Received: November 15, 2017
Revision received: March 21, 2018
Accepted: March 25, 2018

www.estp.com.tr
DOI 10.12738/estp.2018.6.197 ♦ December 2018 ♦ 18(6) ♦ 2979-2988

Research Article

Analysis of Mapping Knowledge Domains of Tennis Teaching Research in China

Baoliang Wang[1]
Liaoning Economic Vocational Technological Institute

Zengke Wang[2]
Hainan University

Abstract

Using Citespace V visual analysis software, this analysis takes 2,893 documents on tennis teaching research included in China National Knowledge Infrastructure (CNKI) as research object to draw the mapping knowledge domains in the field of tennis teaching research, and probes into the research. hotspots and development process of tennis teaching. Research holds that the number of published papers in the field of tennis teaching research shows an increasing trend. Yu Zhenkai, Yang Xudong and Zhi Jixin constitute the high-yielding authors of tennis teaching research. Beijing Sport University, Wuhan Institute of Physical Education and Physical Education College of Zhengzhou University constitute high-yield institutions in the field of tennis teaching research. The research hotpots of tennis teaching lie in tennis, tennis sports, tennis teaching, current situation and sports teaching. The research puts forward several suggestions, such as strengthening the exchange and cooperation, constructing the academic community; stabilizing the research trend and increasing the research depth; grasping the opportunity of the times and improving the level of tennis teaching so as to promote the relevant research progress in the field of tennis teaching.

Keywords

School Sports • Tennis Teaching • Mapping Knowledge Domains • Research Hotspots

[1] Liaoning Economic Vocational Technological Institute, Liaoning 110122, China; Email: wangbaoliang421@163.com
[2]**Correspondence to:** Hainan University, Hainan 570228, China. Email: 309313073@qq.com

Citation: Wang, Z. K, Analysis of Mapping Knowledge Domains of Tennis Teaching Research in China. *Educational Sciences: Theory & Practice, 18(6),* 2979-2988. http://dx.doi.org/10.12738/estp.2018.6.197

In the 13th Five-Year Plan of Sports Development issued by the General Administration of Sport of China, it is proposed that "we should promote young people to form physical training habits and master more than one sports skill". There is no doubt that tennis, known as "the second largest sport in the world", coincides with "mastering more than one sports skill" mentioned in the "13th Five-Year Plan", and the development of tennis has ushered in a new opportunity. Tennis teaching is an indispensable part of tennis. From the search in CNKI, it can be found that the researches of tennis teaching mainly focus on ball games, tennis competitions, tennis courses and experimental research in colleges and universities. In the face of thousands of documents, which researchers and research institutions have become important forces in this field and what hotspots have been concentrated in the research of tennis teaching in China. On this basis, knowledge visualization is used to show the development and evolution of tennis teaching research in China to explore the hotspots and trends of tennis teaching research and to provide relevant reference for the research of tennis teaching in China.

Data Sources and Research Methods

Data sources

The research data come from CNKI. At present, the number of Chinese core periodicals in CNKI is far more than other databases (Jiang, 2015). The specific search method is as follows: Through the advanced search function of CNKI, we input enter "tennis teaching" on November 21, 2018. There are 2,906 documents, including 695 masters' and doctoral papers, 2,168 periodical papers and 46 conference papers. Through data filtering of the searched documents, 2,893 documents are obtained by deleting the documents which don't accord with the research subject. These documents are exported into a plain text format and saved.

Research methods

The research adopts the method of knowledge visualization, uses the research tool Citespace V to draw the mapping knowledge domains of tennis teaching. Citespace is a knowledge visualization tool developed by Dr. Chen Chaomei, a Chinese professor at Drexel University in the United States. Citespace can visualize the relevant research documents and directly represent the research process in a certain field through the form of map.

