# Visual analysis and comparison of data from two databases on global competence: Using the Cite Space knowledge graph

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## Abstract

This study uses the Social Sciences Citation Index (SSCI) database from 1997 to 2022 and the Chinese National Knowledge Infrastructure (CNKI) from 2008 to 2022 to analyse global competence in order to examine the present condition of global competence research. The results showed a rising trend in global competence where the United States was in the leading position and China ranked second in academic publications but its influence was relatively weak. According to a keyword analysis, "global competence," "education," "model," "globalization" and "global governance" were the most prevalent topics. The keyword time map analysis generated three periods of 'global competence research: the embryonic stage before 2010, the initial exploration period from 2011 to 2016 and the development period from 2017 until now. Future studies should concentrate on developing a theoretical framework for localization and creating practical assessment tools based on the framework. Implementation strategies must also be actively investigated.

**Keywords:** Cite space, Data visualization analysis, Global competence, Literature review.

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**Transparency:** The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.
**Institutional Review Board Statement:** The Ethical Committee of the School of Education, Baoshan University, China has granted approval for this study on 12 January 2023 (Ref. No. BSU202301).

# 1. Introduction

The term "global competence" was first coined by the Council on International Education Exchange (CIEE) in a 1988 study titled "Educating for Global Competence" highlighting a strong emphasis on the importance of developing global knowledge and skills. Several years later in 1993, Lambert founded an educational perspective of 'global competence' identifying five critical components: knowledge, empathy, support, foreign language proficiency and work performance [1]. He was known as the "father of global competence education". The Programme for International Student Assessment (PISA) Global Competence Framework was then released on December 12, 2017 by the Organisation for Economic Co-operation and Development (OECD) in collaboration with Harvard Graduate School of Education Project Zero. The PISA examination was modified to include Global Competence the following year. Global competency is defined as follows [2] (see Figure 1):

The capacity to examine regional, international and intercultural issues to comprehend and value other people's perspectives, to engage in appropriate and productive interactions with people from different cultures and to contribute to the well-being of the community and sustainable development.



**Figure 1.**
PISA global competence framework.
**Note:** OECD [2].

International organisations and developed countries have been paying more attention to global competence as globalisation has progressed during the 20th century. In China, the education system has gradually given more attention to the components of global competence as a result of the implementation of reform and open-door policies which are guided by the spirit of the "three education orientations" (modernization, globalisation and future construction). For instance, in May 2010, the Ministry of Education put forth the 'Outline of the National Medium- and Long-Term Education Reform and Development Plan (2010-2020)' highlighting the need for developing a substantial cadre of internationally-minded talents. These individuals should possess a global vision, be conversant with international rules and be capable of engaging in international affairs and competitions [3]. Furthermore, the 2016 publication of ' core competencies of Chinese students' development' suggested that students should embody six key competencies: inherent humanistic qualities, a healthy life, responsibility, the implementation of innovation, learning to learn and a scientific spirit. Within these competencies, responsibility encompasses social responsibility, national identity and international understanding [4]. Eight departments including the Ministry of Education introduced ' opinions on accelerating and expanding the opening of education in the new era' in 2020. This research stressed the importance of improving the international competitiveness of higher education personnel training and expediting the cultivation of high-level international talents with a global perspective [5]. In the current global landscape, it is of paramount importance to foster global competence among students. Since 1997, the literature on global competence has been abundant but few people have used metrology analysis to organize, analyze and summarize from history to the present. Cite Space (bibliometric analysis software) can quantitatively present the characteristics of global competence research effectively avoiding the loss of traditional literature research methods in vast data and the bias of subjective judgment.

The Social Science Citation Index (SSCI) is a world-renowned core database engaged in social science research and the included studies have high reference value. This study intends to use the SSCI database as one of the sources of literature information and statistics. On the other hand, the United States has the highest number of publications in the global competence field followed by China according to the preliminary search of the SSCI database. Therefore, this study intends to select the China National Knowledge Infrastructure (CNKI) as another statistical source of literature information. CNKI is the largest platform of knowledge and information resources in Chinese with over 30,000 institutional users in

Mainland China and over 1,600 institutional users outside China. Visualization and analysis of the literature in the global competence field were achieved by using Cite Space to show the pulse and evolution pattern of global competence research through association, clustering and maps. The main objectives are as follows:
  (1) Identification of growth trends in published literature.
  (2) Identification of major contributing journals.
  (3) Identify major research countries, research institutions and their research collaborations.
  (4) To reveal hot spots and recent trends.
  (5) Analyze the evolution of research.
  (6) Identify future research directions.

## 2. Research Methods
### 2.1. Research Tools
     Cite Space 5.8.R3 (64-bit) knowledge graph software was used to explore the research status of global competence at home and abroad by knowledge graph analysis  and predict the possible development direction of global competence in the future from aspects of literature research hotspots [6-8].

### 2.2. Data Source Description
     Journal papers indexed in the SSCI (1997-2022) and the CNKI (2008-2022) data bases were reviewed. "Global competence" was used as the key word. The search results were also further inspected and invalid data including comments, reports, reviews, and news was carefully removed.   Relevant literature in the field of global competence was only retained. Finally, 229 valid data of SSCI and 224 valid data of the CNKI were obtained. According to the format requirements of the analysis programme, CNKI literature data was exported in Refworks format for simplicity in analysis. Each document contains title information such as the name of the document, the name of the author and the abstract of keywords which are then converted into the data source of this study.
     Table 1 presents information about data sources for knowledge graph analysis.

