Knowledge Mapping of University Interdisciplinary Education Research: Visual Analysis Based on Cite Space (1978-2021)

Ziqi Yang[a,*] and Hua Fan[b]

Institute of higher education, Yunnan University, Kunming, China

[a] aegean26@163.com, [b] abelxmu@163.com

*corresponding author

Keywords: Interdisciplinary; Interdisciplinary Education; Knowledge Map; Visual Analysis

Abstract: Objective: In today's world, human society is facing the background of complex environment, resources, ecology and other problems, and these highly comprehensive social problems require the use of knowledge in many scientific fields. Interdisciplinary education has been widely concerned by countries all over the world. Based on the co-occurrence analysis of countries, institutions and authors of interdisciplinary education in Universities from 1978 to 2021, as well as keyword co-occurrence analysis, keyword cluster analysis and time sequence diagram, this paper expounds the characteristics, research hotspots and development trend of interdisciplinary education in universities, so as to provide reference for the interdisciplinary construction of higher education in China. **Methods:** In this study, citespacev visualization software is used to build a knowledge map of articles published in web of science database from 1978 to 2021, which directly shows the research results, core authors, core journals, research hotspots and development trends in this field. **Results:** According to the analysis of literature reports, first of all, the relatively strong interdisciplinary education research is mainly concentrated in the United States, including high-quality interdisciplinary education institutions are also concentrated in the United States. Secondly, Acad Med is the most popular journal. Finally, the keywords form nine clusters, focusing on interdisciplinary education, higher education and sustainability. We can see that the characteristics of today's university interdisciplinary education are to attach importance to interdisciplinary and interdisciplinary cooperation in cultivating talents, to set courses based on the combination of higher education and interdisciplinary majors, to focus on major social problems and global challenges to promote sustainable development, and to have a long period of interdisciplinary education in cultivating talents.

This study used Web of Science with "interdiscinplinary education" as the search subject, searched all time period documents (search time is April 12, 2021), and obtained 3693 documents after deduplication processing. Take these documents as samples to analyze and examine the basic situation of interdisciplinary education abroad. By analyzing the cited journals and keywords in the interdisciplinary education literature, it provides references for investigating the connotation of interdisciplinary education. The English terms of "interdisciplinary" and "interdisciplinary" are both interdisciplinary. In 1970, the OECD (Organization for Economic Cooperation and Development) first defined "interdisciplinary" as "two or two The interrelationships between different disciplines above, it refers to the field of education and research from a simple exchange of ideas to a wider range of education and research". The "interdisciplinary" mentioned in this research mainly refers to breaking through the boundaries of disciplines. Educational activities involving two or more disciplines, also known as interdisciplinary education by scholars, aim to promote college students to master interdisciplinary knowledge and cultivate compound talents for the society. And "interdisciplinary education" is not only an educational concept, but also a curriculum or teaching mode. Colleges and universities integrate two or more disciplines to form courses, and promote students to use interdisciplinary knowledge and methods to solve complex social problems [1].

1 The Rise of Interdisciplinary Fields

The concept of "interdisciplinary" was first proposed in 1926. "Interdisciplinary" was proposed by the famous psychologist Woodorth (R.S.). "Interdisciplinary" is also called "interdisciplinary". This term was first used by Woodworth in 1926 at the Society of the American Social Science Research Council. He believes that "interdisciplinary" is carried out beyond the boundaries of a subject, involving two or more subject research fields [2]. In 1970, the Organization for Economic Co-operation and Development (OECD) first defined "interdisciplinarity" as "the one of two or more different disciplines" at the International Interdisciplinary Symposium. Interrelationships, which refer to the interrelationships between simple ideas exchanges, to a wider range of education and research concepts, terminology, procedures, data, methodology, epistemology, and organizations. This is also an "interdisciplinary "This concept was officially defined for the first time [3]. In 1998, The Boyer Commission on Educating Undergraduates in the Research University pointed out that "In the first few decades of the 20th century, scientific research was constrained by the boundaries of traditional disciplines. But the second Since the Second World War, new projects integrating multiple fields have continuously emerged, which has proved the permeability of disciplinary boundaries" [4].

