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Review Article

Bibliometric Analysis of Cooperative Learning (1974–2023)

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Abstract
The importance of cooperative learning in achieving educational goals cannot be overlooked. According to existing literature, cooperative learning methods have proven to be effective in enhancing student achievement and fostering collaboration among them. A study conducted a comprehensive bibliometric analysis spanning the period 1974–2023 to explore the status and trends of cooperative learning implementation. In this bibliometric analysis, Samples were drawn from 4,367 refereed journal articles in the Scopus database. The research findings encompass several key points, including the peak publication in 2022 with 379 papers, the dominance of the keyword "cooperative learning," the work of Dorigo, M and Gambardella, L.M as the most frequently cited documents, and David W. Johnson as the most prolific author. Journals such as the Journal of Chemical Education, Sustainability Switzerland, and Primus were also classified among the best, as well as institutions like the University of Minnesota Twin Cities, Arizona State University, and The University of Queensland. Furthermore, the United States and China are recognized as the most influential countries in the development of cooperative learning. The study's conclusion provides a valuable contribution by presenting a comprehensive overview, mapping the scientific landscape, and offering directions for the future development of this teaching method.

Keywords: Bibliometric analysis, cooperative learning, research trends

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1. INTRODUCTION

Learning is a fundamental biological capacity that undergoes further development in humans compared to other living beings (Illeris, 2018). Therefore, humans are intrinsically created and destined to be inevitable learners engaged in the continuous activity of gathering and acquiring knowledge. Several perspectives in contemporary society indicate that every individual is practically compelled to be a learner. In almost every country, the obligation to learn takes place for several years, involving the acquisition of various new knowledge beneficial for everyday life (Hamad et al., 2018). In this context, efforts and strategies are required to achieve learning goals. One effective method is to pay attention to and prepare for the learning process, as an efficient learning process will result in optimal learning quality (Münchow & Bannert, 2019).

In engaging students in the learning process, teachers have a variety of strategies at their disposal, one of which is implementing cooperative learning

models. Cooperative learning encompasses several techniques that involve small groups of students working together as a team to address challenges, complete tasks, create products, and achieve common goals (Coleman & Gallagher, 1995). Cooperative learning requires careful planning of learning tasks so that students can act as resources for each other to achieve learning objectivesm (Shevin, 1994). The approach using cooperative learning involves various strategies and structures that integrate student collaboration to enhance learning, utilizing principles of positive interdependence, individual accountability, heterogeneous grouping (with students of various skill levels), interaction in a supportive environment, and equal participation opportunities for all students (Johnson & Johnson, 1989). Therefore, cooperative learning is not just a method but a key to unlocking deep learning while fostering respect and friendship among students from different groups (Slavin, 2014).

Numerous studies have been conducted on cooperative learning, spanning from elementary school to higher education. To the best of our knowledge, there has been no bibliometric study on cooperative learning in the last two years. Therefore, this research is conducted to gather more comprehensive information and data, Requiring an in-depth examination of research advancements over the past twenty years concerning cooperative learning. This study employs a bibliometric analysis approach. Bibliometric analysis is a method to investigate the evolution of a research domain (Donthu et al., 2020). Generally, bibliometric analysis is used in various disciplines and focuses on quantitative studies (Heersmink et al., 2011). The purpose of this examination is to reveal research endeavors across time, recognize notable authors, and their affiliations (Aria & Cuccurullo, 2017).

In the bibliometric analysis of this research, the researcher utilizes the Vosviewer application, and the analyzed data is sourced from the Scopus database. Scopus serves as the most extensive database of peer-reviewed literature, incorporating bibliometric tools to effectively monitor, evaluate, and portray research. It encompasses over 22,000 titles derived from a diverse array of more than 5,000 global publishers (Elsevier, 2014). Conducting an analysis of peer-reviewed journal articles recorded in this leading database provides researchers with the opportunity to comprehend and identify the most crucial trends in their field of study.

