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| RESEARCH ARTICLE

Discussion on the Scientific Research Cooperation Network of Local Colleges and Universities Based on the Perspective of Knowledge Governance

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| ABSTRACT
In recent years, many scholars at home and abroad have carried out relevant research work on scientific research cooperation, but the social network analysis method is commonly used, and the literature on the research cooperation network of local universities is relatively small and lacks a systematic theory. Taking knowledge governance as the basic perspective, we analyze the existing research on scientific research cooperation, carry out the analysis of the necessity and feasibility of establishing a scientific research cooperation network in colleges and universities, and take 10 colleges and universities in Fujian Province as samples to explore the existing problems of scientific research cooperation network in local colleges and universities, so as to provide theoretical support and new perspectives for the level of scientific and technological innovation and service capability of colleges and universities to enhance the competitiveness of college education.

| KEYWORDS
Knowledge Governance; Local Universities; Research Collaboration

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1. Introduction

In 2019, China Science and Technology Network and Clarivate jointly released a report entitled "Building a Dream for 70 Years, Striving for the Road of Scientific Research -- Looking at China's Scientific Research Development from the Data of Global Academic Literature", pointing out that after China's reform and opening up, international cooperation in the field of scientific research has developed rapidly and achieved fruitful results. By 2018, the regular volume of SCI, SSCI and A&HCI in China and the United States has been very close; 193 countries and regions have cooperated with China in papers, and the total number of cooperative papers is more than 2300 times that of 1980 (Fang, 2019). Premier Li Keqiang proposed at the 2021 National Science and Technology Award Conference that "deepen international scientific and technological cooperation" and "carry out multi-level and wide-ranging scientific and technological exchanges and cooperation.

In the context of the rapid development of science and technology in the world and the ever-changing innovation and creation, scientific research cooperation is particularly important. In recent years, the reform of universities in the fields of industry-university-research cooperation has achieved initial results, and universities are becoming a veritable force of scientific and technological innovation, among which the most important cooperation mode is paper cooperation. In recent years, many scholars at home and abroad have carried out relevant research on scientific research cooperation. However, there are few documents on the research of local university scientific research cooperation networks, and there is a lack of systematic theory. There are few studies on the formation mechanism and governance performance of the cooperation network (Liu et al., 2021).

From the basic perspective of knowledge governance, this paper will analyze the necessity and feasibility of establishing a scientific research cooperation network in universities and colleges by analyzing the existing scientific research cooperation research, and

exploring the operation mechanism of the local scientific research cooperation network in universities and colleges, so as to provide support for the level of scientific and technological innovation and service capacity of universities and colleges and improve the competitiveness of universities and colleges.

2. Literature Review

2.1 Research Collaboration

Using the data from four large public literature databases in the United States from 1995 to 1999, Newman (2005) analyzed the short path, clustering coefficient and other characteristics of the scientific research cooperation network. Subsequently, the relevant literature mainly focuses on three aspects. First, research on cooperation networks in a specific field. Maria and Fermanda (2016) discussed the scientific research cooperation network of aquatic vertebrate survival and the commercial hunting industry; Floyd and Spencer (1994) studied the scientific cooperation between scientific researchers; Xu *et al. (2017)* took the scientific research cooperation among in-service teachers of a secondary college as the research object; Other documents have studied the scientific research cooperation between industry, university and research (Graf, 2010). The second is the use of social network analysis. Xu *et al. (2001)*. systematically analyzed the characteristics and laws of the cooperative network by using the social network analysis method. Taking social network analysis as the basic idea, Li (2011) investigated the paper cooperation between 14 research universities in the urban agglomeration of the middle reaches of the Yangtze River and institutions inside and outside the region. The third is the empirical analysis method mainly used in the current literature. Most of them studied the appearance of the scientific research cooperation network but lacked research on the internal mechanism and governance performance of the cooperation network.