**Table 1.**
Retrieval of data sources for knowledge graph analysis of global competence research.

| Search conditions | Search content and results | |
| --- | --- | --- |
| Database | CNKI | Web of science: SSCI |
| Keywords | Global competence | Global competence |
| Document type | Journal articles and dissertations | Articles |
| Time span | 2008-2022 | 1997-2022 |
| Search results | 375 articles | 313 articles |
| Citation counts | 224 | 229 |

## 3. Basic Publication Information Analysis
### 3.1. Quantitative Analysis of Literature in the Field of Global Competence
     The number of publications on global competence in the SSCI database showed a rising trend from 1997 to 2021. Among them, the number of published papers from 1997 to 2016 showed an unstable increase and the average annual published papers were mainly in the single digits. After 2017, there were typically 20–30 publications per year owing to the OECD's inclusion of the PISA test's global competency component.  There were five publications in May 2022 during the time in which the present study was conducted.
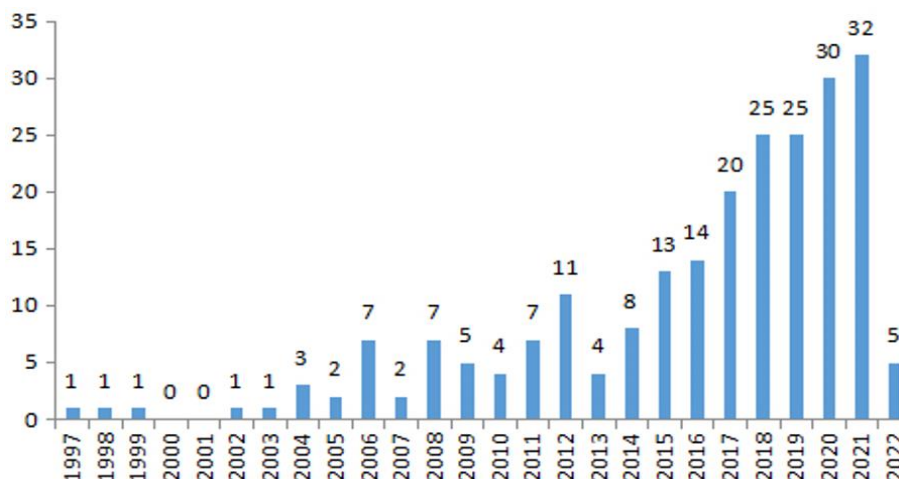


**Figure 2.**
The trends of research publications of global competence in SSCI.

Figure 3 shows that between 2008 and 2021, the number of articles on global competence in the CNKI database increased significantly with 2018 being the turning point. Before 2018, the average number of annual publications was less than 10. The annual publication number has ranged between 35 and 55 (2022 omitted) as the OECD added global competence to the PISA exam in 2018.
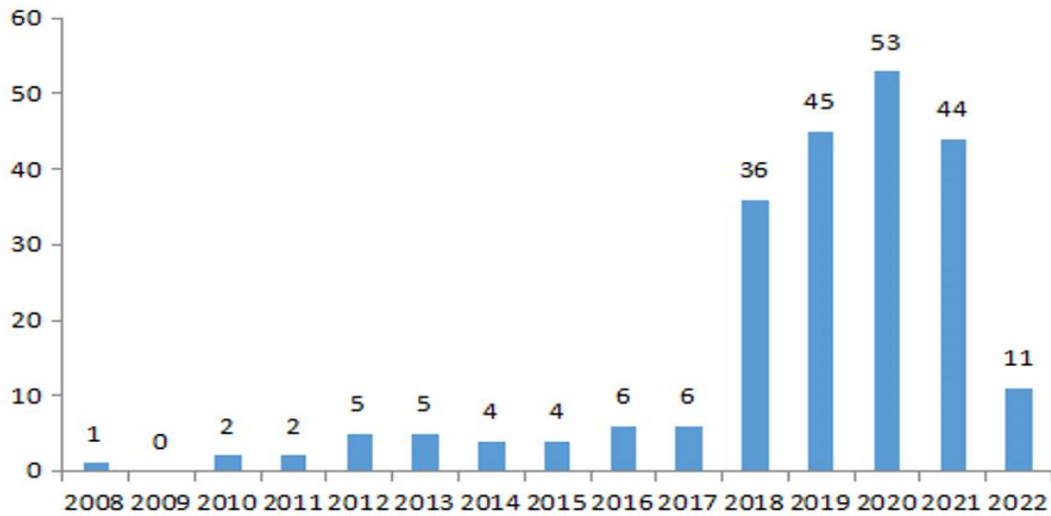
**Figure 3.**
The trend of CNKI research publications in the field of global competence.