1.1 Aim of the Study

This research aims to comprehensively explore the dynamics and recent trends in the cooperative learning model over the past two decades. The focus involves the analysis of annual production, prevalent keywords, documents with the highest citations, authors with the highest productivity, journals with the highest activity, institutions with the highest productivity, and countries significantly contributing to this research. By examining recent peer-reviewed journal papers on cooperative learning in the context of education, The objective of this research is to enhance the current body of literature by examining prevailing trends and patterns in the publication of cooperative learning.To guide this research, several fundamental questions are posed as follows:

RQ1: Since 2003 until 2023, how many publications have been issued regarding cooperative learning?
RQ2: Which keywords appear most frequently in authors' publications on cooperative learning?
RQ3: Which research document is most frequently cited by authors in the context of cooperative learning?
RQ4: Who is the most cited author in publications related to cooperative learning?

RQ5: Which journal is the most active in generating research papers in the field of cooperative learning?
RQ6: Which institution has contributed the most to publishing publications on cooperative learning in the last 49 years?
RQ7: Which country is the most productive in generating research papers on cooperative learning?

2. METHODS

2.1 Study Design

This comprehensive analysis is designed to comprehend the evolution of cooperative learning. To achieve this goal, we extracted scientific literature from the Scopus database for the period 1974–2023. In this bibliometric study, we adopted the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analyzes) guidelines developed by Moher et al., (2009) to present a comprehensive overview of the literature on cooperative learning. The complete process of performing a bibliometric mapping analysis following the PRISMA protocol is outlined in Figure 1. Bibliometric analysis can provide systematic information detailing quantitative publications, assisting researchers in identifying trends and patterns of research in specific domains.

2.2 Procedure

The materials examined in this study were obtained from the Scopus database (https://www.scopus.com/) on October 5, 2023. The identification process included inputting the keywords “cooperative learning” into the database. Various variables were scrutinized, including publication language, keywords, publication year, cited documents, active journals, cited authors, productive journals, and productive countries. Quantitative analysis was performed on the frequency of each variable to discern trends in the field. The search did not impose specific time constraints, and the bibliometric analysis covered documents published throughout the years. The earliest article on cooperative learning dates back to 1974, and a total of 7,525 papers from 1974 to 2023 were retrieved after the initial exploration.

