

Research Hotspot and Frontier Analysis of Virtual Community in China based on CiteSpace

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Abstract. The purpose of this study is to present the research groups and relationships of subject literature in virtual community, and to explore the hot spots and frontiers of research topics. CiteSpace visual analysis software was used to analyze the institutions, scholars and keywords of 1,558 documents. The research found that: (1) The development of this research can be divided into the initial period (2000-2005), the rapid development period (2006-2011), the fluctuating growth period (2012-2017) and the stable period (2018-2017). (2) Most of the articles with high publication volume are information journals, while most of the cited articles are management journals; (3) Research institutions and scholars are concentrated in the central and eastern cities, and the cooperation between institutions has regional characteristics, and the cooperation among scholars is mainly based on the relationship between colleagues and teachers and students; (4) The current hot research topics are online healthy community and virtual academic community; (5) The research methods and research fields need to be further explored.

Keywords: Virtual Community; Citespace; Hot Spots; Frontier.

1. Introduction

With the development of the Internet, virtual community (VC) has grown rapidly, and has become the most powerful platform for integrating Internet users. The outline of the 14 th Five-Year Plan proposes to promote the construction of a network power, drive the change of production mode, lifestyle and governance mode with digital transformation, and lead China's future economic development direction. As an important part of the strategy of network power, virtual community promotes the formation of cyberspace destiny community. At present, there is no clear and accepted concept of virtual community. In 1993, H. Rheingold, the father of virtual community, first defined virtual community as a social aggregate that forms interpersonal networks in cyberspace after many people have long-term discussions on the Internet and have strong enough emotions. After 30 years, scholars have carried out extensive research, involving management, economics, computer science, library and information science, sociology, psychology and many other fields. However, the existing research is scattered, and there is little induction and collation of subject literature in the past. In view of the research theme of virtual community, this paper uses CiteSpace, a bibliometric analysis software, to visually count and analyze the papers included in core journals in CNKI database, in order to deeply understand the hotspots and frontiers of virtual community research and provide reference for domestic virtual community research.

2. Research Tools and Data Sources

In this study, CiteSpace 5.5.R2 visual analysis software developed by Professor Chen Chaomei of Dressayre University is used, which needs Java application as a platform, and is a visual knowledge analysis tool suitable for multivariate, time-sharing and dynamic complex network analysis. [1] With the help of quantitative analysis atlas of this tool, it focuses on three aspects: First, it reveals the distribution of typical institutions and representative scholars in the field of virtual community research and their cooperation through the co-occurrence atlas of institutions and scholars; Second, the research hotspots and their relations are reflected by the keyword co-occurrence atlas and the clustering timeline atlas; The third is to detect the research frontier through the detection map of emergent words. On the basis of existing atlas and representative literature data, qualitative research

conclusions are drawn to present the overall research outlook of virtual communities in China, and to seek the development direction of future research on virtual communities.

This paper takes CNKI as the literature source, adopts advanced retrieval type, the data retrieval time range is set to not be limited to 2021, and the literature search range is set to the documents published in CSSCI (including extended edition) and core journals. Referring to scholars' general definitions and literatures of virtual community in the past, the key words with high similarity were clarified, and the retrieval theme (Su) = virtual community or SU= online community or SU= electronic community or SU= online community was determined. A total of 3,504 documents were retrieved from 2000 to 2021. In order to ensure the typicality and reliability of the research, 1,558 valid documents were obtained as the data source of the research after eliminating duplicate documents, unpublished documents and documents without reference significance such as meetings, essays, news, interviews and recommended reading.