Results and Analysis

Time distribution of published papers

The relationship between the number and time of published papers in the field of tennis teaching research can reveal the research history and development speed in this field, and predict its development trend (Wang, Chen and Tang, 2015). The time distribution of published papers in the field of tennis teaching research in China is shown in Figure 1. It can be seen from Figure 1 that the research papers on tennis teaching were first published in 1983. In the following ten years, there were no articles on tennis teaching included in CNKI and or no articles on the subject of tennis teaching were included in 1996. The papers published on tennis teaching can be divided

into three stages. The first stage is from 1983 to 2003. In the 20 years, the number of published papers is relatively low and is only 56, accounting for 1.9% of the total number of papers. The second stage is from 2004 to 2012 when the research papers on tennis teaching are increasing gradually. The number of published papers is 1,134, accounting for 39.1% of the total volume of published articles. The third stage is from 2013 to 2018 when the number of published papers is 1,689, accounting for 58.3% of the total number. The number of published papers tends to be stable.

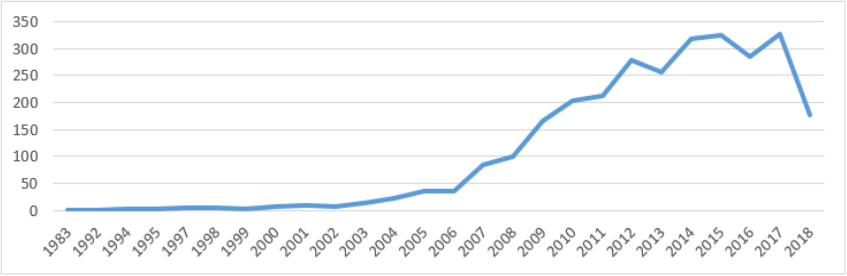

Figure 1. Time distribution of published papers in the field of tennis teaching research in China

Co-occurrence network of scientific research authors

The number of papers published by researchers reflects their knowledge production capacity and is one of the criteria for evaluating the efficiency of scientific researchers (Gao, Duan and Han, 2015). It is generally believed that the high-level research achievements of scientific researchers are in direct proportion to the scientific and technological achievements (Pao, 1981). By selecting authors through Citespace V network node, the co-occurrence network of research authors in the field of tennis teaching research in China can be generated (as shown in Figure 2). Statistics are made on the top 10 authors in the number of articles about tennis teaching research (as shown in Table 1). The nodes in the map represent the research authors in the field of tennis teaching, the size of the node represents the number of papers published by the research authors, and the connection line between the nodes represents the cooperative relationship between the researchers, and the thickness of the line represents the cooperation degree of research authors (Liu, Chen and Hou, 2008).

As shown in Figure 2, 394 researchers (N = 394) participate in the related researches of tennis teaching in China, and they have 80 (N = 80) research cooperation of varying degrees, showing that a relatively stable research team is formed in the field of tennis teaching research. As can be seen from Figure 2 and Table 1, Yu Zhenkai of School of Physical Education, Yuxi Normal University has published 16 papers in the field of tennis teaching and his main research direction is tennis teaching in colleges and universities. Yang Xudong of Department of Physical Education, Shenyang Jianzhu University has published 10 papers and ranks the second. His main research direction is sports training. In the third place is Zhi Jixin of Physical Education College of Zhengzhou University. He has published 9 papers and he is mainly engaged in the research of tennis physical education and training. Some studies suggest that scientific output is highly correlated with the frequency of cooperation among scientists, and that high rate of output is positively correlated with the high level of

cooperation. According to the analysis of Figure 2, the largest research cooperation network in the field of tennis teaching research is the research cooperation team composed of Wang Haiming, Zou Kening, Li Yifeng, Wang Xiangfei, Feng Sheng, Wang Ke and Li Nan. The second largest research cooperation network is composed of Zhang Tao, Li Yinping and Pang Qingjun. The third largest research cooperation network consists of Zhao Debao, Sun Yongsheng and Zhao Zhenwu. In addition, Yu Haisheng and Zhao Yufei, Li Liang and Liu Yan, Du Shaohui and Si Qingluo, Wang Hao and Lv Chunshuang, Yu Zhenkai and Feng Yanping, Zhou Shouyou and He Jianwei, Jiang Xiaohong and Zhang Xuhui, Chen Jijian and Lian Guangxiang, Zhang Hongbo and Tang Qinghu, Yang Xudong and Wang Jian, Zhou Fei and Yuan Juan form research cooperative groups in pairs. Their researches have made important contributions to the development of tennis teaching. From the co-occurrence network of scientific research authors in the field of tennis teaching research in China, it can be seen that the connection line between the nodes of scientific research authors is thin, which shows that there is little research cooperation of scientific research authors in the field of tennis teaching research.