### 3.2. Analysis of Journals Published in Global Competence

The sources of foreign co-cited journals related to global competence research as shown by the map of co-cited journals in the SSCI database (see Figure 4) were primarily journals of studies in international education, international journals of intercultural relations, globalisation societies and education, higher education, journals of applied Psychology and other journals in the field of education and social sciences. The analysis showed that the journal of studies in international  education (cited 37 times, centrality 0.17) has a high core position in global competence research.
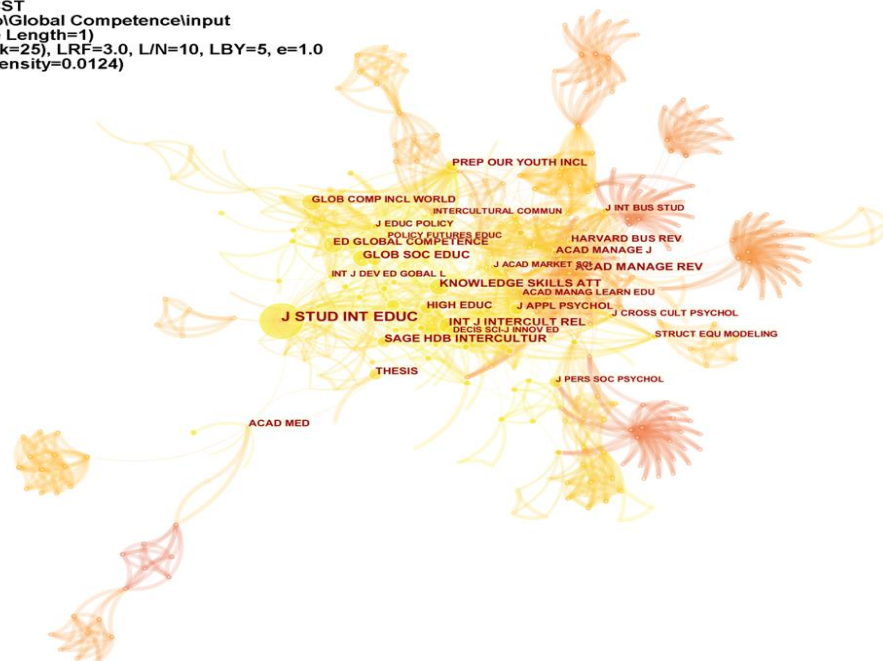
**Figure 4.**
Map of SSCI co-cited journals.

### 3.3. Analysis of Major Countries in Global Competence

The United States, China, the United Kingdom and Germany dominated research on global competence, according to the network map of major countries in global competence in the SSCI database (see Figure 5). Among all, the number of publications in the United States (n=73) was much higher than that of other countries and the centrality was 0.35 both figures were ahead of other countries. China has published 22 articles ranking second after the United States in terms of publication numbers. However, its centrality was only 0.08 which was lower than that of the United Kingdom (0.13) and Germany (0.10). Nodes with a centrality exceeding 0.1 are called critical nodes. As a result, when it comes to the study of

global competency, the United States, the United Kingdom and Germany are all crucial countries but China has to be strengthened in this area.



**Figure 5.**
Network map of major countries in SSCI global competence.

### 3.4. Analysis of Research Institutions

According to the information provided by the SSCI database an institution-wise knowledge map was produced (Figure 6). It can be seen that the SSCI high-yield institutions include Harvard University (America), The Education University of Hong Kong (China) and the University of Sao Paulo (Brazil) but the centrality of all institutions was 0. It means that there is no cooperative relationship between institutions in global competence and the research of each agency in this area is carried out relatively independently. Then, an institution-wise knowledge map was produced based on the information provided by the CNKI database and existing literature (Figure 7). It can be seen that in the CNKI database, the highly-yielding institutions were the Xiamen University Education Research Institute, the International Comparative Education Research Institute of the Beijing Normal University and the School of Educational Sciences of the Nanjing Normal University. However, there was less cooperation between institutions and the centrality of all institutions was also 0. Therefore, whether Chinese or foreign institutions are involved in the study of global competence, they all really need to cooperate with local and foreign ones. It can be seen that a core research institution that plays a central role in research on global competence has not yet been formed.
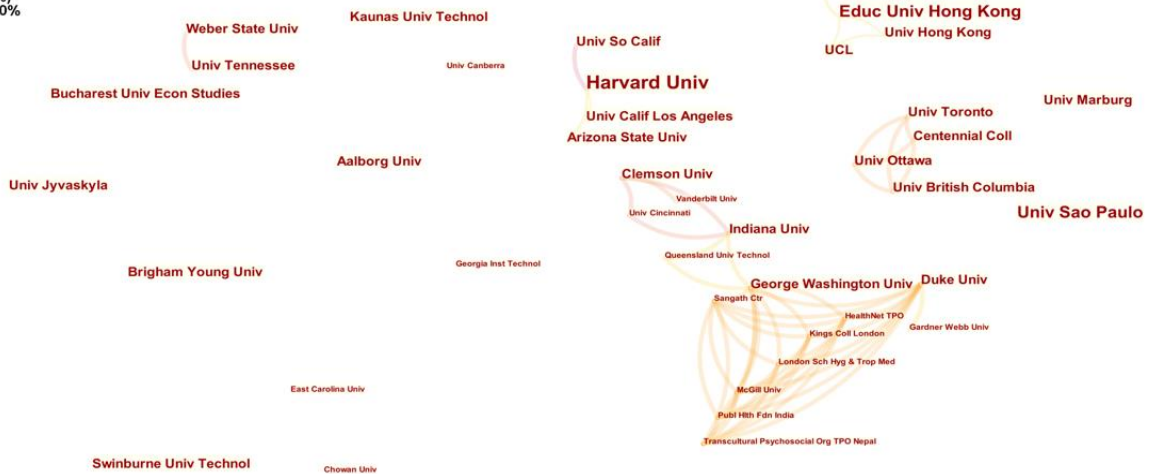


**Figure 6.**
A map of cooperating institutions publishing SSCI articles on global competence.

CiteSpace, v. 5.8.R3 (64-bit)
May 29, 2022 9:01:34 PM CST
CSSCI: C:\Users\dell\Desktop\全球胜任力\output
Timespan: 2006-2022 (Slice Length=1)
Selection Criteria: g-index (k=25), LRF=3.0, L/N=10, LBY=5, e=1.0
Network: N=121, E=10 (Density=0.0014)
Largest CC: 5 (4%)
Nodes Labeled: 1.0%
Pruning: None
Modularity Q=0.7548
Weighted Mean Silhouette S=0.9346
Harmonic Mean(Q, S)=0.8352

