Knowledge Domain and Emerging Trends of General Education Research in China Based on Co-citation Analysis

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Abstract: General education, as a mode of personnel training, plays an important role in training all-round and innovative talent, in recent years, it has become a hot topic in undergraduate education in China. Based on 429 literatures (1998-2019) of Chinese Social Science Citation Index (CSSCI) database, the present study analyzed the research topics, knowledge bases and research frontiers of general education in China by using the methods of co-citation analysis and cluster analysis. The literature co-citation network of general education suggest the most frequently cited references which are fundamental in the development of general education. The co-citation cluster analysis of literature on general education reveals the following research topics: induction and collation of general education literature, current situation and problems, and reform countermeasures, theoretical and practical research, the relationship between humanistic quality education and general education, curriculum design and teaching theory research, college English teaching research and human resource capacity building research. The present analysis is expected to provide some clues for the future development of general education research in China.

Introduction

General education originated from the Western Liberal Arts Education. In the early 19th century, Professor A.S. Parkard first linked it to university education. In the mid-1980s, Taiwanese scholar M.S. Gao translated it into "Tong Shi Jiao Yu" according to the thought of general education and liberal education. In 1995, the former State Education Commission began to promote quality education in higher education, and general education have developed rapidly.

After more than 20 years of development, China's general education theory and practice have made great progress. For example, L. Lin et al. used co-word analysis that based on 814 articles from CNKI database to analyze the hotspots and evolution of domestic general education research from the perspectives of authors, publishing organizations, keywords, etc. [1]. Similar to the research method adopted above, W. Liu and M.Y. Wang expanded the articles count to 3576 and 4219 form CNKI database respectively, the results show that college English teaching under the background of general education and comparative study of general education have become research hotspots [2, 3].

It can be seen that many studies on research advances of general education in China have been achieved .In the field of higher education, general education have achieved wide attention from researchers and educational institutions and have become an important issue in undergraduate education especially. However, the above works only revealed the basic properties of general education based on co-word analysis, and the relationship among research topics was not revealed clearly, such as their knowledge base and research frontier, the internal correlation of each research topic and the external correlation among them .The present paper teases out the relevant literature of general education presented in the data corpora of the CSSCI database, and review knowledge base and research frontier of general education research in China based on literature co-citation analysis by CiteSpace, and provide some reference for the future research in order to enhance the development of general education research in China.

Data and Methods

Data Collection. The data for bibliometric analysis came from the CSSCI database which ensure the high quality of the presented literature. We used the CSSCI to retrieve general education related studies published from 1998 to 2019, and the index term included "General Education". The reason why the timespan starts from the year of 1998 is that the CSSCI has been included since 1998 only. Thus, 429 related articles were found and downloaded on July 15th, 2019. Each downloaded article included the title, authors, abstract, keywords and references etc., and then the records were converted into software-recognizable format by CiteSpace data format conversion tool. Finally, the results in this study were exported to CiteSpace for subsequent analysis.

Research Methods. There are two methods employed in this study as follows:

1) Literature research method. Literature research refers to the process of collecting, retrieving and identifying documents according to certain requirements. The CSSCI database follows the law of bibliometric and selects journals with strong academic standard from more than 2700 academic journals of Chinese humanities and social sciences. At present, there are more than 500 academic journals in 25 categories, including law, management, economics, history, and politics and so on. This paper searches and analyzes the literature on general education from the CSSCI database and discusses the general development.

2) Literature Co-citation analysis. In 1973, American intelligence scientist Henry Small first proposed the concept of "Co-Citation". Co-citation analysis means that two documents appear together in the bibliography of the third citing document, and the two documents form a co-citation relationship. Paper citation is the flow of knowledge on different research topics and the process of knowledge unit reorganization to generate new knowledge [4]. Different from the method of co-word analysis used by the foregoing scholars, this paper employs literature co-citation analysis and get the knowledge mapping about the co-citation network, which provide the clues for the knowledge base, research hotspots and frontier of general education.

Research Tool. In view of the inconvenience of traditional bibliometric methods, the research tool used in this study is the information visualization analysis software CiteSpace (version: 5.3.R4), which is currently widely used for the mapping of knowledge domain. CiteSpace is developed by Professor C.M. Chen who come from Drexel University, and the literature co-citation analysis function is the earliest use and theoretical discussion on platform of CiteSpace, and it is also the most prominent function [4]. We use the function of this software to present a vivid image of literature co-citation network, cluster and distribution of knowledge in general education field.