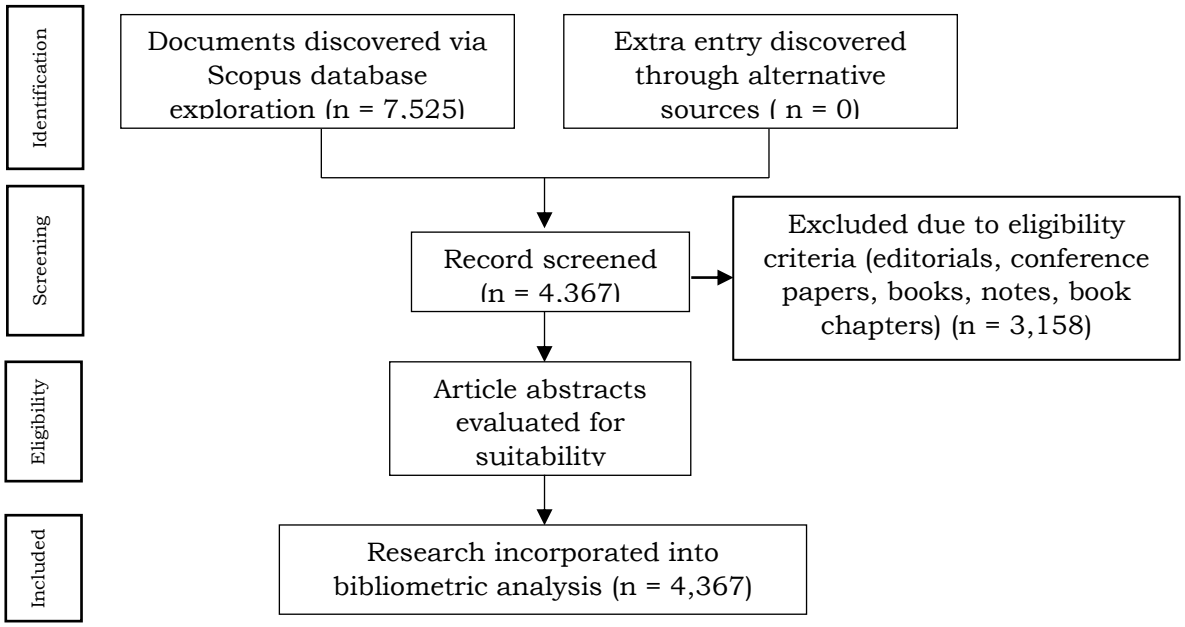

Figure 1. PRISMA Flow Diagram of the Present Study

In this evaluation, materials were precisely categorized as journal articles, with editorials, books, conference papers, book chapters, corrections, theses, and letters being excluded. Scopus filters were used to remove 3,158 irrelevant items, encompassing editorials, comments, and book reviews. Following the exclusion of documents not pertinent to the research objectives, a final set of 4,367 articles was derived. Citation information, bibliographies, abstracts, and keywords for each article were downloaded, and the files were subsequently uploaded to the VOSviewer application.

2.3 Data Analysis

To address our research inquiries, we conducted a meticulous examination of the final articles with the goal of extracting pertinent data. Throughout the analytical process, we closely scrutinized the data. For the bibliometric analysis, we retrieved data sourced from the Scopus database and converted it into comma-separated values (.csv) and research information systems (.ris) files. Subsequently, we conducted various analyses, including descriptive statistics, citation analysis, and co-citation analysis. Descriptive statistics, such as frequency and percentage, were employed to assess the outcomes. We showcased quantitative data, including annual publication growth, sources with the highest publication volume, and institutions or authors with the highest productivity. Citation analysis centered on the frequency of an author's citations in other works indexed in Scopus. Each individual identified as an author in the sampled papers was equally counted to determine the contribution of each paper. The bibliometric analysis, as a quantitative method, integrated co-authorship, co-occurrence of keywords, citations, bibliography merging, and other techniques to ensure accuracy.

To visually represent and analyze networks, we utilized VOSviewer, a widely utilized computer software. This tool aided in collecting, analyzing, creating, and visualizing bibliographic features in our research. VOSviewer was specifically employed to generate network visualizations and graphical representations of frequently utilized keywords, terms in abstracts, and conducted citation and co-citation analyses within the chosen papers. The software was used to visualize the occurrence of author keywords, author bibliography merging, and country bibliography merging.

The selection of VOSviewer software (van Eck & Waltman, 2010) for this study was motivated by its widespread use in publications employing bibliometric analysis. Moreover, Microsoft Excel was utilized to present tables and graphs related to publication language, annual publication count, highly referenced documents, prolific authors, pertinent journals, prolific institutions, and engaged countries.

3. FINDINGS

3.1 Annual Production

In addressing RQ1, we illustrate the yearly scientific productivity concerning cooperative learning. The findings reveal fluctuations in the publication count over the years, reaching its zenith in 2022 and hitting the lowest point in 2003. Notably, there is a substantial surge in 2022, with the number of published documents being eight times more than that recorded in 2003, as depicted in Figure 2.

The evolution of literature on cooperative learning from 2003 to 2022 reflects a consistently upward growth trajectory, reaching its zenith in 2022 with a total of 379 articles. The most recent data gathered for this review, as of October 2023, shows a total of 229 articles, and it is anticipated that scholarly contributions will continue to expand. The volume of research evidence in this field consistently shows a robust

growth pattern, reflecting a positive response from the academic community towards cooperative learning up to the current time. The determination coefficient (R2) of 0.93 attests to the reliability of the exponential trend line. However, it is noteworthy that the number of citations fluctuates each year, with the highest citation peak over the past two decades recorded in 2004, totaling 3,112 citations (13.29%).