**Figure 7.**
A map of cooperating institutions publishing CNKI articles on global competence.

## 4. Analysis of Research Hotspots

### 4.1. Keyword Co-Occurrence Analysis

We categorised and calculated high-frequency keywords in global competency and listed out high frequency keywords with word frequencies greater than 5. The share of keywords with a word frequency of more than 5 was 17.88% for the 481 co-occurring frequencies in the SSCI database. In the CNKI database of 182 common occurrences, the share of keywords with a word frequency over 5 is 54.95%. As shown in Table 2, the high-frequency keywords in SSCI papers were global competence, intercultural competence, higher education, performance, cultural competence, education and model. In Cite Space, centrality is a key indicator for analyzing the importance of keywords and nodes with a centrality over 0.1 are more important and have greater influence in research. Global competence, education and model had a centrality exceeding 0.1 in studies on global competence in SSCI publications. The high-frequency keywords in CNKI papers were global competence, globalization, core literacy, undergraduate, teacher education, the United States, global governance, the OECD and international education.

**Table 2**.
High-frequency keywords in global competence research.

| No. | International high-frequency keywords | Frequency | Centrality | High-frequency keywords in China | Frequency | Centrality |
|---|---|---|---|---|---|---|
| 1 | Global competence | 41 | 0.59 | Global competence | 27 | 0.22 |
| 2 | Intercultural competence | 10 | 0.09 | Globalization | 15 | 0.13 |
| 3 | Higher education | 9 | 0.06 | Core literacy | 14 | 0.08 |
| 4 | Performance | 7 | 0.08 | Undergraduate | 12 | 0.07 |
| 5 | Cultural competence | 7 | 0.04 | Teacher education | 8 | 0.03 |
| 6 | Education | 6 | 0.11 | United States | 7 | 0.02 |
| 7 | Model | 6 | 0.11 | Global governance | 6 | 0.11 |
| 8 | | | | OECD | 6 | 0.01 |
| 9 | | | | International education | 5 | 0.01 |

### 4.2. Keyword Cluster Analysis

Modularity Q serves as a metric for assessing the quality of divisions in clusters. A Q value exceeding 0.3 denotes a significant network structure. On the other hand, the mean silhouette serves as a measure of a cluster's homogeneity and a value greater than 0.5 signifies a rational clustering result [9, 10]. Referring to the keyword cluster analysis results from the SSCI database (as depicted in Figure 8), the modularity Q value was calculated to be 0.7723 exceeding the threshold of 0.3 and signifying a significant network structure. Concurrently, the Mean Silhouette value was determined to be 0.9298, surpassing the 0.5 criterion, thereby indicating a rational and coherent clustering. Then, the cluster diagram formed by the

CNKI database data (as shown in Figure 9) showed its modularity Q (Q value) was 0.7382 which was greater than 0.3; the Mean Silhouette (S value) was 0.9346 which was greater than 0.5 indicating a reasonable clustering.

The cluster labels in global competence in the SSCI were global competence, children, uncertainty, clinical competence; professional development, etc. (see Figure 8). On the other hand, Figure 9 indicates clustering in the CNKI database. The cluster labels of China in global competence were global competence, Tsinghua University, core competence, indicator system, college students, influencing factors, multiculturalism, talent training etc.
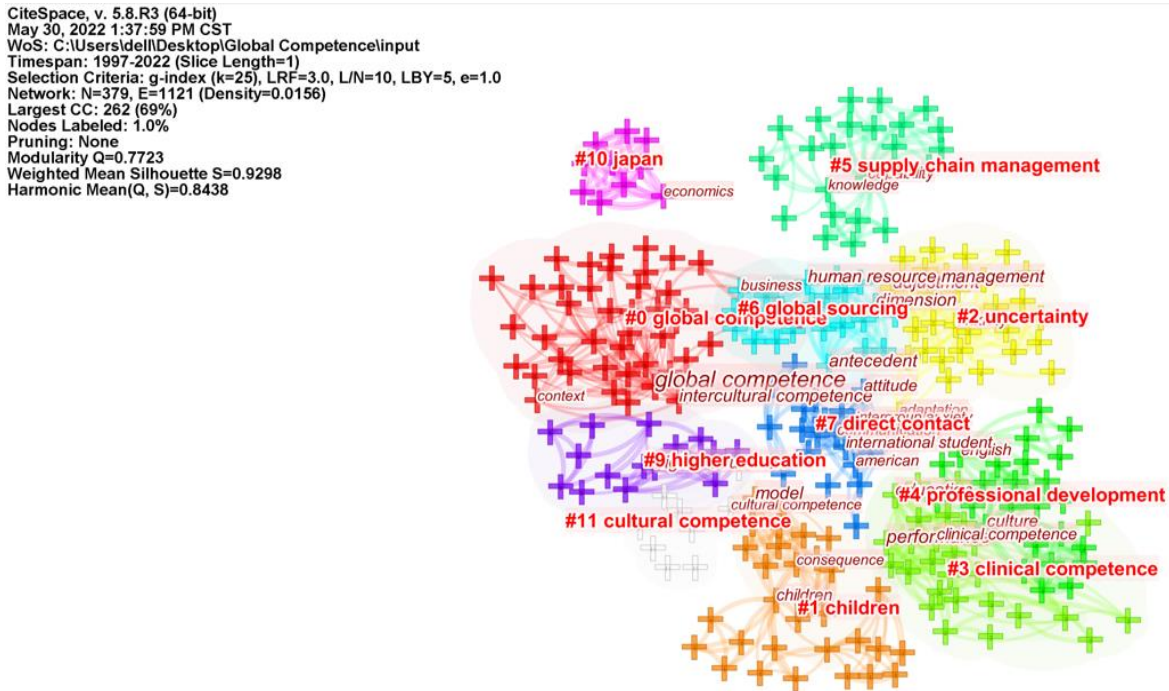