Table 1
Top 10 Research Authors in the Field of Tennis Teaching Research

No.	Author	Number of published papers	Unit of author
1	Yu Zhenkai	16	School of Physical Education, Yuxi Normal University
2	Yang Xudong	10	Department of Physical Education, Shenyang Jianzhu University
3	Zhi Jixin	9	Physical Education College of Zhengzhou University
4	Yu Haisheng	8	Sports Training College of Jilin Sport University
5	Li Liang	8	Tennis Teaching and Research Office of Wuhan Institute of Physical Education
6	Gao Chao	7	College of Physical Education, Suzhou University
7	Hao Ce	7	College of Sports Science, Shenyang Normal University
8	Wang Hao	7	Department of Physical Education, Northeast Petroleum University
9	Li Jun	6	Inner Mongolia University of Science & Technology Faculty of Physical Education, Baotou Teachers' College
10	Huang Huana	6	Physical Education College of Zhoukou Normal University

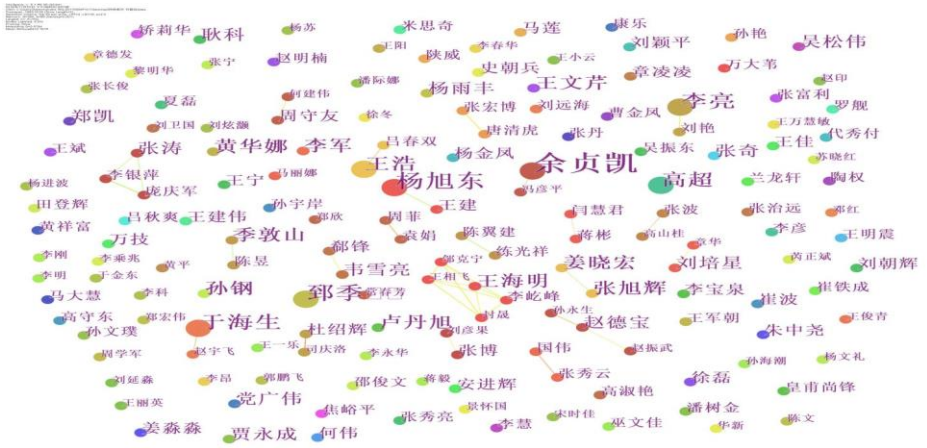

Figure 2. Co-occurrence network of scientific research authors in the field of tennis teaching research

Co-occurrence network of scientific research institutions

The co-occurrence analysis of scientific research institutions can directly show the main strength and influence distribution of physical education research in China. Citespace V software is used to select institution and adjust the threshold value of the generated map appropriately. The secondary colleges to which the research institutions belong are merged. For example, “Wuhan Institute of Physical Education” and “Graduate School of Wuhan Institute of Physical Education” and “Tennis Teaching and Research Office of Wuhan Institute of Physical Education” are merged into “Wuhan Institute of Physical Education”; “Jilin Sport University” and "Jilin Institute of “Sports Training College of Jilin Sport University” are merged into “Jilin Sport University”; “Xi'an Physical Education University” and “Graduate School of Xi'an Physical Education University” are merged into “Xi'an Physical Education University”; “Beijing Sport University” and “Graduate School of Beijing Sport University” are merged into “Beijing Sport University”; “Shanghai University of Sport” and the “School of Economics and Management of Shanghai University of Sport” are merged into “Shanghai University of Sport”. After the merger of the research institutions, a co-occurrence network in the field of tennis teaching research in China can be created (as shown in Figure 3). At the same time, statistics are made on the top 10 research institutions in the field of tennis teaching research (as shown in Table 2).