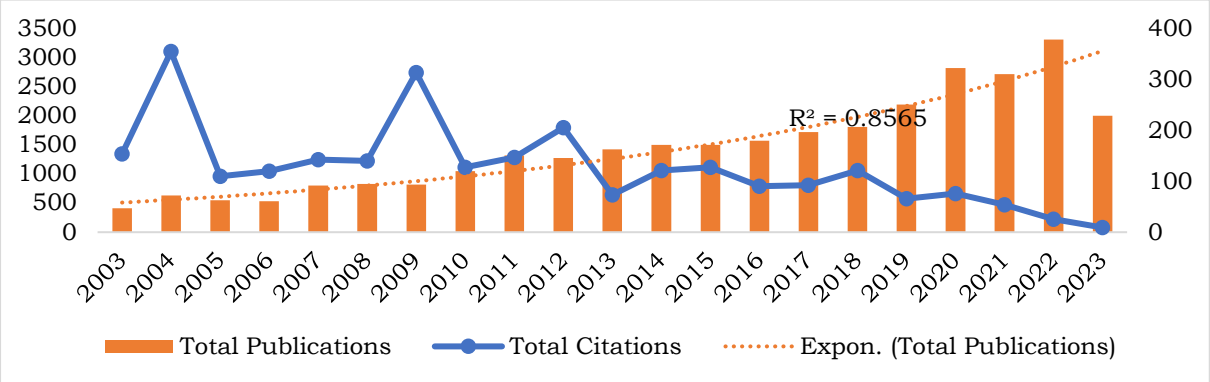

Figure 2. Evolution of Publication and Citation (2003–2023)

3.2 Most Used Keywords

Addressing RQ2, we examined the frequency of each keyword to identify commonly used terms in the published articles. This analysis involved nodes representing terms, with the distance between nodes indicating the relationships among terms, as described by De-Marcos et al. (2014) The size of the words in the analysis reflects both their frequency in the compiled research and the strength of their associations with other words. The visualization of keyword occurrences is presented in Figure 3. Using the VOSviewer application, we set the minimum occurrence of keywords to 5, resulting in the automatic selection of 458 keywords. The analysis revealed twelve clusters on the visualization map. The most frequently used keyword is “cooperative learning,” occurring 1,571 times with a total link strength of 2,299. Additionally, the keyword “collaborative learning/cooperative learning” is also prevalent, appearing 548 times with a total link strength of 3306.

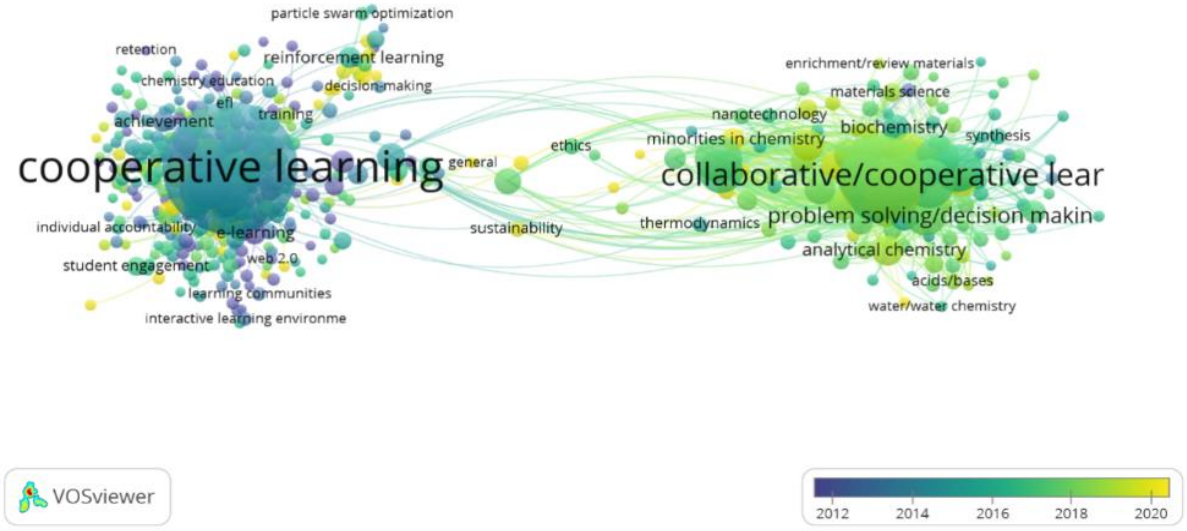

Figure 3. Map Depicting the Co-Occurrence of Author Keywords

3.3 Most Highly Cited Document

Concerning RQ3, we identified and presented the paper with the highest citation count in Table 1. This table showcases papers that have garnered the highest citation frequencies among cooperative learning publications since 1974.