2.2 Knowledge Sharing and Knowledge Governance

The concept of knowledge governance was first discussed within the scope of enterprises. From the perspective of organizational economics, Foss *et al. (2003)* believe that knowledge governance is to select formal and informal organizational mechanisms with the goal of optimizing the process of knowledge creation, transfer and sharing. After that, there emerged relevant research on knowledge sharing and knowledge governance applied in enterprises or organizations. Hansen's research (1999) shows that under a weak team member relationship, although the project team is good at searching, in terms of highly complex knowledge, there is a big problem in knowledge transfer due to less interaction between members and the team. Heiman (2004) pointed out that organizations with complex tasks and knowledge transfer should have formal proprietary agreements for supervision. Cabrera (2006) focused on the determinants of individual participation in knowledge sharing. Therefore, in order to improve the efficiency of knowledge sharing in organizations, when we study knowledge sharing, we should explore the factors for the establishment and survival of formal and informal organizations rather than separate them. Informal factors such as culture are semi permanent characteristics of organizations and are even more difficult to change than formal factors such as organizational structure and reward system.

Later, knowledge governance gradually became the analysis method of enterprise R&D and performance. The existing literature is mainly divided into two aspects. The first is based on knowledge. Conner *et al. (1996)* pointed out that private knowledge is the basic source of competitive advantage. The second is based on the openness of enterprise organizations. Emery *et al. (1996)* proposed a concept that likens the organizational boundary to a semi permeable membrane. Knowledge is given different rates to pass through the membrane. As time goes by, the external knowledge will flow into the company, increasing the company's assets, and may also generate more new combinations to improve the company's creativity. Therefore, the study of knowledge governance mechanism should take into account the impact of the characteristics of knowledge itself and the internal and external environment of the organization on governance performance.

In recent years, some domestic scholars began to explore the scientific research cooperation network among universities from the perspective of knowledge governance. Wang *et al. (2018)* studied how enterprises should integrate independent R&D and cooperative R&D activities based on the perspective of knowledge governance. Zhang (2017) systematically analyzed the current situation of knowledge governance research at home and abroad, sorted out the reference theory, research theme, research methods and analysis levels, and discussed the development trend of future research on knowledge governance. Huang *et al.* (2017) showed that university knowledge governance includes "governance of knowledge" and "governance with knowledge". Universities must effectively combine knowledge activities among various subjects through knowledge governance and achieve knowledge innovation and development through the acquisition of external knowledge and the integration of internal knowledge.

In a word, domestic and foreign research on the forms and influencing factors of scientific research cooperation between schools, enterprises, governments and research institutes is rich, but there is a lack of research on the scientific research cooperation network between universities, and there are few institutional and countermeasure research from the perspective of knowledge governance to explore its mechanisms and governance strategies. This paper intends to study this aspect.

3. Necessity and Feasibility

The following is an introduction to the necessity and feasibility of establishing a scientific research cooperation network in colleges and universities.

3.1 Necessity

First, the need for national scientific and technological innovation and development. Xi emphasized that "science and technology are cosmopolitan and epochal, and the development of science and technology must have a global perspective", and "it is necessary to gather the spirit of the world and take advantage of the power of all sides." In the new era, scientific research in colleges and universities should actively "go out" and not be confined to "laboratories"; It is not only necessary to carry out scientific research cooperation across industries, schools, regions and countries but also to "bring in", attract foreign scientific research institutions to participate, jointly build research centers, plan and promote scientific research cooperation from a global perspective, and comprehensively strengthen the development of China's university education and industry.

Table 1 Comparison of scientific and technological data in Chinese universities

	"211" and colleges and universities jointly built by the province and the ministry	Other colleges
Number of teaching and scientific research personnel	366 919	902 051
Science and technology expenditure (thousand yuan)	161 356 272	95 951 971
Number of research projects	317 945	378 769
International cooperation research (person time)	5824	12 908

Source: Science and Technology Department of the Ministry of Education, Compilation of Science and Technology Statistics of Colleges and Universities in 2021, Beijing: Higher Education Press, 2021.6

The second is the need for the diversity and complementarity of scientific research resources in colleges and universities. Although there is a complete college education system in China, its status is totally unequal. Grades such as "985 universities" and "211 universities" have widened the gap between universities in obtaining educational resources. Table 1 shows the comparison of scientific and technological data of colleges and universities in China. In terms of scientific research resources, "211" and provincial and ministerial colleges and universities have more resources but lack sufficient human resources support; The software and hardware conditions for other colleges to carry out scientific research are insufficient, which wastes a lot of human resources.