Figure 3. Co-occurrence network of scientific research institutions in the field of tennis teaching research

Table 2
Top 10 Scientific Research Institutions in the Field of Tennis Teaching Research

No.	Number of published papers	Scientific research institutions
1	32	Beijing Sport University
2	27	Wuhan Institute of Physical Education
3	22	Physical Education College of Zhengzhou University
4	21	Xi'an Physical Education University
5	16	College of Sports Science, Shenyang Normal University
6	16	College of Physical Education, Southwest University
7	15	Jilin Sport University
8	13	School of Physical Education, Yuxi Normal University
9	12	Guangzhou Sport University
10	12	Chengdu Sport University

In Figure 3, each node represents a scientific research institution and the size of node is proportional to the number of papers published by the scientific research institution. The connection line between the nodes represents the cooperative relationship between the scientific research institutions and the thickness of the connection line represents the cooperation degree between scientific research institutions. As can be seen from Table 2 and Table 3, Beijing Sport University has the largest number of nodes and the largest number of published papers with a total of 32; In the second place is Wuhan Institute of Physical Education with 27 published papers; In the third place is Physical Education College of Zhengzhou University with 22 published papers. Among the top 10 scientific research institutions, there are 7 professional sports colleges and universities and 2 normal universities, which indicates that sports colleges and universities are the important research force in the field of tennis teaching research.

From the co-occurrence network of research institutions in the field of tennis teaching research in China, it can be seen that 244 research institutions (N = 244) participate in the relevant researches on tennis teaching, and these research institutions have 80 cooperation (E = 80). The largest research and cooperation network consists of Beijing Sport University, Wuhan Institute of Physical Education, Shanghai University of Sport, Physical Education College of Huaibei Normal University, Physical Education College of Zhengzhou University, Beijing Normal University- College of P.E and Sports, School of Physical Education, Henan University, Physical Education College of Inner Mongolia University for Nationalities and Physical Education College of Hubei University of Science and Technology. In addition, Physical Education College of Anhui Normal University and Physical Education College of South China Normal University, Yuxi Normal University and Physical Education Department of Zhongkai University of Agriculture and Engineering, Physical Education Department of Dongbei University of Finance & Economics and Physical Education Department of Shenyang Jianzhu University, College of Physical Education, Southwest University and School of Physical Education and Health, Yangtze Normal University form research cooperation networks in pairs. It can be seen from the co-occurrence network of scientific research institutions in the field of tennis teaching research that the connection line between scientific research institutions is relatively thin, which indicates that the cooperation degree of scientific research institutions in the field of tennis teaching research isn't close enough.

Co-occurrence network of research hotspots

Key words are the core and the essence of an article, as well as high degree of generalization and conciseness of topic (Zhang and Liu, 2016). Citespace V software is used to select key words of network node. There are 110 nodes (N = 110) and 418 connection lines (E = 418) in the co-occurrence network of key words in the field of tennis teaching research (as shown in Figure 4). At the same time, statistics are made on the top 10 high-frequency key words and high emergent words in tennis teaching (as shown in Table 3).

Table 3 lists the top 10 high-frequency key words and high emergent key words in the field of tennis teaching research in China. Among them, tennis has the highest occurrence frequency as the subject word of the study with the occurrence frequency of 825 times; the second is tennis teaching with the occurrence frequency of 574 times; in the third place is tennis with the occurrence frequency of 373 times. Among the high emergent words, the emergence value of tennis teaching is the highest, which is 0.26; the second is tennis with the emergence

value of 0.22; in the third place is tennis sport with the emergence value of 0.17. It shows that tennis teaching, tennis and tennis sport are the center of tennis teaching research.

Table 3
Top 10 Key Words in the Field of Tennis Teaching Research

No.	High-frequency key words	Frequency	High emergent words	Emergence value
1	Tennis	825	Tennis teaching	0.26
2	Tennis teaching	574	Tennis	0.22
3	Tennis sport	373	Tennis sport	0.17
4	College and universities	370	College and universities	0.17
5	Current situation	236	Regular institutions of higher learning	0.12
6	Teaching	174	Tennis optional course	0.12
7	Countermeasure	167	Physical education	0.1
8	Regular institutions of higher learning	161	Teaching quality	0.09
9	Experimental study	102	Countermeasure	0.07
10	Teaching method	100	Experimental study	0.07

Figure 4. Co-occurrence network of research hotspots in the field of tennis teaching research

Figure 4 is the co-occurrence network of research hotspots in the field of tennis teaching research in China which is divided into five research knowledge groups according to the cluster nodes and the connection lines between clusters. These knowledge groups represent the research hotspots in the field of tennis teaching research in China.