3. The Overall Result Analysis

3.1 Posting Trend

Through statistical analysis of the target documents, the number of published articles and the general trend in each year under the theme of "virtual community" are obtained, and the results are shown in Figure 1. According to Figure 1, the research on virtual communities in China can be divided into four stages of development: (1) Initial stage (2000-2005): the research on virtual communities is in the initial stage, the concept of virtual communities has just been introduced into China from abroad, and scholars have started to combine the research on virtual communities with the Internet. At this stage, the number of papers published is small, with an average of only 8.2 papers per year; (2) Rapid development period (2006-2011): The government issued the National Informatization Development Strategy for 2006-2020 to support the development of the Internet. The research on virtual communities in China grew rapidly, the Internet continued to grow, its influence was increasing day by day, and social networks were colorful. The rise of Renren.com and QQ attracted the attention of scholars, and the number of posts published in this period reached its peak in 2011. (3) Fluctuation growth period (2012-2017): At this stage, the virtual community is applied to a wider research field, the cooperation of research institutions is obvious, and the number of publications fluctuates greatly, with an average annual fluctuation of 13.52%; (4) Stable period (2018-2021): The related theories and methods of virtual community are becoming more and more mature, and the research enthusiasm has remained high for a long time. The number of periodical papers has remained relatively stable, with the average number of published papers reaching 119.8/year. In 2021, the slight decline was due to the related literature at the end of the year and was officially published in paper, which was only the first online publication, so it was not taken into account.

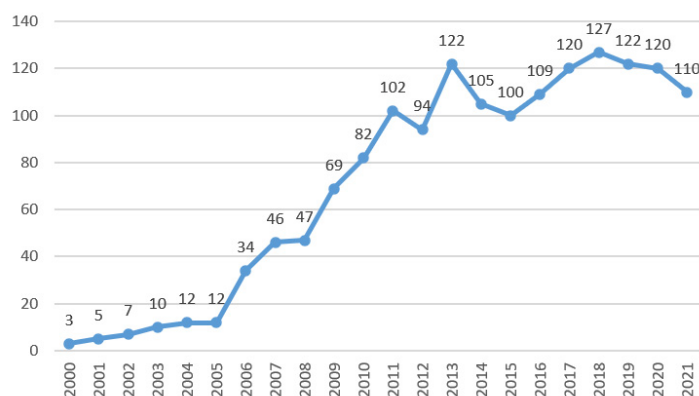


Fig 1. Annual publication of virtual community core and CSSCI journal papers

3.2 Analysis of the Cooperative Network of Research Institutions

Taking institutions as node types for statistical analysis, Figure 2 is obtained. Figure 2 shows the names of institutions with 5 or more articles, and describes the relationship between institutions. Each node represents a research institution, and the size of the node is positively correlated with the number of posts. The connection between nodes represents the cooperation between institutions; There is a positive correlation between the thickness of the connection line and the number of common posts. In Figure 2, the number of nodes (N) is 149, the number of node connections (E) is 44, and the Density value is 0.004, which shows that the research of each institution is relatively independent, and there are few cases of cooperation and publication.

According to the seven geographical regions, we can see that there is a strong cooperative relationship between the School of Management of Jilin University in Northeast China and the Information Resource Center of Jilin University; There is less cooperation in North China, and only the School of Public Policy and Management of the University of Chinese Academy of Sciences has a cooperative relationship with school of information management in Central China. The output of papers in East China is mainly in Nanjing, and the School of Information Management of Nanjing University has strong cooperation with the School of Economics and Management of Nanjing University of Science and Technology. There is a cooperative relationship between the School of Information Management of Central China Normal University and the Information Resources Research Center of school of information management and Wuhan University, but there is no direct cooperative relationship between the School of Management of Central China University of Science and Technology and the three. There is no obvious cooperative relationship among South China, Southwest China and Northwest China. On the whole, research institutes are mostly concentrated in the developed central and eastern cities represented by Wuhan and Nanjing.