Table 1. Top 10 Most Cited Documents

Authors	Title	Year	Source title	Cites
Dorigo M.; Gambardella L.M.	Ant colony system: A cooperative learning approach to the traveling salesman problem	1997	IEEE Transactions on Evolutionary Computation	6574
van den Bergh F.; Engelbrecht A.P.	A cooperative approach to participle swam optimization	2004	IEEE Transactions on Evolutionary Computation	1869
Crouch C.H.; Mazur E.	Peer Instruction: Ten years of experience and results	2001	American Journal of Physics	1589
Cohen E.G.	Restructuring the Classroom: Conditions for Productive Small Groups	1994	Review of Educational Research	1313
Johnson D.W.; Johnson R.T.	An educational psychology success story: Social interdependence theory and cooperative learning	2009	Educational Researcher	1057
Strayer J.F.	How learning in an inverted classroom influences cooperation, innovation and task orientation	2012	Learning Environments Research	899
Slavin R.E.	Research on cooperative learning and achievement: What we know, what we need to know	1996	Contemporary Educational Psychology	899
Alavi M.	Computer-mediated collaborative learning: An empirical evaluation	1994	MIS Quarterly: Management Information Systems	743
Slavin R.E.	Cooperative Learning	1980	Review of Educational Research	610
Ntoumanis N.	A self-determination approach to the understanding of motivation in physical education	2001	British Journal of Educational Psychology	596

Concerning the article with the most significant impact, determined by the highest number of citations, we selected the top 10 works. Upon scrutiny based on the year of publication, it was observed that all the top 10 papers were published after 1980. As delineated in Table 1, the paper with the highest citation count is titled “Ant colony system: A cooperative learning approach to the traveling salesman problem,” published in 1997. This paper introduces the Ant Colony System (ACS) as a distributed algorithm specifically designed to address the challenges posed by the traveling salesman problem (TSP). Within this framework, ants collaborate through a unique form of communication, facilitated by the deposition of pheromones on the edges of the TSP graph as they construct solutions. In the aforementioned article, the mean number of citations annually is 11.63.

3.4 Most Prolific Authors

Addressing RQ4, details regarding the top ten most prolific authors, determined by the highest number of publications within the realm of cooperative learning, are available in Table 2. It is crucial to emphasize that the volume of publications serves as an indicator of productivity.

Table 2. Number of Publications in the Top 10 Authors

Author	Institution	Country	N	H-index
Johnson, D. W.	University of Minnesota Twin Cities	US	56	49
Slavin, R. E.	Johns Hopkins University	US	34	52
Gillies, R. M.	The University of Queensland	Australia	30	33
Johnson, R. T.	University of Minnesota Twin Cities	US	27	32
Dansereau, D. F.	Texas Christian University	US	24	35
Roseth, C. J.	Michigan State University	US	17	24
Casey, A. J.	Loughborough University	UK	17	22
Fernández-Río, J	Universidad de Oviedo	Spain	16	28
Buchs, C	Université de Genève Faculté de Médecine	Switzerland	14	41
Chen, W	Xidian University	China	13	43