Since the 20th century, with the advancement of science and technology, social development has shown the characteristics of complexity and diversification, and modern science has also shown the characteristics of highly integrated disciplines. Interdisciplinary research has become one of the mainstream scientific research forms. Many interdisciplinary subjects have also appeared in some European and Nordic countries such as the United States and Germany. For example, the emergence of interdisciplinary research centers and departments such as Art&Humanities of Columbia University, Equity and trusts in context (LWM10) of the University of London, and Interdisciplinary Research Hub on Gender of the University of Cambridge. In order to ensure the quality of training talents and better meet the needs of the future society, interdisciplinary education has gradually emerged as a new talent training model. The interdisciplinary concept is applied to the field of education, and we call it interdisciplinary education. The definition of interdisciplinary education scholars is as follows: as a reform or transformation of a single education model based on the division of special disciplines or majors that has been implemented for a long time, Interdisciplinary education is based on the tremendous changes in the current society. The rapid development of science and technology and the increasing complexity of knowledge production have led to the need to "master deep and extensive knowledge, and have the ability to integrate, integrate, and solve complex problems." There is an urgent need for talents with a series of relevant professional knowledge.

Interdisciplinary education is based on problems as the link, or projects as the main form. Teachers with interdisciplinary knowledge and methods or scientific research teams composed of teachers from different disciplines and professional backgrounds and students are the subjects of equal participation in the educational process. Through dialogue , The teaching method based on contact and cooperation, and the inquiry and discussion education link, jointly promote the integration of knowledge and methods from two or more different disciplines and the process of corresponding thinking training [5].

2 Research Design

2.1 Data Source

The literature of this study comes from the core collection of web of science. The data retrieval strategy includes the following content: (1) Search subject: "University interdisciplinary" or "University interdisciplinary education"; (2) Index: (SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED) Document type: "Article", "Proceeding Paper", "Review", "Editorial Material" and "Early Access"; time span: 1978-2021 (search date: April 12, 2021). No language restrictions, 3693 articles on university interdisciplinary education were obtained.

2.2 Research Tools

This research uses CiteSpace visualization software to visualize and analyze the literature of university interdisciplinary education. The analysis methods used are: co-occurrence analysis, cluster analysis, centrality analysis, sequence diagram analysis, etc. The visualization software can generate node connection diagrams and other visualization maps. These maps can visually observe the development trajectory and research hotspots of a discipline. In the knowledge map generated by CiteSpace, nodes represent analysis elements, such as countries, authors, institutions, journals, and keywords. The size of nodes reflects the number or frequency.

2.3 Research Process

This research will be carried out according to the following steps:

(1) Demonstrate the national co-occurrence analysis of university interdisciplinary education from 1978 to 2021;

(2) To show the analysis of institutional co-occurrence of university interdisciplinary education from 1978 to 2021;

(3) To show the author's co-occurrence analysis of interdisciplinary education in universities from 1978 to 2021;

(4) Show the keyword co-occurrence analysis, cluster analysis and time series diagrams of university interdisciplinary education from 1978 to 2021.

2.4 Research Method

Interdisciplinary education is a composite subject, and its research involves multiple disciplines such as education, engineering, and sociology. Different research methods are needed to ensure the interpretation of interdisciplinary education. The research methods used in this study are as follows:

(1) Literature research method. The purpose of literature research is to collect, compare, and integrate relevant literature, extract useful information, dig out the essence of the research problem, and explore the internal connections and development trends of the research objects. This research explores the characteristics and development trends of interdisciplinary education by searching and analyzing the literature on interdisciplinary education in the web of science database.

(2) Knowledge mapping analysis. This kind of analysis is based on citation analysis theory and information science technology, a research method that has emerged in the fields of scientometrics and bibliometrics, which vividly shows the subject structure and development trend through visual images [6]. This quantitative analysis evaluates scientific activities. This research uses the research methods of scientometrics and CiteSpace software to analyze the documents in the web of science database to obtain network knowledge graphs of journals, authors, and keywords, providing information on the characteristics, research hotspots and development trends of interdisciplinary education in accordance with.