Results and Discussion

Literature Co-citation Analysis. The co-citation network drawn by CiteSpace consists of a set of independent networks, each of which contains documents published within a certain time interval. On the platform of CiteSpace ,the "node types" is set as "Reference", and the "time slicing" is set as "from 1998 to 2019", the "year per slice" as "2". The "Jaccard" method is used for the strength of network node association, and the thresholds are set to 1, 1, 15; 2, 2, 20; 2,2,20 respectively. Finally, using the Minimum Spanning Tree (MST) pruning network, the co-citation network of the literature on general education is shown in Fig. 1. Because the number of references cited in the literatures is low, there are more isolated and scattered nodes in the co-citation network. Filters are used in this study, and Fig. 1 shows the sub-networks with the top 5 network sizes. In the co-citation network, the number of network nodes is 324, the number of node connections is 262, the network density is 0.005, and the largest sub-network (top 5) member nodes are 105 (accounting for 32% of the total nodes).

In the co-citation network, each node corresponds to a document. The key node is the node that connects two or more different clusters in the network, and has higher relative centrality and citation frequency. The importance of nodes is often measured by the co-citation frequency and the

centrality. To show how the frequently cited references have influenced the development of general education, we list its high cited references by citation counts in Table 1. From Table 1, we can see that the article "Discussions on the Conceptual Connotation of General Education" (L.M. Li et al., 1999) has been cited the most frequently. Firstly, this paper expounds the concept and translation method of General Education, secondly, it constructs the connotation of General Education from three perspectives of nature, purpose and content, and finally points out that General Education is a rich, multi-dimensional and multi-stage historical category [5]. Among the documents cited more than or equal to four times, there are three papers by L.M. Li, which shows that she has a strong academic influence in this field and is an important research force in the field of general education.
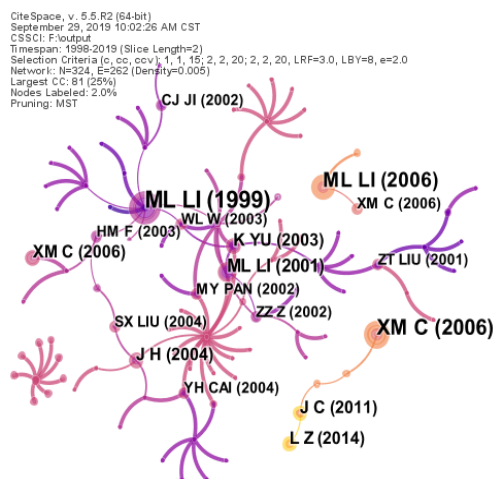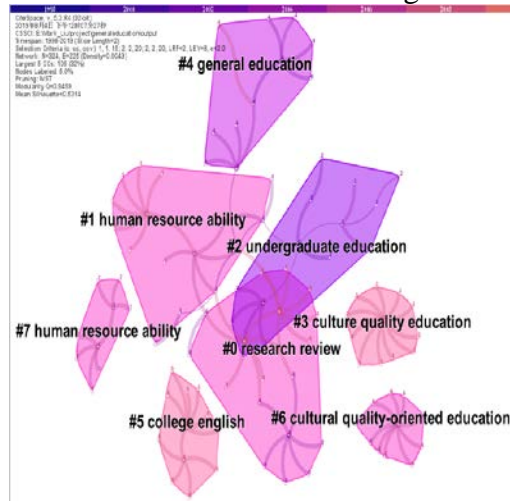

| Figure 1. Literature co-citation network | Figure 2. Co-citation clusters network |

Table 1 List of high co-citation frequency references (co-citation frequency ≥4)

No.	citation counts	cited references
1	8	Discussion on the Conceptual Connotation of General Education(L.M. Li et al.,1999)
2	7	An Analysis of Some Concepts about General Education(X.M. Chen,2006)
3	6	Reflections on the Construction of General Education Ideas and Systems in Chinese Universities: 1995-2005(L.M. Li,2006)
4	5	On the Relation Between General Education and Professional Education from the Yuanpei Program of Peking University(X.M. Chen,2006)
5	5	Investigation and Analysis of the Present Situation of General Education in China's Universities and Colleges: Taking Peking University, Tsinghua University, Renmin University of China and Beijing Normal University as Examples(L.M. Li et al.,2001)
6	4	Two Central Links of General Education in Universities(Y. Gan,2006)
7	4	Combining General Education with Professional Education(J. Huang,2004)
8	4	General Education Reform in China: Achievements, Dilemma, and Solution(L. Zhang,2014)
9	4	Survey and Analysis of General Education in Chinese Universities(K. Yu,2003)
10	4	Integrating International Experience to Build Undergraduate Teaching Model Combining General Education with Individualized Training(J. Chen,2011)