**Figure 8.**
A clustering map showing global competence keywords in SSCI.
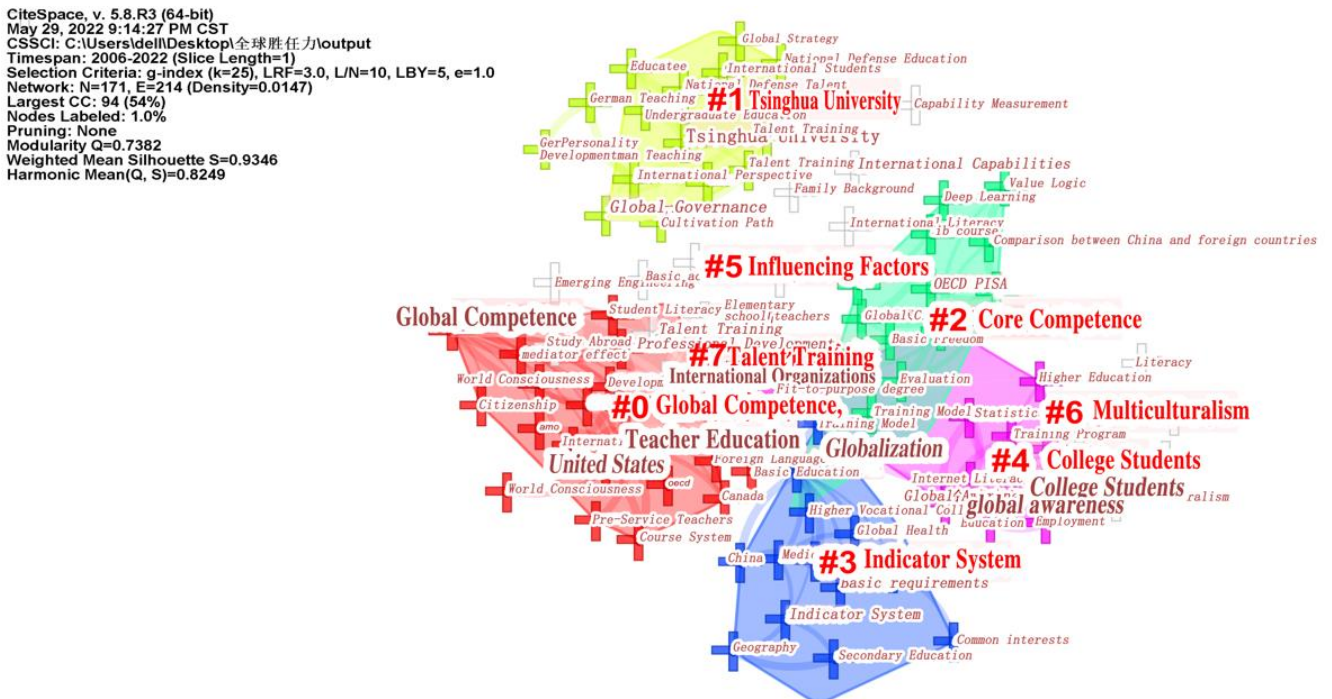


**Figure 9.**
A clustering map showing global competence keywords in CNKI.

### 4.3. Burst Analysis

Burst analysis refers to the analysis of words that frequently appear in a relatively short period of time. Researchers can discover popular subjects and frontier concerns in a study field based on the frequency and year of occurrence of burst terms [11, 12]. According to the map of burst terms related to global competence in the SSCI database (Figure 10), the first indication of related mutant words first appeared in 2006 and they related to adjustment (focus on cross-cultural

adjustment) and dimension (focus on the content of global competence, especially the dimensions) in this early stage. Education started to become a mutant term in 2013. After 2016, studies focused on cultural competency, global competence and higher education. It is clear that the main study areas in the field of global competency have changed along with the growth and changes in economic society and the global context. The words with higher strength were global competence (strength 9.93) and higher education (strength 4.8). This suggests that global competence in higher education is the current and probably the most trending topic in global competence.

## Top 10 keywords with the strongest citation bursts

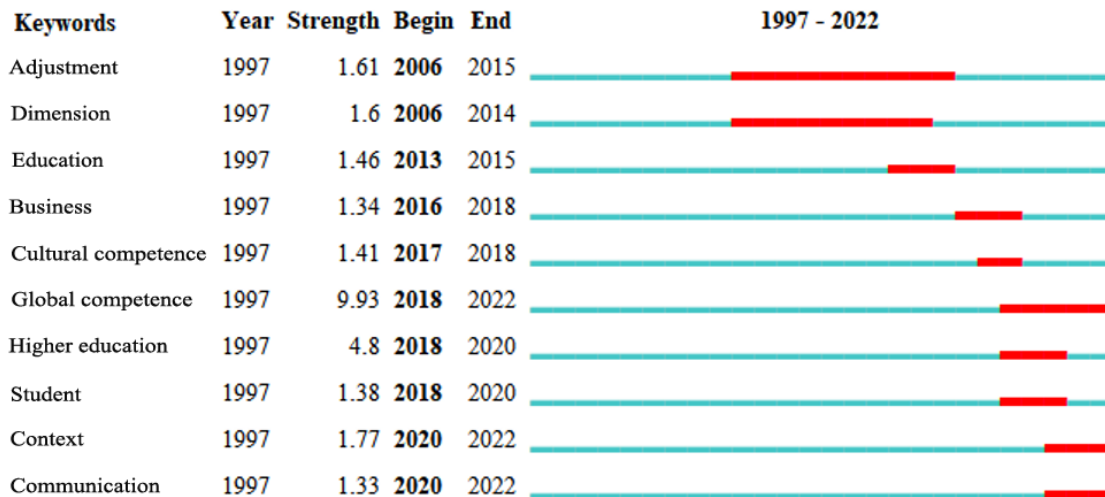| Keywords | Year | Strength | Begin | End | 1997 – 2022 |
|---|---|---|---|---|---|
| Adjustment | 1997 | 1.61 | 2006 | 2015 | |
| Dimension | 1997 | 1.6 | 2006 | 2014 | |
| Education | 1997 | 1.46 | 2013 | 2015 | |
| Business | 1997 | 1.34 | 2016 | 2018 | |
| Cultural competence | 1997 | 1.41 | 2017 | 2018 | |
| Global competence | 1997 | 9.93 | 2018 | 2022 | |
| Higher education | 1997 | 4.8 | 2018 | 2020 | |
| Student | 1997 | 1.38 | 2018 | 2020 | |
| Context | 1997 | 1.77 | 2020 | 2022 | |
| Communication | 1997 | 1.33 | 2020 | 2022 | |