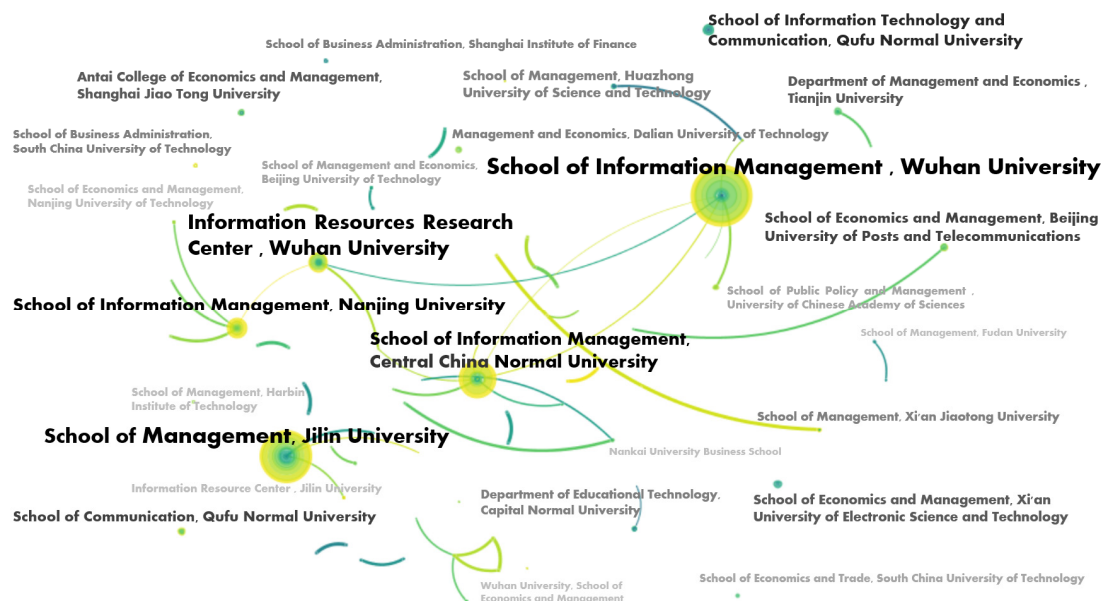


Fig 2. Cooperation network of research institutions

3.3 The Author Cooperation Network Analysis

In CiteSpace, the Author is used as the node type for statistical analysis, and the map of scholars' cooperation network is drawn. As shown in Figure 3, the larger the nodes and the more connections, the stronger the influence of scholars in the research field of old-age care institutions. Figure 3 measures the frequency and cooperation of scholars, and the names of scholars with more than 5 papers emerge.

In the research of virtual community, scholars have a close cooperative relationship, forming a certain number of cooperative groups. Most of the partners are colleagues, teachers and students of

the same institution. Table 1 lists the close cooperative relationships in the figure, and indicates the main research topics of each team. In addition to the scholars with relatively fixed cooperation, there are some scholars with weak cooperation partners and relatively independent research, which have high influence. They are presented by independent names in the figure. Table 2 shows the institutions and main research topics of these scholars.



Fig 3. Scholar cooperation network

Table 1. Cooperation among scholars

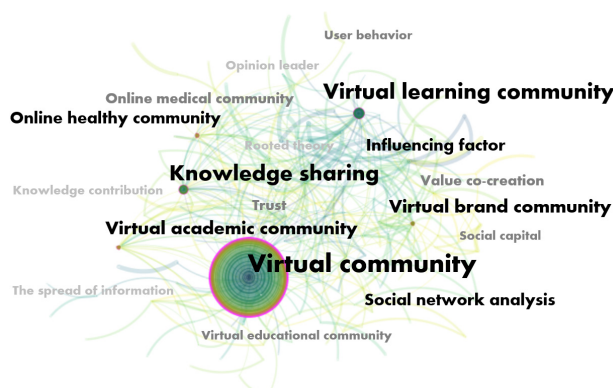
Scholar	Relationship	Organization	Research topic
Zhu Qinghua and Yuan Qinjian	colleague	Dept. of information management, Nanjing university	Cognition, Meta-analysis
Liu Guoliang and Wang Dong	colleague	School of management, Jilin university	Knowledge Sharing
Zhang Min and Zhang Yan	colleague	School of information management, School of Public Policy and Management, University of Chinese Academy of Sciences	Healthy community, diagnosis and treatment information, help-seeking behavior
Tan Chunhui and Wang Zhanping	colleague	School of information management, Central China Normal University	Virtual academic community, influencing factors
Zhang Xiangxian (teacher) and Lu Heng (student)	teacher and student	School of management, Jilin university	Knowledge aggregation