In the knowledge group 1, “tennis” has the largest nodes in the co-occurrence network, which is closely related to the key words “teaching”, “quick tennis”, “experimental study” and “serve technology”. It shows that tennis is the main part of tennis teaching research, and teaching is the important way of tennis teaching. Tennis sport is difficult for beginners and the introduction of “quick tennis” is popular (Zhou *et al*., 2010), hoping to reform tennis, instruments and other methods to reduce the difficulty of entry and to promote the tennis sports

population. The reform of tennis sport needs experiment to support and verify. There are many researchers designing experiment around the tennis reform to promote the tennis sports reform through this kind of practice.

Knowledge group 2 centers on “tennis teaching” that forms a close sub-network with “ball games”, “physical education”, “teaching reform”, “tennis course”, “tennis club”, “tennis course” and “applied research”. Tennis teaching follows the teaching methods and rules of ball games to a certain extent, and it is also an integral part of sports teaching. Tennis course needs tennis teaching as an important support. Tennis club is also a platform for tennis teaching. Teaching reform is the main driving force to promote the development of tennis teaching. The technical course reform in colleges and universities is a long-term work. It is an important challenge for sports reform to improve students’ sports skills and learn sports skills so as to form a good habit of participating in sports for the whole life.

Knowledge group 2 takes “tennis sports” as the center which is closely related to “regular institutions of higher learning”, “higher vocational colleges”, “tennis optional course” and “tennis training”. The research of tennis teaching is widely distributed in regular institutions of higher learning and higher vocational colleges, which reflects the wide range of research on tennis teaching. Most of the tennis courses in colleges and universities are carried out in the form of optional courses with strong popularization. Tennis training is the further improvement of sports technology and sports ability with high-end characteristics.

Knowledge group 4 is composed of “colleges and universities”, “college sports”, “optional course” and “teaching model”. It shows that most of the research results of tennis teaching come from the field of physical education in colleges and universities, and the discussion of the teaching model has become the focus of the relevant researchers.

Knowledge group 5 is composed of the key words of “current situation”, “teaching current situation”, “development current situation”, “influence factor” and “feasibility”, showing that the research depth of tennis teaching is shallow, and the research work is mainly the basic research. The research content needs to be enriched and perfected.

Co-occurrence network of research hotspot time zone

The time zone in Citespace V software can reflect the evolution path of the hotspot structure in tennis teaching research and analyze the frontier dynamics of the research hotspots . As can be seen from Figure 5, the tennis teaching research in China can be divided into two stages. The first stage is from 1983 to 2000. In the process of nearly 20 years, the relevant research on tennis teaching is in a relatively macroscopic situation, and the research is not detailed enough. The main research hotspots are “tennis”, “ball games” and “tennis teaching”. The second stage is from 2001 to 2018 when the research is gradually refined from macroscopic to microscopic level, and the focus of the research is shifted to the aspect of school sports, college sports and sports teaching. By 2010, quick tennis and tennis culture have become new research hotspots, which indicates that the change of the focus of research on tennis teaching reform and highlights the role of sports colleges and universities in tennis teaching.