Third, the need for the promotion of college teachers' professional titles. The 18th National Congress of the Communist Party of China (CPC), for the first time, proposed in the report that "promoting the connotative development of higher education". One of its important indicators is scientific research achievements. Teachers' self-development and professional title promotion cannot be separated from the support of scientific research. A person's energy, perspective and ability are inevitably limited, and the scientific research model of fighting alone is no longer suitable for the development of reality. It is the so-called "people gather firewood and fire high" to establish an efficient scientific research cooperation network, which is not only conducive to the completion and selection of scientific research projects among colleges and universities but also conducive to the promotion of members' professional titles and social reputation.

3.2 Feasibility

First, the macro policy has become the premise for the establishment of a scientific research cooperation network. At present, the joint construction of the "the Belt and Road" is widely welcomed by the international community. The "the Belt and Road" is a road of innovation, and scientific and technological cooperation with relevant countries is an important part of the joint construction of the "the Belt and Road". On the global innovation stage, domestic scholars should make full use of both domestic and foreign resources. In recent years, in order to solve the "pain points" of scientific researchers, enhance the sense of gain, and stimulate innovation and creativity, the state has introduced a series of "deregulation + incentives" policies. Premier Li Keqiang stressed, "Let good policies be implemented as soon as possible so that scientific and technological personnel have more sense of gain". College teachers should make full use of this opportunity to actively form a benign and interactive scientific research cooperation network.

Second, the sense of scientific research achievements has become the driving force for the establishment of scientific research cooperation networks. In real development, it is difficult to achieve sustainable and considerable scientific research results only by personal strength or a temporary scientific research team. Scientific research achievements are the basis of teaching. They can not only improve teachers' personal theoretical literacy, make them recognized by society, and stimulate their interest in scientific research, but also enhance the depth and breadth of teaching and promote the construction of disciplines and specialties.

Therefore, it can be seen that the acquisition of college teachers' sense of scientific research achievement is the power and foundation of an efficient and sustainable scientific research cooperation network, and the latter also provides a guarantee for the former.

Third, informal organizations have become the basis for the establishment of scientific research cooperation networks. There are some unofficial research cooperation teams among colleges and universities. They spontaneously gather together because of their teachers, classmates, relatives and friends, and research interests. It is characterized by the existence of a core leader who leads the team members with his knowledge level, scientific research ability or personality charm. The initial purpose of informal organizations may be to complete the scientific research tasks of the school. However, with the remarkable scientific research performance, the sense of belonging of team members is enhanced, and members are increasingly integrated into the team to improve their own development, and they begin to strengthen the running in, focus on division of labor and cooperation, and the team goals and vision are clearer.

4. Issues

This sample selects 10 local colleges and universities in Fujian Province, taking into account liberal arts and science, undergraduate universities and higher vocational colleges. The names and codes of Institutions are shown in Table 2 below.

Table2 Institution Name and Code

Institution Code	Institution Name	Institution Code	Institution Name
01	Xiamen University	06	Huaqiao University
02	Fuzhou University	07	Minjiang Teachers College
03	Jimei University	08	Fuzhou Polytechnic
04	Sanming University	09	Xiamen Huaxia University
05	Fujian Normal University	10	Xiamen Institute of Software Technology

Take the paper as the main form of scientific research cooperation between colleges and universities. In the full text database of CNKI, use the names of the above 10 schools in pairs as the key words, and use the fuzzy option to search the papers of scientific research cooperation between two universities during 2012-2022. The statistics of the number are shown in Table 3.

Table 3 Statistics on the Number of Cooperative Papers of Sample Universities

Institution Code / Number of Articles / Institution Code	01	02	03	04	05	06	07	08	09	10
01		222	404	10	176	329	0	3	2	5
02			73	68	424	95	1	50	0	0
03				1	71	88	1	2	0	1
04					56	24	0	0	0	0
05						87	18	65	0	0
06							0	1	0	6
07								0	0	0
08									0	0
09										0
10										

It can be seen from Table 3 that, at present, Fujian undergraduate universities and higher vocational colleges have achieved some scientific research cooperation, but some problems have also been exposed.

First, the scale and level of scientific research cooperation between undergraduate colleges and universities are small.