Table 2. Important independent authors

Scholar	Number of posts issued	Organization	Research topic
Hu fangang	20	School of Information Technology and Communication , Qufu Normal University	Virtual educational community
Wu Jiang	9	School of Information Management of Wuhan University	Online medical community, information service
Xu Xiaolong	9	School of Business Administration, Shanghai Lixin University of Accounting and Finance	Consumer behaviour
Zhang Haitao	7	School of Management of Jilin University, Information Resources Research Center of Jilin University	Virtual academic community
Qiu Jiangnan	7	DUT Faculty of Management and Economics	Online knowledge community
Guan Jun	6	School of Management, Jilin University	Sports information, sports efficiency
Yang Lina	6	School of Management and Economics, Beijing Institute of Technology	Virtual learning community
Ning Lianju	5	College of Economics and Management, Beijing University of Posts and Telecommunications	Customer experience and customer loyalty
Wang Lu	5	Department of Educational Technology of Capital Normal University	Teachers' Professional Development and Virtual Learning Community
Gu Bin	5	College of Economics and Trade, South China University of Technology	Knowledge sharing and social network analysis
Xiong Huixiang	5	School of Information Management, Huazhong Normal University	Online medical community, virtual academic community
Deng Shengli	5	Information Resources Research Center of Wuhan University, School of Information Management of Wuhan University	Network Q&A Community and Social Q&A

4. Hot Spot Analysis

4.1 Co-occurrence Analysis

**Fig 4.** Keyword Co-occurrence

Focusing on research topics is the condensation of research topics and contents, which can better show the research hotspots in this discipline. [2] The network node is set as Keyword and analyzed, and the keyword co-occurrence graph is obtained, with a total of 267 keywords and 501 connection lines among keywords. Figure 4 shows the keyword names with frequencies of 15 and above. Excluding the search words such as "virtual community", the remaining keywords are sorted by frequency to get Table 3.

Table 3. Keyword List

Keyword	Frequency	Centrality	Keyword	Frequency	Centrality
Virtual learning community	146	0.26	Trust	24	0.14
Knowledge sharing	132	0.23	Social network	23	0.07
Virtual academic community	70	0.11	Virtual educational community	22	0.06
Virtual brand community	69	0.13	User behavior	20	0.09
Influencing factor	65	0.35	Social capital	20	0.05
Online healthy community	57	0.12	Opinion leader	19	0.04
Social network analysis	42	0.13	Knowledge contribution	18	0.06
Value co-creation	25	0.03	The spread of information	16	0.07
Online medical community	25	0.12	Rooted theory	16	0.05

Through CiteSpace, we get the list of documents in the key node cluster (List Citing Papers to the Cluster), and comb and dig out the following thread: the early virtual community was restricted by the technical level of Internet development, and was more limited to information storage and sharing. With the increasing number of users in the virtual community, members wanted to acquire knowledge through the network, and the research on knowledge sharing began, and the educational virtual community and virtual learning community were derived. From 2000 to 2009, e-commerce entered a stable period of sustainable development. However, the virtual, social and weak normative features of the online shopping environment make consumers' trust in businesses not high in e-commerce, and the trust problem in virtual communities needs to be solved urgently. Around 2011, the Internet technology got a rapid development. With the improvement of technology and the awakening of consciousness, scholars began to realize the importance of "people" in the network environment. The core purpose of virtual community is to share and exchange knowledge among community members. Knowledge sharing among users is of great significance to the survival and development of virtual community. At this stage, social network analysis and a series of research on influencing factors such as user behavior and user participation appeared. In addition, the categories of virtual communities have been further expanded. In addition to the general knowledge community, various professional communities have begun to appear, including virtual academic communities. In 2013, China officially entered the 4G era, with the innovation of domestic online services, online health community has become an important medium for people's self-care, and scholars have conducted research on its user behavior and user willingness. From 2016 to 2021, with the support of Internet technology, the rise of live video and short video, and the emerging ways of knowledge dissemination gave birth to in-depth exploration of knowledge dissemination and knowledge sharing behavior.

4.2 Timeline Analysis

According to the co-occurrence intensity of keywords and keywords, the keywords with higher intensity are clustered together to achieve the classification of research hotspots. In this study, we choose Logarithmic Likelihood Ratio (LLR) algorithm to cluster and analyze keyword co-occurrence, and get the time chart of keyword clustering with frequency above 5. The results are shown in Figure 5. Modularity $Q=0.5905>0.3$, cluster structure is significant; Mean Silhouette $=0.376<0.5$, The poor clustering effect of keywords indicates that the topics in this cluster are scattered, so it is necessary to filter and merge the clusters.