**Figure 10.**
Burst terms in SSCI articles.

From the burst word map based on the CNKI database (Figure 11), it can be seen that the emergence of burst terms relevant to global competence research began in 2006 and continued until 2016. In 2015, researchers began to pay attention to undergraduates. In 2016, 'OECD' became the burst term and lasted until 2018. 'Core competence' emerged as the burst term and lasts until 2020. Since 2020, no burst terms have emerged yet. Before 2016, Chinese scholars increased their interest in training university students, especially engineering students, in global competence influenced by increasing internationalization and the Plan for Educating and Training Outstanding Engineers (PETOE). Subsequently, with the inclusion of global competence in the PISA test by the OECD, Chinese scholars paid more attention to "OECD" and "core literacy".

## Top 5 keywords with the strongest citation bursts

| Keywords | Year | Strength | Begin | End | 2006 – 2022 |
|---|---|---|---|---|---|
| Emerging engineering | 2006 | 5.07 | 2006 | 2016 | |
| Talent cultivation | 2006 | 3.95 | 2006 | 2016 | |
| Undergraduate | 2006 | 1.62 | 2015 | 2017 | |
| OECD | 2006 | 1.92 | 2016 | 2018 | |
| Core competencies | 2006 | 1.55 | 2018 | 2020 | |

**Figure 11.**
Burst terms in CNKI articles.

### 4.4. Analysis of Research Evolution

A time-zone view of keywords was generated in order to clarify the evolution of the research. It mainly used the time dimension to represent the dynamic evolution of trending topics. The time-zone map of the SSCI and CNKI databases (see Figures 12 and 13) indicated three periods of research on global competence. The initial period was before 2010, the initial exploration period was from 2011 to 2016 and the development period was from 2017 to the present.

In the early period (before 2010), ' global competence' was referred to 'global competitiveness' or the development of abilities that might stand out in a global marketplace. For example, Chisholm [13] and Cutler and Borrego [14] focused on engineering. Saee [15] laid emphasis on hotel and tourism services and Pottie and Hostland [16] were more concerned

about global competence training for medical students. In this research, the most representative was Lambert [1] who proposed five elements of competence: knowledge, empathy, support, foreign language ability and job performance. Similarly, Hunter [17] three dimensions and 17 indicators and Schejbal and Irvine [18] three dimensions and 22 indicators were also seminal. Chinese scholars [19] refer to the exploration of the connotation of global competence during this period as "module-element" logic which borrows from the traditional research approach of "competency" in the field of human resources to uncover the basic modules and fundamental elements of "Global Competence".

The second stage was the initial exploration period (2011-2016). At this stage, researchers began to think about the relationship between the elements of global competence and explore practical paths on this basis. For example, the Global Competence Model™' consists of eight dimensions that were grouped into external readiness and internal readiness, it visually represents the specific combination of knowledge, skills and attitudes necessary for global competence [20, 21] and on this basis, it developed and designed the 'Global Competence Aptitude Assessment'(GCAA) which established a solid foundation to put theories into practice. Meanwhile, the book 'Educating for Global Competence: Preparing our Youth to Engage the World' authored by Mansilla and Jackson [22] clearly pointed out the steps of global competence development [23]. It also inspired researchers to examine the development of global competence [23] and explore how to cultivate global competence in the teaching of some basic subjects such as chemistry [24], physical education [25], language learning [26] etc.