3 Visual Data Analysis

3.1 Country Co-occurrence Analysis

In CiteSpace, the node type is set to "country", the threshold is set to top 20, and the core advantage knowledge map is generated (Figure 1). The United States has the most articles with a centrality of 0.62, which highlights the United States' advantages in university interdisciplinary education status. Table 1 shows the top 5 countries with centrality related to university interdisciplinary education. The United States ranks first, followed by Germany.

Figure 1. National knowledge map for interdisciplinary education

In addition, it can be further found from Figure 1 that the research on university interdisciplinary education has an obvious "national agglomeration and diffusion effect." The previous research mainly focused on the development circle with the United States as the core, which has a high research growth pole. However, over time, the core development circle will create academic stimuli to other low-growth pole regions, induce knowledge spillover and research diffusion, and form many faster research growth centers. As shown in Figure 1, in the USA big year wheel, the center circle of different intercontinental countries will be gathered, such as Germany, Brazil, Spain, United Kingdom, Australia and so on. This also indirectly shows that interdisciplinary education research in universities has received widespread attention from various countries in regional studies.

Table 1. The top 5 countries with the centrality of interdisciplinary education

Ranking	Citation frequency	Centrality	Research institute	Year
1	772	0.62	USA	1978
2	169	0.05	GERMANY	1991
3	137	0.10	BRAZIL	2004
4	127	0.07	SPAIN	2006
5	115	0.28	ENGLAND	1996

3.2 Institutional Co-occurrence Analysis

In CiteSpace, the node type is set to "institution", the threshold is set to top 20, and the core advantage knowledge map is generated (Figure 2), which highlights the superiority of Univ British Columbia's interdisciplinary education, especially in American universities. For example, Columbia University in the United States has established three interdisciplinary research centers, namely Interdisciplinary Center for Innovative Theory and Empirics, Interdisciplinary Research to Prevent Infections (CIRI), and Interdisciplinary Studies in Education (Teachers College), with a total of 11 faculties; the University of Edinburgh established The Interdisciplinary center and research collaborators. Table 2 shows the top 5 centrally ranked institutions related to university interdisciplinary education, with Univ Washington ranked fifth.

Figure 2. Institutional knowledge map for interdisciplinary education

Table 2. The top five institutions in the central position of interdisciplinary education

Ranking	Citation frequency	Centrality	Research institute	Half-life
1	20	0.02	Univ British Columbia	17.5
2	14	0.02	Univ Sydney	12.5
3	13	0.01	Monash Univ	14.5
4	13	0.01	Univ Minnesota	14.5
5	13	0.02	Univ Washington	16.5

In the top five cited institution map, the key institutions are mainly distributed in the United States and Australia, and the main representatives are Columbia University, University of Minnesota, University of Washington, Harvard University, etc., and they cooperate closely and complement each other. The main force of university interdisciplinary research. Australia has followed closely. In recent years, it has formed a research group centered on the University of Sydney and Monash University. It often echoes the North and South of American universities and conducts cross-research and cooperation in different interdisciplinary fields, which promotes interdisciplinary research in universities. Research progress. Compared with China, it started late, and there is still a certain lag in the establishment and development of interdisciplinary research institutions. They are mainly concentrated in some comprehensive universities in the east, such as the Chinese Academy of Sciences and the Chinese University of Hong Kong. The research fields are curriculum reform, Subjects are mainly set up.

3.3 Author Co-occurrence Analysis

In CiteSpace, the node type is set to "author", the threshold is set to top 30, and a co-citation graph of authors who publish papers publicly in university interdisciplinary education is generated (Figure 3). The author with the most citations is [ANONYMOUS] (311 times) Citations), followed by UNESCO (64 citations) and KLEIN JT (62 citations). It can be seen that the most representative author in the field of interdisciplinary education is [ANONYMOUS]. Table 3 shows the top 5 authors with centrality related to university interdisciplinary education.

