrence Map (in Chinese)

3.2 Keywords Clustering Analysis

CiteSpace's keyword clustering analysis can reflect the hot spots and trends in a certain field.[4] This paper uses the LLR algorithm for clustering. The clustering results are shown in Figure 6. Modularity network modular evaluation index, its value is directly proportional to the clustering effect, Modularity Q>0.3 means trusted service, Silhouette network homogeneity index, S>0.5 means reasonable clustering,[3] The Q value of Figure 6 is 0.5428, indicating that the network community structure is significant, and the S value is 0.633, indicating that the clustering result is reasonable.

It can be seen from the figure that there are 6 clustering themes in the domestic smart learning environment research, respectively are: smart classroom, online learning space, artificial intelligence, smart learning environment, smart classroom, social network analysis.

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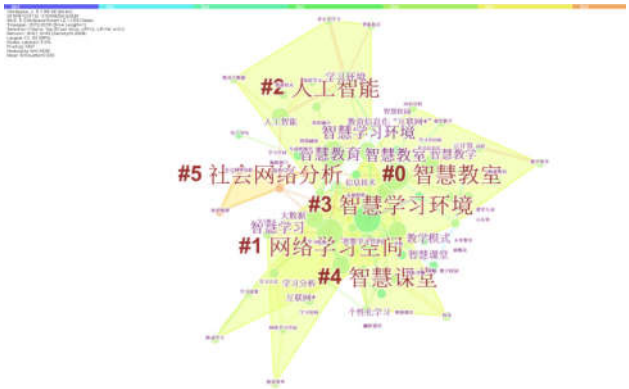

Figure 6. Keywords clustering map (in Chinese)

3.3 Research Hotspot Analysis

By summarizing hotspot keywords and literature, three aspects of the research related to smart learning environment are summarized.

3.3.1 The Theoretical Framework of the Smart Learning Environment

The representative is Ronghuai Huang (2012) on the concept of smart teaching environment, he pointed out that the smart learning environment is an interactive tool that can sense learning scenarios, identify learner characteristics, provide appropriate learning resources and conveniences, automatically record learning processes, and evaluate learning outcomes to promote learners' effective learning or activity space.[4] Zhiting Zhu (2012) believes that the smart learning environment can be perceived and recognized, and flexible to generate adaptive learning task activities, to guide learners to make correct decisions, to promote the development of smart capabilities and the emergence of new learning environments for smart actions. Xianmin Yang (2015) summarized the smart learning environment as "one center, two types of environments, three content libraries, four technologies, five types of users, and six types of services". Yongbin Hu (2016) defines the definition, elements and scale of the learning environment for smart learning environment.[5]

3.3.2 Research on the Design and Construction of Smart Learning Environment

The current practice of the smart learning environment has mainly turned into a study of the smart classroom. Baohong Shi (2017) built a smart classroom architecture based on Internet of Things, cloud computing, virtualization, VOIP, video surveillance and other technologies; Ning An (2017) explores and builds a smart classroom that realizes intelligent attendance management, diversified teaching and presentation methods, convenient use of resources, and interactive teaching;[6] Peiran Hu (2018) expounded the design, construction and management of Shangchao's smart learning environment combining Internet of Things, artificial intelligence, mobile internet and big data;[7] Kai Zhang (2018) builds a smart classroom consisting of six core parts: multi-screen presentation, teaching and sound reinforcement, intelligent interaction, direct recording, IoT integrated control and service, smart class card, teaching resource construction and application cloud platform.[8]

3.3.3 Research on the Teaching Application of Smart Learning Environment

Although the construction of the smart learning environment is not mature enough, scholars have studied the teaching application and learning effects in the smart learning environment. The research has many aspects. The first is the application of learning analysis and personalized learning, Li Tang (2016) analyzes the learning intervention mechanism based on learning analysis. Hongyan Wu (2015) to build a personalized online learning system, Yonghe Zhang (2012) study learning context recognition; the second is the research on teaching interaction and teaching mode. Hongmei Li (2015) explores the application of ARS interactive teaching mode. Shenglan Xue (2018) explored the hybrid teaching mode of smart phones integrated into classroom teaching. Wang Jing (2018) studied the classroom teaching mode based on Pad. Yi Qiu (2018) summarized typical patterns such as personalized learning, flipping classrooms, and generative teaching based on the smart classroom environment.

4. Conclusions and Trends

4.1 Research Conclusions

Based on CiteSpace software, this study conducts different levels of visual analysis of the core of the smart learning environment and CSSCI literature in the CNKI database from 2012 to 2018. The research progress and current status of the domestic smart learning environment are systematically reviewed. The main conclusions are as follows:

4.1.1 Time Distribution Map Analysis

The smart learning environment related research has experienced rapid development in 2015-2016 and has received extensive attention. After the growth slowed in

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2017, the growth in 2018 has increased; the overall trend is on the one hand. On the one hand, it is affected by the development of technology. On the one hand, it is affected by the policy. In the future, there should be more scholars' input and attention.

4.1.2 Institution and Author Analysis

There are many institutions and scholars involved in the research of smart learning environment, and some small-scale cooperation networks have been formed, however, most of them are based on cooperation within the university or within the institute. There is less inter-school cooperation and there is a lack of exchanges and cooperation between scholars in different disciplines.

4.1.3 Research Hotspot Analysis

Hot keywords include "smart classroom", "smart learning environment", "smart education", "smart learning", "smart teaching", "teaching mode", "smart classroom", "learning environment", "personalized learning" , "learning analysis", "big data", "internet +", "artificial intelligence", etc. The research focuses on three aspects: theoretical framework, design and construction, and teaching application research. Overall, practice and application are not perfect enough, although some colleges and universities have built smart classrooms in the past two years, they still cannot fully meet the requirements of the smart learning environment, and further research and improvement are needed in the future.

4.2 Trend Analysis

4.2.1 Improve the Theoretical System of Smart Learning Environment

At present, there is still doubt about the smart learning environment and the "smart" of smart education. There is no unified understanding, and the measurement standards for "smart" and "not smart" have not yet taken shape. Subsequent research should further strengthen the theoretical research of smart learning environment, clarify the connotation of related concepts, and refine the relevant theories of various typical fields of the smart learning environment (such as schools, communities, etc.), and improve the theoretical system of smart learning environment.

4.2.2 Strengthen the Construction of Smart Learning Environment

At present, many schools have actively invested in the practical exploration of the smart learning environment, and have achieved certain results, but they cannot be completely called the true smart learning environment. In the future, we should further explore the research and application of technologies such as Internet of Things, cloud computing, big data, virtual reality and artificial intelligence related to the construction of smart learning environment, and strengthen the construction and practice of smart learning environment.

4.2.3 Explore Teaching Applications of Smart Learning Environment

With the continuous construction of the smart learning environment, the attention of the academic community in the future of smart learning environment teaching applications should increase. Both educational information workers and teachers need to consider how to teach in such a smart learning environment, change teaching methods, and promote innovation in education and teaching.

4.2.4 Establish a Smart Learning Environmental Assessment System

The domestic theoretical and practical research on the smart learning environment is still in its infancy, and no relevant evaluation index system has been constructed. Many schools are built separately and there is no uniform standard.

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