Influenced by factors such as geography, specialty, discipline and the nature of arts and sciences, the scientific research cooperation of local universities in Fujian Province shows the characteristics of small-scale and low-level. According to Table 3, during the period of 2012 to 2022, the number of papers cooperated by 10 universities is not very large, only 2283, of which Fuzhou University and Fujian Normal University have the largest number of papers, up to 424. The setting of provincial key disciplines and the active exchanges between teachers have made the cooperation results remarkable. Secondly, Xiamen University, Jimei University and Huaqiao University complement each other's advantages, and the number of cooperative papers also ranks the top, 404 and 329, respectively. Although Jimei University, Fuzhou University and Fujian Normal University have set up economics and management majors, the number of cooperative papers is small due to the different natures of the university and the focus on discipline construction. Sanming University may be affected by its geographical location and has little cooperation with other universities.

Second, the awareness of scientific research cooperation in higher vocational colleges is weak, and the frequency is low.

Higher vocational colleges aim to cultivate skilled talents. Scientific research is not a strong point. What's more, under the constraints of less investment and resources in scientific research, teachers' scientific research awareness is not strong, their ability is reduced, and the number of co-authored papers is small. It can be seen from Table 3 that there is very little communication between the four higher vocational colleges, the number of thesis cooperation is 0, there is no communication and cooperation between the senior management of the school, and there is less communication between teachers. In addition, the scientific research cooperation between undergraduate universities and higher vocational colleges in Fujian Province is generally small. The total number of co-authored papers of six undergraduate universities and four higher vocational colleges in the sample is only 155, accounting for less than 7%, wasting the theoretical research of undergraduate colleges and the complementary advantages of advanced equipment of higher vocational colleges.

Third, there is still room for expansion of geographical and institutional proximity.

It can be seen from the table that the scientific research cooperation of local colleges and universities in Fujian Province is greatly affected by the geographical location, which indicates that it wastes the cluster advantage of the university town. Obviously, Fuzhou Institute of Education and Fuzhou Vocational and Technical College, Xiamen Huaxia Vocational College and Xiamen Software Vocational and Technical College belong to the same university city, but the number of co-authored papers is very small. Moreover, universities with similar cultural backgrounds, operation modes, construction objectives and other factors have a high degree of institutional proximity.[20] For example, there are many cooperative papers between Fuzhou University and Fujian Normal University due to the high institutional proximity. On the contrary, the institutional proximity of Jimei University and Huaqiao University is not significant, and scientific research cooperation needs to be further improved.

Fourth, the form of cooperation is single, and the short-term utility is serious.

At present, there are problems with short-term scientific research and low cooperation efficiency. The main reason is that the main purpose of university teachers' scientific research projects is to pass the annual assessment and promotion. After studying the relationship between the scholars of the above cooperative papers, we found that most of them are teachers, relatives, friends, colleagues, and other relationships, and the main form of cooperation is the paper. Even some of the signed authors have never been involved in this aspect of research and only increase their scientific research achievements through signing. Finally, because of the pursuit of utilitarianism and the lack of long-term and reasonable planning, a vicious circle is formed.

5. Conclusion

From the basic perspective of knowledge governance, this paper first analyzes the existing research on scientific research cooperation and then analyzes the necessity and feasibility of establishing scientific research cooperation networks in colleges and universities. Finally, taking 10 colleges and universities in Fujian Province as samples, this paper discusses the problems existing in the scientific research cooperation networks of local colleges and universities and puts forward suggestions for colleges and universities to integrate scientific research resources, complement each other's advantages, and improve the performance of scientific research cooperation. Different from the empirical analysis of scientific research cooperation networks by domestic and foreign scholars, this paper aims to provide theoretical support and a new perspective for the construction of scientific research cooperation networks in universities. This paper points out that the development of national scientific and technological innovation, the diversity and complementarity of scientific research resources in colleges and universities, and the need for the promotion of teachers' professional titles all urgently need to promote various forms of scientific research cooperation between colleges and universities; Macropolicy, sense of scientific achievement and informal organizations have become the basis for

establishing and improving scientific research cooperation networks. The inadequacy of the study is that although this paper analyzes the necessity and feasibility of establishing and improving the scientific research cooperation network, it does not put forward specific university operation mechanisms and knowledge governance models, which can be further improved in the future.

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