As shown in Figure 5, a total of 10 clusters are marked, and the most representative keywords in the same cluster are used as cluster names, and each cluster is given labels of 0-9. The smaller the number, the more keywords it contains. By comparing the cluster name with the keywords contained in the cluster, it is not difficult to find that the similarity between "learning community" (#7), "deep learning" (#8) and "virtual learning community" (#4) is high, and the content of "user participation" (#9) and "virtual brand community" (#3) fits well, which complements the time-line distribution under the cluster after the merger.

In the theme of Virtual Community (#0), influential nodes include network, community, online game, library, information service, perceived value, social capital, motivation and so on. Figure 5 shows that the attention to this theme originated in 2000, that is, domestic scholars first began to pay attention to virtual communities in this period and continued to study it for more than 20 years. Domestic attention to virtual communities is later than that of foreign countries, and in 2000, China's Internet was still in its infancy, and the expansion of virtual communities was limited, mainly focusing on simple professional applications, such as network teaching, chemical resources navigation and so on. In the early research of virtual community, scholars paid more attention to the concept distinction between "community" and "virtual community", involving research fields including sociology, network economy, e-commerce, marketing and so on. In order to better spread the emerging concept of virtual community, the subject research turned to various services that virtual community can provide, from basic library virtual community to extensive knowledge information services, and then to the perceived value of virtual community members to knowledge information.

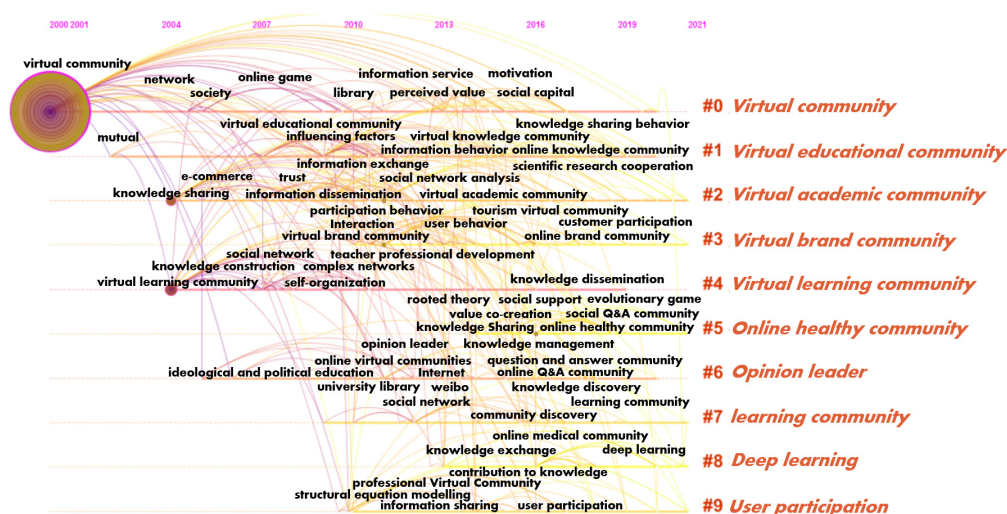


Fig 5. Keyword clustering timeline

To enhance perceived value, Cheng Quan [3] explores the factors that influence community knowledge sharing from the perspective of social capital theory, Nai & Nianxi [4] further combines social capital and personal motivation, and the empirical research results prove that both of them have positive effects on shared motivation.

"Education virtual community" (#1) is the first field that has attracted the attention of academic circles, and it is also a classic theme that has maintained a high popularity for twenty years. Interaction, influencing factors, virtual knowledge community, information behavior, online knowledge community and knowledge sharing behavior constitute the main contents of this cluster. Hu Fangang extracted "educational virtual community" from the concept of "community" and "virtual community" in his early research, and thought that it was an open and free network virtual environment across time and space. Community members interacted and shared resources, thus influencing and promoting each other, and finally formed an ecological social relations community with common community cultural psychology. After that, the research focused on "communication", the effective factors of communication, the theoretical model of communication, the rules and