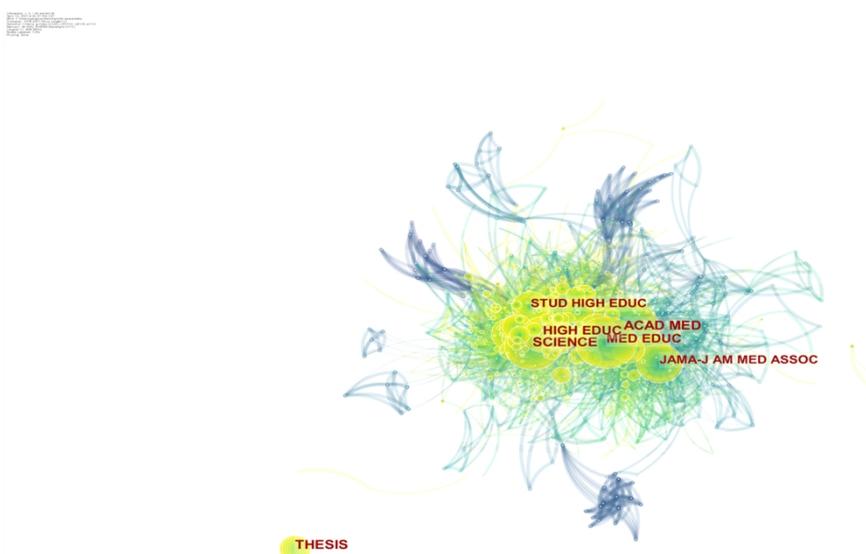**Figure 3.** Author's knowledge map for interdisciplinary education

Table 3. The top five authors ranked in the center of interdisciplinary education

Ranking	Citation frequency	Centrality	Author	Start year
1	311	0.14	[ANONYMOUS]	1998
2	64	0.01	UNESCO	2014
3	62	0.09	KLEIN JT	2007
4	50	0.03	FREIRE P	2009
5	44	0.03	BARTH M	2014

Based on the above maps and data, it can be seen that ANONYMOUS, which has a larger annual ring, is the most representative and authoritative. Its related university interdisciplinary education research literature was mainly published in 1998 and has been widely cited and cooperated in subsequent studies. The rest of the authors in the map are more evenly distributed, and the top five authors have been cited about 55 times per capita, and they have obvious cooperative links with each other. The author's interdisciplinary research on universities has developmental stability, numerous numbers, and close cooperation.

3.4 Journal Co-occurrence Analysis

In CiteSpace, the node type is set to "cited journals" and the threshold is set to top 20, which generates a co-citation graph with journals related to university interdisciplinary education (Figure 4). Table 4 shows the top 5 co-cited journals based on citation frequency and centrality. The journal with the highest citation frequency and centrality is ACAD MED, followed by HIGH EDUC.

Figure 4. Periodical knowledge map for interdisciplinary education

In Figure 4, the university's interdisciplinary education research has formed a strong co-occurrence center represented by ACAD MED, SCIENCE, MED EDUC, HIGH EDUC, etc. in the source journals, highlighting the interdisciplinary research themes in this type of journal. Occupies a considerable proportion of them and undertakes the important function of interdisciplinary research. Although THESIS journal has a relatively large co-citation frequency (214 times), its cooperation and co-citation with external journals is relatively weak, which is characterized by marginalization.

Table 4. The top five journals ranked in the center of interdisciplinary education

| Ranking	Citation frequency	Centrality	Journal
1	243	0.14	ACAD MED
2	214	0.00	THESIS
3	198	0.10	SCIENCE
4	179	0.06	MED EDUC
5	175	0.04	HIGH EDUC

Table 4 mainly sorts out the frequency citations of the current top five interdisciplinary research journals, and shows the main voice positions and research exploration sources of university interdisciplinary education research in international journals. At the same time, it can also be observed that the journal sources focused by the research on this topic are all world-class journals with a large impact factor.