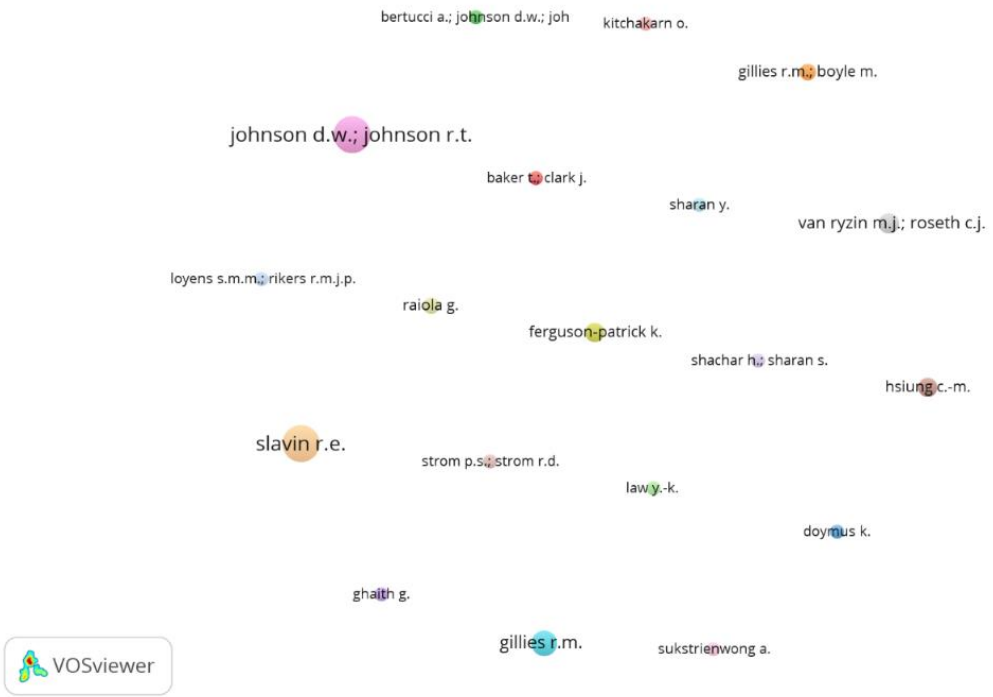

Figure 4. Collaboration Network of Author

It appears that David W. Johnson is the author with the highest number of publications, totaling 56 articles that have been published. Table 2 also showcases the most prolific authors according to the H-index. The H-index is a metric assessing the productivity and impact of a researcher's work within the publications indexed in the Scopus database (Hirsch, 2005). Notably, Robert E. Slavin emerges as the author with the highest H-index, registering at 52. Additionally, this section entails

an examination of the collaboration network among authors within the dataset, visually represented in Figure 4.

A minimum of 3 documents is established as the threshold for individual author contributions, and authors must have a minimum of 20 citations. Figure 4 illustrates the comprehensive collaboration network encompassing 19 authors. As observed in this visualization, each node varies in size, and clusters are disconnected from each other. The larger the node size, the more articles are produced by that author. In conclusion, it can be interpreted that collaboration among researchers in the field of cooperative learning is not yet robust. In fact, research in this domain is generally conducted in small groups consisting of a single author.

3.5 Most Relevant Journals

In addressing RQ1, we illustrate the yearly scientific productivity Concerning RQ5, the analysis provides information on the top 10 journals with the highest productivity, considering metrics such as the number of publications, H-index, Scopus quartile (Q), SCImago Journal Rank (SJR), and home publishing. The findings are then concisely summarized in Table 3.

Table 3. Top 10 Most Active Journals

Journal	N	H-index	Q	SJR 2022	Publisher
Journal of Chemical Education	600	95	Q2	0.56	American Chemical Society
Sustainability Switzerland	42	136	Q1	0.66	MDPI AG
Primus	37	22	Q3	0.33	Taylor and Francis Ltd.
Journal of Educational Research	33	86	Q2	0.65	Routledge
Education Sciences	33	40	Q2	0.61	MDPI AG
International Journal of Engineering Education	32	56	Q3	0.26	Tempus Publications
IEEE Transactions on Education	29	74	Q1	0.73	Institute of Electrical and Electronics Engineers Inc.
International Journal of Educational Research	28	75	Q1	1.02	Elsevier BV
International Journal of Emerging Technologies In Learning	27	39	Q2	0.54	International Association of Online Engineering
Journal of Educational Psychology	26	241	Q1	2.51	American Psychological Association

According to Table 3, the Journal of Chemical Education appears to take the lead in research on cooperative learning, achieving remarkable success with 600 published documents. Meanwhile, the Journal of Educational Psychology is equally impressive with consecutive highest H-index and SJR rankings of 241 and 2.51, respectively. To provide additional details, the SJR value signifies the average weighted citations received by the source title within a single year. This all-encompassing data, including both H-index and SJR, undeniably underscores the significant influence and importance of academic journals in the field of cooperative learning. Notably, the majority of sources within the top 10 journals attain high positions in the Scopus journal ranking, spanning across Q1 (4), Q2 (4), and Q3 (2) categories. It is essential to emphasize that the Scopus Q index offers a clear overview of a journal's influence in a specific field, with Q1 being the highest rank and Q4 being the lowest.

3.6 Most Productive Institutions

Regarding RQ6, Table 4 provides an overview of the distribution of countries, types of institutions, and publication volumes from the top 10 most productive institutions. As shown in Table 4, the top 10 leading institutions contribute a total of 9.39% (n = 410) to the overall number of papers.