principles of communication, etc., which further deepened the multi-faceted connotation of educational virtual community and laid the research foundation of this theme. Since then, scholars have turned to a broader empirical study of "influencing factors": in the field of knowledge sharing, environmental factors, knowledge factors and motivation factors are the three major factors influencing students' enthusiasm for knowledge sharing, and knowledge sharing in educational virtual community depends on the synergy of these three factors.[5]; In addition, the sense of belonging in the educational virtual community is the symbol of community members' self-identity, and the community satisfaction of community members is the decisive factor for the formation or enhancement of community sense of belonging. Community culture, teachers and learners have a positive influence on community sense of belonging. In addition, the sense of belonging in the educational virtual community is the symbol of community members' self-identity, and the community satisfaction of community members is the decisive factor for the formation or enhancement of community sense of belonging. Community culture, teachers and learners have a positive influence on community sense of belonging.[6]; Furthermore, the educational virtual community has actually developed into a knowledge community in a broader sense. For online knowledge communities, whether or not knowledge can be added value becomes the specific criterion to judge whether or not it is successful. [7] Therefore, virtual communities need to pay more attention to individual heterogeneity and perceived value of members in the development process.

In the virtual academic community (#2) cluster, knowledge sharing, e-commerce, information dissemination, trust, information exchange, social network analysis and scientific research cooperation are the nodes with reference significance. Among all the above-mentioned key nodes, the research on the theme of "knowledge sharing" accounts for a large proportion, mainly focusing on the concept, member composition, member interaction and influencing factors of knowledge sharing in virtual academic community. Among them, Xiang Hua and others discussed the business opportunities brought by knowledge sharing activities in virtual communities to e-commerce, and put forward measures to encourage the development of knowledge sharing activities in virtual communities. Li Xuesong, etc. put forward the solutions to the prisoner's dilemma of knowledge sharing in e-commerce, such as changing the preferences of both sides of knowledge sharing, using explicit contracts and using implicit contracts to carry out repeated games. [8] The virtual academic community is full of information dissemination and exchange all the time, but the reality is that the huge information resources can not be fully utilized by people. From a practical point of view, Zhao Xue believes that the information in the virtual academic community should be effectively controlled, and the pertinence of information should be improved to enhance the dissemination effect of information. [9] Zhao Kang, by using the social network analysis method, found that the network information activities of academic organizations and communities have the characteristics of long tail distribution, forming a multi-level core-edge hierarchical structure, and pointed out that academic organizations need to strengthen the responsibility of information construction, ensure the continuous attention and governance of core members to virtual communities, and create a benign interactive information ecosystem. [10] Until 2019, scholars turned their attention to scientific research cooperation in virtual academic community. Most of the researches focus on the influencing factors of scientific research cooperation by combining qualitative analysis (grounded theory) with empirical research. For example, Wang Zhanping found that the cooperation of researchers in virtual academic community has obvious ecosystem characteristics, and the network relationship between subjects and the relationship between subjects and media have positive effects on the willingness of scientific research cooperation.[11]; Another example is Tan Chunhui, who used qualitative analysis to build a model of influencing factors. Then, through empirical analysis, it was found that the willingness to cooperate was positively correlated with the cooperation behavior of researchers in virtual academic community, and the incentive mechanism and ease of use of the system had a significant positive correlation with the cooperation behavior of researchers in virtual academic community [12].

"Virtual brand community" (#3), as a hot research in the field of economics and management, started in 2009 and continues to this day. From Figure 5, it can be seen that the nodes such as user

behavior, customer participation and tourism virtual community constitute this cluster. According to user behavior, Zhu Guowei [13], Pang Lijun [14], Yin Jielin [15] and others respectively explored the influence of word-of-mouth information, information interaction and perceived value on user behavior in virtual brand community, and the results showed that all of them could positively influence user behavior (user participation); Virtual tourism community has become an important channel for obtaining strategy information, sharing travel experience, establishing new social relationships and enterprise marketing as a special branch, [16] there is a closer relationship with consumer experience and customer participation. Regarding the behavior of community members' participation, Zhou Gang and others summed up eight motivations that affect individual participation. [17] Wu Hui et al. found that user participation breadth has an inverted U-shaped influence on loyalty. [18].