3.5 Keyword Co-occurrence Analysis

3.5.1 Keyword Cluster Analysis

Research hotspots are topics discussed in a large amount of literature over a period of time, and they are also recognized as worthy of research. The key words directly reflect the research hotspot. The co-occurrence keyword map shows the hot words in a certain period of time, expounding the current situation and development trend. In CiteSpace, the node type is set to "keywords", and the time span is "1978-2021". The threshold was set to top 50, and a co-citation map of keywords related to university interdisciplinary education was generated (Figure 5). Table 5 shows the top 10 co-cited keywords based on citation frequency and centrality. The keywords with the highest citation frequency and centrality are "education", "interdisciplinary" and "higher education" respectively.
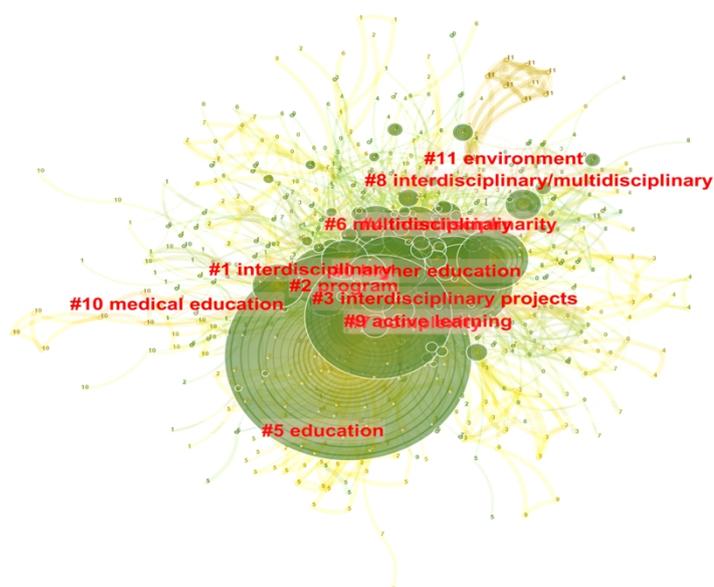
Figure 5. Keyword cluster analysis knowledge map for interdisciplinary education

In the keyword co-occurrence in Figure 5, the larger the annual ring, the more frequently the keyword appears. According to Figure 5, according to keyword relevance and clustering value, the figure divides the interdisciplinary research front topic into 10 types of keyword co-occurrence annual rings, of which the fifth type of keyword (education) is the largest annual ring, followed by For interdisciplinary (interdisciplinary), higher education (higer education), students (student), etc., each category represents the most frequently occurring vocabulary in university interdisciplinary research, revealing the main focus of current research. It also directly reflects that the core of university interdisciplinary education research is student-centered.

Table 5. Top five keywords for the centrality of interdisciplinary education

Ranking	Citation frequency	Centrality	Keywords
1	454	0.28	education
2	195	0.07	interdisciplinary
3	173	0.04	higher education
4	152	0.05	student
5	134	0.08	university
6	119	0.10	curriculum
6	119	0.06	science
7	101	0.04	interdisciplinarity
8	73	0.02	sustainability
8	73	0.06	knowledge
9	66	0.06	collaboration
10	58	0.07	program

Table 5 mainly presents the frequency and centrality ranking of each keyword in the university's interdisciplinary education research. It also provides further feedback on the keyword co-occurrence map, and systematically displays the overview of the theme keywords. It can be seen that in

addition to the top-ranked education and interdisciplinary research, curriculum, sustainability, and cooperation are also hot areas of current research.