The third stage was the development stage (2017-present). This stage was marked by the joint publication of the PISA Global Competence Framework by the Organization for Economic Cooperation and Development (OECD) and the Graduate School of Harvard University [2]. Global competence has been widely disseminated and paid attention to in countries worldwide during this period. The research studies are characterized by: 1) reflecting and reviewing the OECD Global Competence Framework [27-29], sharing relatively rare cases of cultivating global competence or the thinking and practice of various countries [30-32] and further exploring the effective methods and influencing factors for cultivating global competence [33-36].
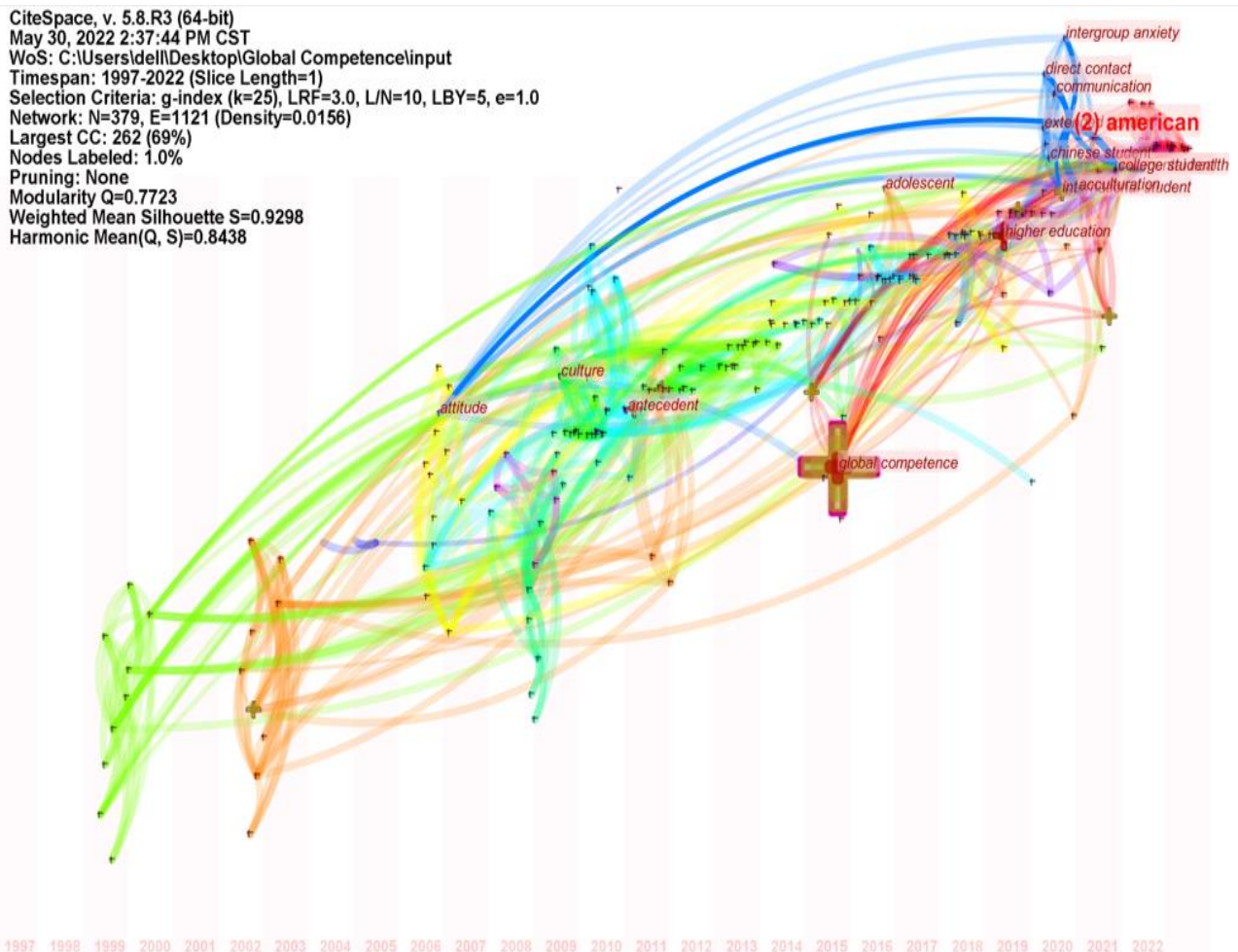