In the cluster of virtual learning community (# 4,7,8), social network, social network, knowledge discovery, knowledge construction, knowledge exchange, deep learning and other important nodes, the representative researches are as follows: Wu Di and others analyzed the network structure and message transmission mode of virtual learning community based on weak relationship theory by using social network analysis method, and proved that [19]; In addition, Ye Junmin and others put forward online learning behavior prediction with semantic enhancement by using deep learning to effectively improve the prediction accuracy of learning outcomes [20]. In the online health community (#5) cluster, nodes such as knowledge sharing, value co-creation, social support, evolutionary game, and socialized question-and-answer community are the main contents of the research. Now people are more and more inclined to consult directly through the network, and the online health community has evolved from this. Knowledge sharing among community doctors and value co-creation among community members are conducive to improving the quality of content information in online healthy communities. Lu Xinyuan and others established an evolutionary game model of knowledge sharing behavior between doctors and patients, and found that the emotional support benefits of patients, reciprocal altruism, sharing costs, privacy concerns, rewards given to doctors, the proportion of community patients, doctors' reputation benefits, execution costs and so on are the key factors influencing the evolutionary game of knowledge sharing among users.[21] In the cluster of opinion leaders (#6), knowledge management, question and answer community and Internet are the key words, and opinion leaders are the core members of virtual communities, and their behavior characteristics are very important for all kinds of virtual communities. Starting with the Q&A community in Wang Xiuli, we found that Zhihu's unique voting and attention mechanism gave birth to a large number of opinion leaders and influenced their knowledge sharing behavior. [22]; Similarly, Zhao Xueqin and others discussed the knowledge sharing behavior characteristics of opinion leaders in the question-and-answer community, and believed that social characteristics were the prerequisite for opinion leaders to share knowledge, and community development could not be separated from user diversification. [23]

5. Frontier Analysis

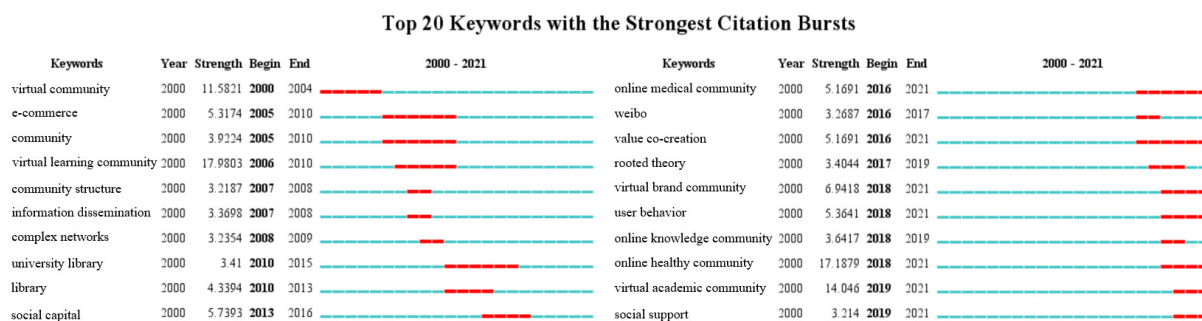


Fig 6. Keyword emergence

Burst Term is used to explore the keyword frequency, and the bold time zone means special attention in this time zone, including the bold time zone in 2021, which is used to indicate the cutting-edge topics under the theme of "virtual community". As shown in Figure 6, there are online medical community, value co-creation, virtual brand community, user behavior, online healthy community, virtual academic community and social support.

Expectations for national health are constantly improving. In 2017, the report of the 19th National Congress put forward that "people's health is an important symbol of national prosperity and national prosperity", which made the theme of "online healthy community" become an important frontier in the following time. The hot spot period is 2018-2021, and the intensity is 17.1879. During this period, scholars' research topics on "online healthy community" focused on community users and community information. From the user's point of view, it mainly focuses on three aspects: user portrait, user behavior and user demand. For user portrait, scholars can effectively identify useful health information through emotional expression, comment capture, etc., and can also distinguish users' age groups and users with special diseases by features, and instantly match and provide medical help. In view of user behavior, the first thing is to explore their participation behavior, participation motivation and participation behavior of users at different levels to understand the basic information of users' history, combine information browsing behavior and information seeking behavior to detail users' real-time needs, and then predict users' future behaviors in the community through knowledge sharing behavior and subjective knowledge hiding behavior, so as to effectively capture key users and improve the effectiveness of online healthy communities; According to the needs of users, scholars pay special attention to the needs of elderly users for health information and carry out feature mining. From the information point of view, it mainly focuses on information credibility and information service quality, information theme and information continuous search.