3.5.2 Keyword Timing Line Chart Analysis
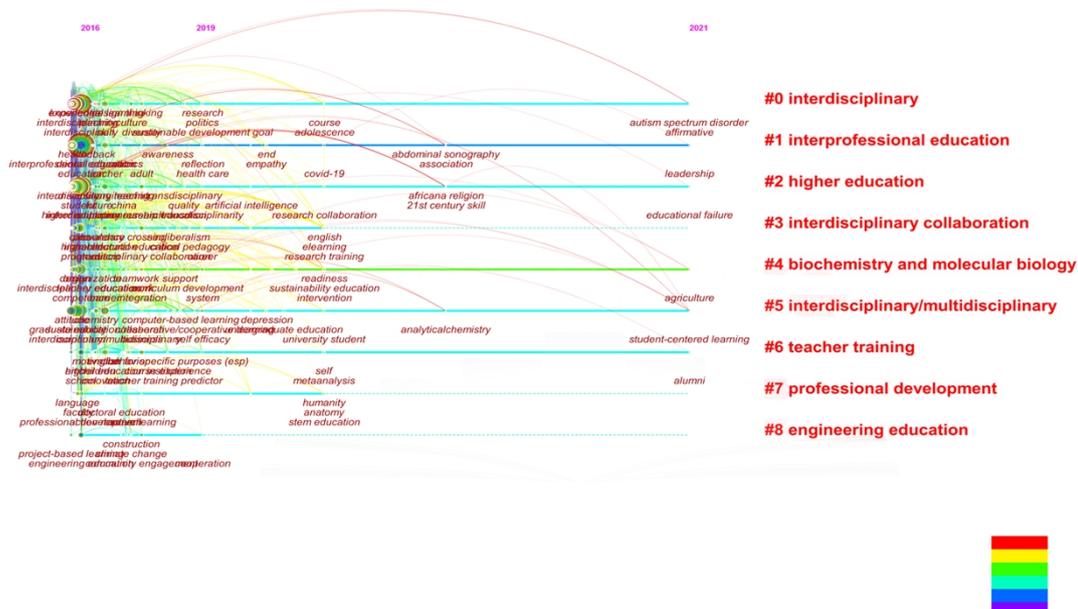
Figure 6. Keyword timing line diagram

From the timeline chart, combined with the two indicators of centrality and citation frequency, some keywords reveal the hot issues of university interdisciplinary education research. Since "higher education", "university" and "interdisciplinary education" are the subject terms of the search, there is no doubt that they are the top keywords. The hotspots of university interdisciplinary education research reflected by these keywords are as follows:

(1) Interdisciplinary collaboration. From the perspective of clustering keywords, teamwork has become a high-frequency subject word. The interdisciplinary nature of interdisciplinary majors determines that it is necessary to comprehensively use knowledge and methods of multiple disciplines to solve problems, and it is difficult to solve comprehensive and complex problems brought about by society by relying on theories and methods of a single discipline. The interdisciplinary curriculum system also needs the support of multiple disciplines, so teachers and students from different disciplinary backgrounds need to cooperate. For example, the tutors of the University of London come from different faculties and schools, about 11 colleges, such as: UCL, Birkbeck, King's College London.

(2) Interdisciplinary curriculum. Interdisciplinary education includes many forms, such as students joining the teacher's scientific research team for scientific research training. However, due to the insufficient preparation of students' own knowledge, it is difficult to participate 100% in scientific research training. Curriculum is the main means and way to achieve school education goals, and the curriculum setting also relates to the quality of talent training [7]. Judging from the literature mastered by researchers, the interdisciplinary curriculum follows the principle of combining traditional curriculum with scientific research training. American research universities have advocated the establishment of a complete interdisciplinary curriculum system, offering students a variety of interdisciplinary courses. In order to help students better deal with complex problems, Princeton University pointed out that it should focus on cultivating students' interdisciplinary vision and knowledge reserves in the course setting and teaching practice, and specially proposed the "Integrated Science" curriculum plan. The University of London offers more than 90 interdisciplinary study courses, involving disciplines such as law, anthropology, and business administration.

(3) Higher education. From the perspective of clustering keywords and related literature, the rise of interdisciplinary education and interdisciplinary research has promoted the reform of the higher

education organization system. The continuous expansion of the scale of interdisciplinary training of talents, the appointment of interdisciplinary teachers, and the establishment of interdisciplinary centers or departments have all brought challenges to higher education organizations and management institutions.