The cluster map of the co-citation network in Fig. 1 is drawn by CiteSpace and eight clusters are obtained. As shown in Fig. 2, the modularity value is 0.9459 (range of values [0, 1]), which is the evaluation index of network modularization, the closer to 1 means the better the clustering of the network. The average Silhouette is the network homogeneity index with a value of 0.5314. The closer the value is to 1, the higher the homogeneity of the network is, generally speaking, the value is above 0.5, it can be considered that the clustering result is reasonable [4]. From the above two indicators, we can find that the co-citation cluster map generated in this paper has high reliability and can better reflect the development of general education research in China. To characterize the nature of each cluster, CiteSpace can extract noun phrases from the titles of articles citing cluster based on three algorithm: latent semantic index (LSI), log-likelihood ratio (LLR), and mutual

information (MI). LLR usually provides the best results in terms of uniqueness and coverage of topics associated with cluster. In the cluster map, the cluster labels are automatically extracted from the English titles of the citing documents according to the LLR algorithm.

Based on the analysis of the cited literature and citing literature contained in each cluster, the important topics of general education research in China are as follows: Cluster 0 mainly focuses on the induction and collation of the general education literature in China, it contains the largest number of nodes, with a total of 19 nodes, and the silhouette value is 0.949, and its subject words are China, university, and summary and so on. Cluster 1 focuses on the current situation, problems and reform strategies of general education research in China, it contains 16 nodes with a silhouette value of 0.929. Its keywords include reference, comments, reformation and curriculum setting, and so on. Cluster 2 is focused on the theoretical and practical research of general education in Chinese universities, it contains 14 nodes, with a Silhouette value of 0.992. The subject terms include comparison, Hong Kong, Taiwan and education institutions, etc. Through citing literature analysis, it is found that although there is no node connection between the Cluster 3 and Cluster 6 in this map, their research topics are similar, mainly focusing on the relationship research between humanistic quality education and general education. Cluster 3 contains 12 nodes, and Cluster 6 contains 11 nodes, and the subject terms have relationship, dialectic thinking and so on. Cluster 4 focuses on the curriculum design and teaching theory research of general education, and includes 12 nodes. Its keywords include pursuit, perspectives, enlightenment, and Japanese universities and so on. Cluster 5 mainly studies college English teaching in the context of general education, including 12 nodes, with the following keywords: implications, higher education, general education, etc. Cluster 7 is mainly devoted to the research of human resources capacity building under the background of general education. It consists of 9 nodes, and its subject words include construction, human resources, and general education, etc.

Knowledge Base Analysis. The knowledge base can be considered as a co-citation network formed by co-citation relationship of published documents, its form is the cluster of co-citation documents [4]. Persson interpreted knowledge base as "a group of documents cited by research frontier"[6]. Table 2 summarizes the literatures of the first three cited frequencies (if the cited frequency is the same, the high centrality ranks ahead) of each of the eight clusters, these literatures represents the knowledge base in the field of general education in China. In the following paper, the knowledge base analysis is carried out for the three clusters: #0, #1, and #2, which contains the top 3 nodes.

Cluster 0 focuses on the induction and collation of general education literature in China. The most frequently cited in this cluster is M.Y. Pan et al.'s paper "Quality Education and General Education in Colleges and Universities". This paper mainly compares quality education with general education in terms of objectives, contents and approaches, and the author thinks that the rich practical experience of general education can be used for reference by quality education in China [7]. Z.J. Feng expounded the development of general education in Hong Kong's universities, and discussed and analyzed the general education situation of four universities, namely, the Chinese University of Hong Kong, Lingnan University of Hong Kong, Hong Kong Baptist University and City University of Hong Kong [8].

Cluster 1 is devoted to the research on the current situation, problems and reform of general education in China. L.M. Li et al. investigated and analyzed the practice of general education in four universities, including Peking University, Tsinghua University, Renmin University of China and Beijing Normal University. They pointed out that there are currently unreasonable distribution of cultural quality education elective courses, biased content towards application and specialization, and lack of clear criteria for the division of curriculum fields, and some suggestions for improvement are put forward[9].

Cluster 2 mainly focuses on the theoretical and practical research of general education in Chinese universities. C.J. Ji focused on the relationship between professional education and general education, the author holds that general education has three missions, which are not only the supplement of professional education, but also the deepening of professional education, and the soul

of professional education, therefore, general education should expand the knowledge of students, help students form a holistic view of knowledge, and implement "whole-person education"[10].