Table 4. Top 10 Most Prolific Institutions

Institution	Country	Type	N
University of Minnesota Twin Cities	US	Public	98
Arizona State University	US	Public	41
The University of Queensland	Australia	Public	40
Johns Hopkins University	US	Private	38
Purdue University	US	Public	38
Universidad de Oviedo	Spain	Public	37
Michigan State University	US	Public	37
University of Toronto	Canada	Public	32
Texas Christian University	US	Private	25
Bar-Ilan University	Israel	Public	24

Observing Table 4, the three most productive institutions in the field of cooperative learning are public institutions, namely the University of Minnesota Twin Cities (98), Arizona State University (41), and The University of Queensland (40). Meanwhile, as a private university, Johns Hopkins University holds the fourth position as the most productive institution with 38 works. Overall, only two private educational institutions are listed in the aforementioned table. As observable in Table 4, 80% of state universities dominate contributions in this domain. Out of the ten institutions mentioned, six are from the United States, while Australia, Spain, Canada, and Israel each have representation from one institution.

3.7 Prominent Contributing Countries

Addressing RQ7, Table 5 displays the top 10 countries with the highest scientific production.

Table 5. Top 10 Most Prolific Countries

Country	N of paper	%
United States	1701	38.95
China	310	6.87
Spain	300	6.87
United Kingdom	183	4.19
Taiwan	166	3.8
Turkey	148	3.39
Australia	144	3.3
Canada	139	3.18
Indonesia	134	3.07
Germany	116	2.66

Referring to Table 5, the top ten most productive countries contribute to 3331 papers or 76.50% of the total papers. The United States stands out as the country with the highest number of papers, reaching 1701 documents or 38.95%, followed by China, accumulating number of documents, which is 310 or 7.10%. In the end, the bibliographies of these countries are merged and presented. Each country must have a minimum of 20 documents and 10 citations to qualify. Automatically, 35 countries will be selected. The analysis involves determining the number of

publications and the total strength of links, and the outcomes are recorded in Figure 5.

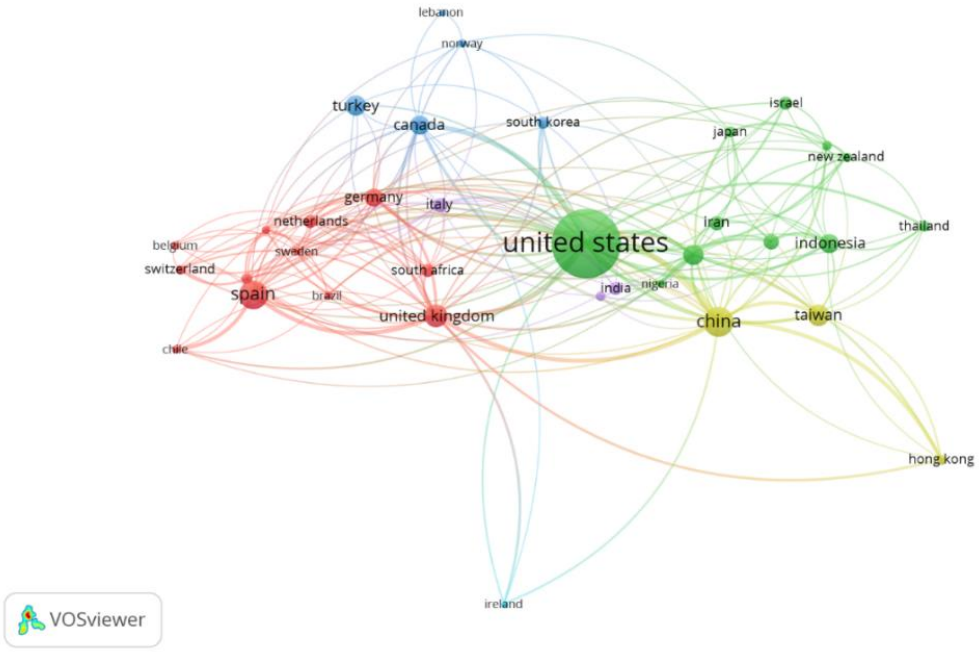

Figure 5. Collaboration Network of Countries

The data is presented in the Figure corresponding to Table 5. From a graphical perspective, different groups are indicated by different colors, revealing five interconnected groups represented by the colors red, green, yellow, blue, and purple. The top country on this list is the United States with 1701 papers and a total link strength of 170, followed by China (310 papers, 110 total link strength) and Spain (300 papers, 55 total link strength). Other recorded countries include Australia (146 papers, 52 total link strength), Canada (140 papers, 49 total link strength), Germany (116 papers, 47 total link strength), Indonesia (134 papers, 30), and so forth.