(4) Interdisciplinary program. From the perspective of clustering keywords and related literature, interdisciplinary education generally implements a project-based cooperative learning model. Setting up interdisciplinary projects is also a common strategy used by the federal government to promote the interdisciplinary training of scientific and technological talents in universities. This model provides teachers and students with a form of cooperation and collaboration between personnel from different professional backgrounds, achieving the purpose of cooperative learning, mastering knowledge of different disciplines, and establishing Establish a systematic knowledge system. For example, Columbia University in the United States established Interdisciplinary Studies in Education (Ed.D.); there are 177 interdisciplinary projects available on the official website of the University of Edinburgh.

(5) Teacher training. The quality of teachers affects the quality of talent training. The interdisciplinary nature of interdisciplinary majors determines that colleges and universities need to adopt inter-academic faculty allocation and inter-academic cooperation in terms of faculty allocation. American colleges and universities break through the constraints of traditional organizational forms and adopt methods such as centralized appointment system, joint appointment system, independent appointment system, and foreign visit system to form an interdisciplinary faculty team. Colleges and universities should provide resources and support for teachers' teaching development, create a platform for interdisciplinary teaching and research activities for teachers, and collaborate with teaching teams to develop interdisciplinary courses [8].

4 Features

As interdisciplinary research has attracted more and more attention from scholars, the bibliometrics of interdisciplinary characteristics and interdisciplinary development trends in interdisciplinary research has also become a hot research issue in the field of bibliometrics.

First of all, pay attention to the cooperation of interdisciplinary and cross-faculty training people. Interdisciplinary training requires multi-disciplinary participation and the cooperation of teachers from different disciplinary backgrounds. For example, the tutors of the University of London come from different faculties and schools, about 11 colleges, such as: UCL, Birkbeck, King's College London.

Second, set up courses based on the combination of higher education fields and interdisciplinary majors. Although higher education is a professional education based on secondary education, it is by no means one-sided professional education. Judging from the curriculum setting of foreign research universities, the interdisciplinary curriculum setting has the focal point, center and theme of interdisciplinary majors, and the purposeful and organized cross-disciplinary integration and integration of this center and theme are formed to form a structure. Curriculum system.

Third, focus on major social issues and global challenges to promote sustainable development. In the keyword cluster analysis, "sustainability" is also one of the eighth-ranked keywords. In recent years, international relations and environmental issues have become increasingly severe, especially the outbreak of the new crown pneumonia in 2020, and public health emergencies have become the global focus. This brings the hotspots of interdisciplinary education research to the direction of sustainable development. Sustainable development has become a global consensus, and interdisciplinary education has become the main way to solve these intricate problems.

Fourth, interdisciplinary education takes a long time to train people. Because interdisciplinary education integrates the knowledge and methods of multiple disciplines, it determines that the cycle of interdisciplinary training of talents is longer than that of professional education [9]. Educational tutors, especially those of higher education, prefer to apply for interdisciplinary postgraduates. Students applying for interdisciplinary education have different undergraduate backgrounds. The adaptation period is shorter than that of students majoring in education. From the existing literature,

they tend to discuss the cultivation of interdisciplinary postgraduates.

Finally, project-based learning is used to train interdisciplinary professional students. The American Research Project is the first interdisciplinary learning project established by Princeton University. The program was established in 1942 and is open to all undergraduates to provide free interdisciplinary learning courses on American history, politics, and culture. For another example, Columbia University in the United States established Interdisciplinary Studies in Education (Ed.D.); there are a total of 177 interdisciplinary projects available on the official website of the University of Edinburgh.

5 Conclusion

This paper uses the interdisciplinary research literature of the Web of Science database as the data source, and conducts a quantitative analysis of 3693 literatures within the scope of statistics. The research conclusions are as follows. The number of publications of interdisciplinary research papers is increasing year by year, and they are mainly distributed in European countries such as the United States and Germany. The distribution of interdisciplinary research institutions is mainly based on American universities. It is found through the word frequency statistics of subject terms or keywords that in the past ten years the subject areas of interdisciplinary research and design are mainly distributed in the fields of engineering, education, and social sciences [10]. Among them, the United States has the most extensive subjects. Through the analysis of core keyword network maps and keyword sequence diagrams constructed from papers published by mainstream interdisciplinary research institutions, it is found that all interdisciplinary institutions involve medicine, engineering, computer science, and Education and other disciplines. "Life Science and Biomedicine" is an interdisciplinary research hotspot that has attracted much attention from scholars in recent years. First-class universities in Europe, America and some Nordic countries all attach great importance to the construction of interdisciplinary research centers[11], interdisciplinary personnel training and the establishment of interdisciplinary research teams; emphasis on inter-academic cooperation and interdisciplinary teacher construction; actively develop interdisciplinary comprehensive courses and establish Interdisciplinary degree points.