Table 2 List of knowledge-based literatures in the co-citation clusters (partial)

#	Freq.	cited references
0	3	Quality Education and General Education in Colleges and Universities (M.Y. Pan, 2002)
	3	Comments of the Curriculum Setting of General Education in Universities and Measures of Reformation (Y.H. Cai, 2004)
	2	Research on General Education in Hong Kong' Universities(Z.J. Feng,2004)
1	5	Investigation and Analysis of the Present Situation of General Education in China's Universities and Colleges: Taking Peking University, Tsinghua University, Renmin University of China and Beijing Normal University as Examples(L.M. Li et al.,2001)
	4	Survey and Analysis of General Education in Chinese Universities(K. Yu,2003)
	3	Seeking the Best Combination of General Education and Specialized Education from the Perspective of Curriculum(W.L. Wang,2003)
2	8	Discussion on the Conceptual Connotation of General Education(L.M. Li et al.,1999)
	3	Relationship between College Professional Education and General Education(C.J. Ji, 2002)
	1	My Academic Career (Part II) (Translated by J.M. Zhao, 2003)

Research Frontier. Research frontier is defined as a group of emerging dynamic concepts and potential research questions. The citations of the clusters constitute the research frontier based on its corresponding knowledge [11]. From the view of knowledge discovery, the research frontier is the leading achievement and thought in a certain research field. From the point of bibliometric, the cited documents constitute the knowledge base, and the research frontier is formed by the references. Table 3 summarizes the citing literature with the highest coverage (the proportion of references to the clustered literature) in each cluster, which can represent the research frontiers in the field of general education in China. For example, the citing literature "Reconsideration of the relationship of culture quality education and general education" (Y.Q. Wang, 2009) cites 25% of the documents in the Cluster 3. This paper reviews the history of these two kinds of education, points out that general education can construct the implementation mode of cultural quality education together with formative education, proposes the framework of cultural quality education including general education, and discusses the practice of developing general education and offering general courses in different types of universities [12]. In 1995, Chinese colleges and universities began to implement cultural quality education, after more than 10 years, Y.Q. Wang's paper re-emphasized a new understanding of the relationship between quality education and general education. It can be found that the research on general education in China has the characteristics of sustainability.

Table 3 List of citing literatures in the co-citation clusters (partial)

#	coverage	citing literature
0	0.21	Research Review on University General Education in China(H.J. Zhang,2009)
1	0.25	On the Role of General Education of Foreign Languages with Chinese Characteristics in Improving the Employment Competitiveness of Foreign Language Majors(H.J Tang,2008)
2	0.21	The Ideals and Practices of General Education in Undergraduate Education(F.F. Liu,2004)
3	0.25	Reconsideration of the Relationship of Culture Quality Education and General Education (Y.Q. Wang, 2009).
4	0.25	Three Perspectives on General Education (C.M. Yang, 2002).
5	0.25	College English as An Integral Part of General Aducation(Y. Ma ,2009)
6	0.18	Towards a Dialectic Thinking about Cultural Quality-Oriented Education and General Education(L. Cao,2007)
7	0.22	The General Education and the Construction of Human Resource Ability(S.P. Xu,2006)

Conclusions

Conclusions. This paper takes 429 literatures(1998-2019) related to general education research in CSSCI database as the object of analysis, and carries out knowledge mapping analysis from key documents of co-citation network, cluster analysis, knowledge base, research frontier and so on, and obtains the knowledge structure and evolution process in the field of general education research in

China.

In this paper, we firstly generally review the research background of general education, the research methods and tool in this study. Secondly, we analyze the co-citation network of general education by presenting the cited references map and the most frequently cited references of general education, and then, we have the visualization analysis of research hotspots in general education by cluster analysis network, it is found that general education in China is divided into seven main research topics: induction and collation of general education literature, current situation and problems, and reform countermeasures, theoretical and practical research, the relationship between humanistic quality education and general education, curriculum design and teaching theory research, college English teaching research and human resource capacity building research. Finally, we analyses the knowledge base and research frontier of general education research.

Discussion. Due to the defects of research design and metrological analysis methods, it is inevitable to bring some limitations to this study. Firstly, the main drawback of research design is that only the CSSCI source journal literatures are selected as sample data, which inevitably restricts the potential scope of research results. If the general education research papers published in a wider range of database journal literature are included in the sample data, these results may undergo significant changes. Secondly, the literature co-citation analysis method itself has some limitation, this method can only analyze and classify a small part of the cited literatures, so the interpretation of the results of the knowledge map inevitably has subjectivity. Finally, the object of co-citation analysis is the references cited in the papers related to general education research in China from 1998 to 2019. These references come from different periods, and the latest published papers can't be cited. Therefore, this method will bring a certain delay, and some of the latest research results may be ignored.

Although there are some limitations in the research, we believe that co-citation analysis of literature has great potential use in the field of general education research, and the quantitative analysis in this paper can be used as an important supplement to the traditional qualitative analysis, therefore, the research results of this paper have certain theoretical significance and reference value. Follow-up research can be carried out by combining literature coupling analysis, co-word analysis and other bibliometric methods. By expanding the scope of the literature, optimizing the selection criteria, the quality of research can be further improved.

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