4. DISCUSSION

In this investigation, we employed the Scopus database to analyze the publication trends of cooperative learning from the inception of publications to the present (1974–2023). This bibliometric review offers a thorough insight into past research and identifies several potential avenues for future exploration in this field. The bibliometric analysis scrutinizes this article by detailing the previous bibliometric analysis. From the results obtained, a total of 7,525 documents were collected, which were then refined to include articles, conference papers, and books, resulting in a total of 4,367 analyzed documents. Howard Lamson popularized cooperative learning research in 1974. In 2022, cooperative learning publications peaked at 379 documents, while the citation count reached its zenith in 2004 with a total of 3,112 citations. Using the VOSviewer application, several clusters were identified in the visualization map shown in Figure 3. The most frequently used keyword is “cooperative learning” with 1,571 occurrences and a total link strength of 2,299. Additionally, the keyword “collaborative learning/cooperative learning” is also quite common, appearing 548 times with a total link strength of 3,306.

After examining the publication years, the top 10 papers were found to be published after 1980, with the highest rank held by the United States. This is not surprising considering these countries have substantial research and development budgets (Asriadi et al., 2023). Research on cooperative learning has become one of the favorite topics among researchers in recent years. According to Slavin and Oickle (1981) an author from the United States with the highest H-index, cooperative learning is described as a learning model where students learn and work collaboratively in small groups consisting of 4 individuals, stimulating students to be more enthusiastic in their work. The goal of Cooperative Learning is to enhance student communication, avoid competitive attitudes, and reduce individualism, especially for low-achieving and high-achieving students (Johnson & Johnson, 2009). However, despite the increased number of publications on cooperative learning, collaboration among researchers in the field of cooperative learning has not been fully realized (see Figure 4).

Journal of Chemical Education leads as the top publisher in the field of cooperative learning, ranking first with 600 published documents, followed by Sustainability Switzerland with 42 documents, and Primus in the third position with 37 documents. The majority of sources in the top 10 journals receive high rankings in the Scopus journal ranking, including categories Q1, Q2, and Q3. When viewed from the institutional perspective, the most productive institutions in the field of cooperative learning are public institutions, namely the University of Minnesota Twin Cities (98), Arizona State University (41), and The University of Queensland (40). Meanwhile, as private universities, Johns Hopkins University has 38 works, and Texas Christian University has 25 works. From the top 10 institutions, it is evident that 80% are state universities dominating contributions in the field of cooperative learning from the United States, Australia, Spain, Canada, and Israel.

The top ten most productive countries contribute approximately 76.50% or 3331 papers out of a total of 4367 papers compiled from Scopus on cooperative learning. The United States occupies the top position with 38.95% of the total documents, followed by China (7.10%), Spain (6.87%), and Germany securing the 10th position with 2.66%. Ultimately, the bibliographies of these countries are merged and presented in Figure 5. The three top countries in this list are the United States with 1701 papers, followed by China (310 papers), and Spain (300).

5. CONCLUSION AND LIMITATIONS

In summary, this study focuses on the bibliometrics of cooperative learning from 1974 to 2023. A total of 7,525 documents were obtained and then filtered down to 4,367 articles based on the researchers' criteria. Throughout the period from 1974 to 2023, the highest citation count occurred in 2003 with 3,112 citations, while 2022 marked the highest publication count at 378. The Scopus database was utilized with the keyword "cooperative learning." Dorigo & Gambardella (1997) emerged as the most frequently cited authors with a total of 6,574 citations. Among active publishers, David W. Johnson contributed with 56 publications. The University of Minnesota Twin Cities stood out as the most contributing institution, and the "Journal of Chemical Education" was identified as the journal frequently publishing articles on cooperative learning. The United States played a prominent role in contributing to this topic.

However, the study has some limitations, such as relying solely on the Scopus database without considering other data sources like Web of Science. The applied database filter encompassed only documents, books, and conference proceedings. It is recommended for future research to explore more diverse data sources.

Additionally, the concept of cooperative learning in this study remains somewhat unspecific, suggesting further research could focus on specific school levels, such as cooperative learning in high schools or universities.

Conflict of Interest

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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