On the other hand, in my country, interdisciplinary started relatively late, and the concept of "interdisciplinary" first entered my country in the 1980s. Professor Liu Zhonglin took the lead in explaining the connotation of interdisciplinary science in 1985 [12]. So far, although interdisciplinary has entered the field of research in my country for more than 35 years, interdisciplinary education is still developing slowly. At present, only some universities have established interdisciplinary research centers, which are limited to some double-class universities in the east. For example, Peking University has established an interdisciplinary science department and faculty; Shanghai Jiao Tong University has established its own discipline as its core and is characterized by the integration of science and culture. The teaching and research base of general education for undergraduates; has trained more than 1,800 high-quality, high-level scientific research types in physics, mathematics, chemistry, biology and related interdisciplinary sciences in the school of Kuang Yaming College, as well as administrative management, financial services, Application-oriented young talents in technology companies and other fields. According to the analysis of relevant literature, the current status of interdisciplinary education in my country's universities is as follows: First, the talent training plan lacks debugging and excessive standardization. Second, in the actual research process, there is no real interdisciplinary integration and communication. Third, the university evaluation mechanism still focuses more on individual evaluation rather than group evaluation.

Acknowledgements

References

[1] Zheng Shiming. Comparison of interdisciplinary talent training models in world-class universities and its enlightenment[J]. Educational Research, 2019, 40(05): 113-122.

[2] Liu Zhonglin. Interdisciplinary research in the era of interdisciplinary science[J]. Research in Science of Science, 1993(02): 11-18.

[3] Chen Xinzhong, Li Fangfang. Analysis of the Graduate Education Model of Princeton University[J]. Graduate Education Research, 2015(01):85-90.

[4] Zhu Shiqing, Reform and Development of Higher Education in the 21st Century-Reform and Curriculum of Undergraduate Education in Some Foreign Universities [M]. Beijing: Higher Education Press, 2002.

[5] Zhang Wei. Interdisciplinary Education: A Case Study of Undergraduate Talent Cultivation in Princeton University[J]. Research in Higher Engineering Education, 2014(03):118-125.

[6] Zhang Wei, Wei Lina, Qu Chen. The characteristics and trends of global interdisciplinary education research——Data analysis based on Citespace[J]. Research in Higher Education of Engineering, 2020(01): 123-130.

[7] Zhang Xiaobao. The practice and enlightenment of interdisciplinary professional education in American research universities[J]. Higher Education Management, 2019, 13(05): 92-103.

[8] Zhu Yongdong, Zhang Zhengang, Ye Yujia. The characteristics and enlightenment of MIT interdisciplinary training graduate students[J]. Research in Higher Engineering Education, 2015(02):134-138.

[9] Liu Junshan. The characteristics, challenges and countermeasures of interdisciplinary postgraduate training in the field of education[J]. Degrees and Postgraduate Education, 2012(06):18-23.

[10] Huang Ying, Gao Tianshu, Wang Zhinan, Wang Xuefeng, Alan L. Porter, Zhu Donghua. Research on interdisciplinary measurement based on Web of Science classification[J]. Scientific Research Management, 2016, 37(03): 124-132.

[11] Bao Shuimei, Wei Yumei. Research on the Basic Path and Characteristics of Interdisciplinary Training of Doctoral Candidates in the United States: Taking the Harvard Graduate School of Education as an example [J]. China Higher Education Research, 2015(05): 47-54.

[12] Lei Min, Zou Ping, Yan Xiaoying. On the Cultivation of Innovative Talents in China Based on the Construction of Interdisciplinary Education[J]. Think Tank Times, 2020(09):277-278.