The hot topic period of "Virtual Academic Community" is from 2019 to 2021, with an intensity of 14.046. The main research topics are knowledge sharing, scientific research cooperation and information dissemination and exchange. From the perspective of knowledge sharing, the mechanism, process and influencing factors of knowledge sharing are the most popular. As the Eden of researchers, the virtual academic community bears the knowledge exchange and knowledge sharing behavior under the background of scientific research activities. [24] This kind of research is conducive to information communication and optimizing the operation of virtual academic community platform [25]; From the perspective of scientific research cooperation, although researchers are the backbone of "virtual academic community", the construction and maintenance of community content quality also need to rely on researchers' enthusiasm and efficiency, but the academic circles are not clear about researchers' cooperative behavior motivation. To solve these problems, virtual academic community can use incentive mechanism to stimulate researchers' cooperation, and then enhance community vitality [26]; Based on the perspective of information dissemination and communication, scholars study its dissemination mode, problems and countermeasures. [9]

The hot topic of "Virtual Brand Community" is from 2018 to 2021, with an intensity of 6.9418. Previous studies have focused on users themselves and the relationship between users and brands, and the concept of value co-creation has gradually become popular in enterprise practice. [27] In order to attract more customers to participate in new product development or marketing interaction [28], it also advocates being the value guide of value co-creation activities. [29] To strengthen the connection between users and brands. The hot topic of "user behavior" is from 2018 to 2021, with an intensity of 5.3641. Scholars mainly explain its behavior types and behavior mechanism theoretically. The hot topic of "Online Medical Community" is from 2016 to 2021, with an intensity of 5.1691. Most of its research topics are similar to those of "Online Health Community". In addition to the above mentioned parts, there is a special grouping study of question-and-answer medical health communities combined with knowledge map under the theme of online medical community. The hot time period of "value co-creation" theme is 2016-2021, with an intensity of 5.1691. There are many literatures about consumer value co-creation based on virtual brand community. [30] The hot period of "social support" theme is from 2019 to 2021, with an intensity of 3.214, which mainly appears as

a research perspective and theoretical basis: the former helps research innovation and expands research fields and backgrounds; The latter lays the foundation for the research, and theoretically demonstrates the necessity and rationality of the research.

6. Shortcomings and Suggestions

Based on the integrated analysis of the literatures in the past twenty years, this paper puts forward the following shortcomings and prospects:

First, from the whole literature, we can see that literature research methods, whether qualitative research (grounded theory) or empirical research, have paradigms in the field of virtual community. Although the amount of literature is large enough, the depth of research is not enough. At present, there are two aspects to be considered: First, many literatures adopt the method of questionnaire survey, and the differences in the group characteristics, problem setting, simulation scenarios, scale design, etc. of the respondents will result. Second, the theoretical excavation is not deep enough. Most of the literatures refer to theories from classic literatures, some from foreign scholars. Under different times and development situations, the application of theories should keep pace with the times. More combination of local cultural characteristics and regional characteristics may lead to more realistic and practical research results.

Second, the State Council has issued several documents to optimize the scientific research management system and encourage scientific researchers to actively innovate. However, scientific research cooperation has not become the academic hotspot and frontier, and the industry has not supported it enough. Overview of literature, at present, the research on the motivation and mechanism of scientific research cooperation in virtual community is not in-depth, which can be improved from the following two aspects: as for the internal mechanism research, the current research methods are limited to qualitative research, relying too much on the subjective cognition of researchers, and we can combine empirical methods with quantifiable data to build a model to verify whether the results are consistent with the actual situation and enhance the persuasiveness of the article; In the study of incentive mechanism, more studies focus on incentive system, communication environment, individual behavior and psychology, etc. Most studies combine empirical methods from the individual and social levels, but the data sample is not large, and the model considers many influencing factors, which cannot be presented in the same article. In this regard, the follow-up research can appropriately expand the sample size, and pay more attention to the interactive trust mechanism between researchers and individual-community managers. Cooperation and interaction mechanism between individuals and authoritative individuals and between ordinary research groups and authoritative research groups

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