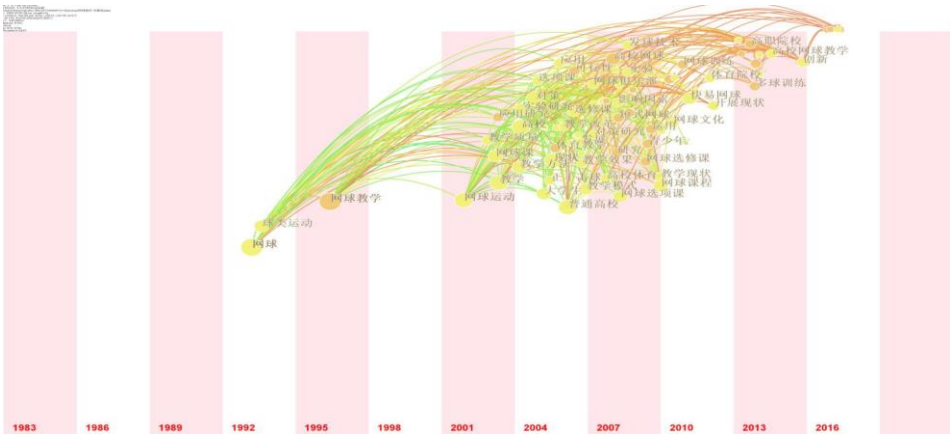

Figure 5. Co-occurrence network of research hotspot time zone evolution in the field of tennis teaching research

Conclusions and Suggestions

Conclusions

In terms of the number of published papers, the number of tennis teaching field shows a growing trend and reaches the peak by 2017. From the scientific research authors, Yu Zhenkai, Yang Xudong and Zhi Jixin are high-yield authors in the field of tennis teaching research. Three large-scale research cooperative groups and several cooperative research groups in pairs are formed in the field of tennis teaching research. In terms of scientific research institutions, Beijing Sport University, Wuhan Institute of Physical Education and Physical Education College of Zhengzhou University are high-yield research institutions. The cooperation network of scientific research institutions is relatively sparse. As for the research hotspots, tennis, tennis teaching and tennis sport have become the hotspots in the field of tennis teaching research, and the research in the field of tennis teaching focuses on physical education teaching in colleges and universities. From the evolution of research trend, attention to the field of tennis teaching has changed to the teaching reform and transition has occurred from tennis teaching training to the construction of tennis culture.

Suggestions

Relevant researchers continue to pay attention to the field of tennis teaching, dare to try new theories, new methods and new perspectives to deepen the reform of tennis teaching. For the authors and research institutions of scientific research papers, the academic community can be established to enhance exchange and cooperation of academic resources. Relevant researchers can increase the frequency of cooperation and promote the production of more research results in the field of tennis teaching. Besides, they shall grasp the opportunity of school physical education reform, learn foreign advanced tennis teaching experience, improve the quality of research results, and create more high-level scientific research results.

References

Gao M., Duan, H., & Han, S. J. (2015). Quantitative analysis of foreign physical education studies based on citespace III. *Sports Science*, *35* (1), 4-12. http://dx.doi.org/10.3969/j.issn.1000-677X.2015.01.002

He, Q. H. (2016). Visualized analysis of physical education in China based on mapping knowledge domains. *Journal of Beijing Sport University*, *39*(2), 98-103.

Jiang, H. B., University, G. O. (2015). A review of the quality of full-text databases of three major chinese periodicals. *Modern Intelligence*, *35*(9), 84-88, 170. http://dx.doi.org/10.3969/j.issn.1008-0821.2015.09.016

Liu, Z. Y., Chen, Y., & Hou, H. Y. (2008). Methods and Applications of Mapping Knowledge Domains. *Beijing: People's Publishing House*, *68*.

Meng, G. Z., & Cao, Z. H. (2017). Frontier dynamic visualized analysis of China sports law research in recent 20 years. *Journal of Wuhan Institute of Physical Education*, *51*(3), 38-44.

Pao, M. L. (1981). Co-authorship as communication measure. *Library Res*, *(2)*, 327−338.

Wang, Z. K., Chen, H. W., & Tang, W. J. (2015). Review and prospect of research on public sports service in china since the beginning of the 21st century: based on bibliometrics and analysis of mapping knowledge domains. *Journal of Capital Institute of Physical Education and Sports*, *27*(2). http://dx.doi.org/109-115. 10.14036/j.cnki.cn11-4513.2015.02.003

Zhang, Y. H., & Liu, M. Y. (2016). Visualized analysis of Chinese sports industry research based on mapping knowledge domains. *China Sports Science and Technology*, *52*(1), 24-29, 35. http://dx.doi.org/10.16470/j.csst.201601004

Zhou, F., Li, M. Z., Liu, Y. L., & Yu, H. F. (2010). On Quick Tennis. *Sports Culture Guide*, (11), 46-49.