**Figure 12.**
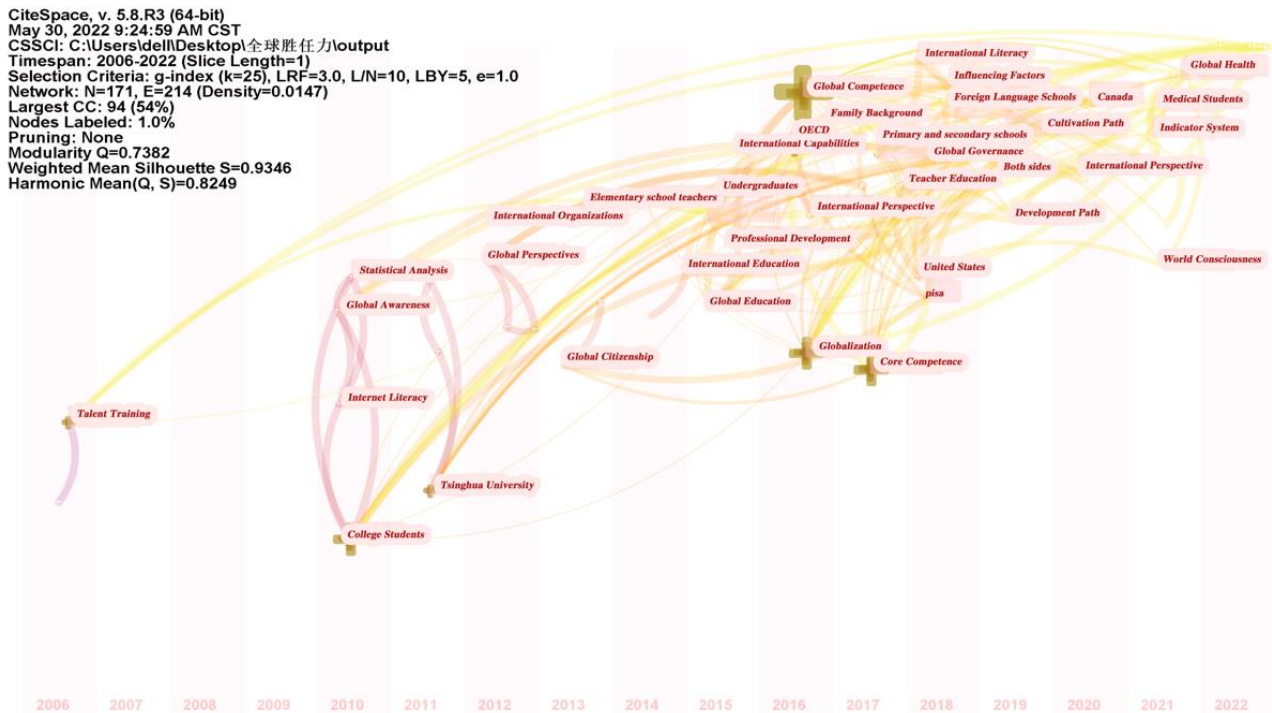Time-zone map of global competence keywords in SSCI articles.

**Figure 13.**
Time-zone map of global competence keywords in CNKI articles.

## 5. Research Outlook

Although 'global competence' has been the trend of talent cultivation worldwide, the current research on global competence is not sufficient. As far as China is concerned, the idea of global competence has only been practiced in a few domestic educational institutions. There has not been enough focus on developing students' global competency and there is not yet a formalised method for educating for it or evaluating it. Future research can focus on the following aspects:

Build a theoretical framework for localization: Chinese academics have recently given this topic greater attention. However, the majority of them are sorting out and introducing foreign achievements. According to Liao, et al. [37] and Tsinghua University's proposal from 2018, "global competency" is the capacity to successfully learn, work and interact with others in a multicultural environment. According to Mansilla and Wilson [38], developing global competence in the context of Chinese culture involved self-cultivation, a lifelong process of establishing a moral personality and the study of ways to improve the world. Mansilla and Wilson [38] of Tsinghua University focused on the "virtue" in traditional Chinese culture from the viewpoint of the connotation of global competence. In the future, on the basis of following the fundamental task of 'cultivating people by virtue' and under the guidance of the vision of a community with a shared future for mankind, it is necessary to actively absorb excellent local culture, build a theoretical system suitable for the local area and clarify the connotation and extension of global competence.

The second is to develop scientific and reasonable assessment tools for global competence that are appropriate for the local area. Evaluation is an important part of cultivating global competence and reasonable assessment tools are an important guarantee for the evaluation work. At present, some scholars have paid attention to the status quo of Chinese students' global competence and designed corresponding assessment tools. For example, Lei and Wen [39] designed the 'Adolescent Global Competence Assessment Scale ' based on Hunter's theoretical model. Tang, et al. [40] compiled the 'Global Competence Assessment Questionnaire for Undergraduate Students' with reference to the OECD's theoretical framework. However, their designs were based on the theoretical framework of Western scholars and have not yet formed an influential, scientific and reasonable assessment tool appropriate for the local area.

The third aspect involves proactive exploration of practical pathways. The contemporary world is experiencing an era of unprecedented transformation, characterized by the "VCUA era" (VCUA representing volatile, uncertain, complex and ambiguous conditions) [41]. Consequently, it is imperative to focus on and cultivate students' global competence. While certain scholars have directed their attention to teaching methodologies associated with global competence [34, 35][42, 43], achieving a consensus on the significance of fostering students' "global competence" remains a challenge within the educational community, unlike other competencies such as "scientific literacy." Notably, in China, only select educational institutions have embarked on efforts to cultivate students' global competence. Thus, the pursuit of effective and practicable pathways is poised to emerge as a prominent area of investigation in future research endeavours.

## 6. Conclusion

In this study, 229 (SSCI) and 224 (CNKI) papers on global competence in the SSCI database (1997-2022) and the CNKI database (2008-2022) were studied. With the help of bibliometric methods and the information visualization and analysis software cite Space, the current status and trends of global competence studies were examined and the following conclusions were drawn:

(1) The Journal of Studies in International Education has a high citation frequency and centrality which shows that it has a wide academic influence on global competence and scholars should pay more attention to the articles published in this journal.

(2) esearch on global competence in the SSCI database is dominated by the United States, China, the United Kingdom and Germany with the United States taking the absolute lead in terms of the number of articles published and the level of research. Although China ranks second in terms of the number of articles published, the international influence of the literature is weak.

(3) In the SSCI database, among the top ten institutions, three were from China and three from the United States while the SSCI database and the CNKI database have insufficient influence among institutions and the cooperation among institutions is insufficient too.

(4) The co-occurrence of keywords analysis indicated that 'global competence' 'education', 'model', 'globalization' and 'global governance' were important topics.

(5) In terms of research evolution, there are three periods of research on global competence. In the early period (before 2010), scholars borrowed the traditional 'competence' research ideas in the field of human resources to explore the basic modules and basic elements of 'global competence'. In the initial exploration period (2011-2016), researchers began to think about the relationship between the elements of global competence and explore practical paths. In the development stage (2017present), catalysed by the influence of the OECD and the ranking of countries' PISA test results, global competence has been widely disseminated.

Young people today must not only learn to participate in a more interconnected world but also appreciate and benefit from cultural differences [2]. The global outbreak of the new pneumonia epidemic since 2020 has touched the reef under the wave of globalization. In this era of counter-globalization, unilateralism and protectionism, the meaning of education will become narrow if we only emphasize the interests of one individual or one group.

By visualizing the literature based on the global competence field, collaborations, research hotspots and the latest trends can be seen to provide a better reference for scholars' research in related fields. It also suggests to relevant scholars that although the publication of the PISA Global Competence Framework promotes the popularization of global competence in education in various countries, the current research based on global competence is not sufficient. On the one hand, the structure and connotation of global competence as a highly integrated competency is still controversial. Countries, institutions and individuals can explore these issues and pay attention to improve the quality and impact of research by strengthening exchanges and cooperation.

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