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Bibliometric Analysis of The Term 'Cooperative Learning Chemistry'

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Abstract

Bibliometric analysis related to cooperative learning methods is a new theme and has never been studied. The research pattern related to cooperative learning methods is still uncharted and it is not known how effective it is when analyzed from several previous studies. Cooperative learning chemistry concepts provide suitable solutions for improving activity of students and chemistry learning outcomes. This study aims to demonstrate an all-compassing bibliometric analysis in the terms and concepts of 'cooperative learning'. The articles evaluated were identified through Google Scholar database as well as the perish or publish software. Furthermore, scimagojr.com (Q1, Q2, Q3, and Q4) was adopted during scanning, and a total of 19 articles were analyzed from 7 reliable journals. This research using literature review method. The type of research used a bibliometric review in five measures method pioneered. These five steps describe the keyword of the search as cooperative learning chemistry, initial search results, improvement of these results, collection of initial data statistics and data analysis, as explained below. The results showed the practice of cooperative learning in chemistry is being widely accepted. However, there is a need for further research and Collaborations on inter-regional studies involving Asian scholars and developed nations in particular regions. The results showed that more than 75% of cooperative learning has a significant effect on learning outcomes. The learning model is an external factor that affects learning outcomes.

Keywords: Cooperative Learning Chemistry, Bibliometric Analysis

1. Introduction

There was an increase in interests towards cooperative learning during the early 1980s, particularly after the first meta-analysis was published. This includes 122 researches in influence of individualistic, competitive, cooperative goal structures on the productivity Student performance and accomplishment in North American school samples (Johnson & et al, 1981). According to the results, Cooperation was more than successful compared interpersonal championship or Individualist endeavors. Similarly, collaboration through Competition between groups was discovered toward produce better results compared to interpersonal competition or individualistic learning. Furthermore, no major distinctions were recorded among inter personal competition and independent achievement. Those reports have been also discovered to be consistent in all the subject areas (language, social studies, arts, reading, science, physical education, and mathematics), in every age group, and task comprising understanding of concepts, problem solving, reasoning, as well as categorizing.

The bibliometric study carried out will provide an overview pattern of how the cooperative learning method is carried out (Hinojo-Lucena et al., 2019). This will build systems and information networks related to the influence of cooperative learning methods on learning output. Bibliometric research studies can also be a reference for further research related to the effectiveness of cooperative learning in chemistry subjects. Analytical bibliometric research related to cooperative learning methods is a new theme and has never been studied (Karakus et al., 2019). Some analytical bibliometric research is more related to computer-based learning and e-learning, such as the theme of technology-enhanced learning in higher education (Shen & Ho, 2020), augmented reality research in education (Jiménez et al., 2019), Publication Trends in Physics Education (Jamali et al., 2017) artificial

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intelligence in higher education (Hinojo-Lucena et al., 2019). Bibliometric study related to cooperative learning in chemistry subjects is new and becomes the basis for research gap research. Bibliometric research in the learning method will describe the most effective patterns from the method in order to produce maximum learning output (Tibaná-Herrera et al., 2018).

However, students must not be expected to automatically know how to cooperate upon grouping, and the lack of interpersonal dispute resolution on the part of members often causes a group to implode. These skills form the fourth crucial component of successful cooperative learning, and therefore, it is explicitly necessary to be practiced (Older pupils) and impacted (Younger kids). Furthermore, several studies on influence Structured and unstructured communities of cooperatives on student behavior, also interaction discovered students trained to practice cooperation are better at including, respecting and considering the opinions of others, and teaching fellow students, compared to the non-participating counterparts (Gillies, 2003b, 2003a, 2004, 2006, 2008; Gillies & Ashman, 1996, 1998). Meanwhile, a report on the aftermath of club prepare on the accomplishment of 48 seniors and college students in middle school, discovered greater achievement was possible through participating in group processing discussions (Jonassen et al., 1999). In this study, group processing refers to ensuring all participants engage in summarizing, exchanging and discussing ideas and information, as well as ascertaining all members support the decisions made. In addition, group processing enhances respect among members, and consequently, increases the commitment, acceptance of group norms, and collective identification among members (Johnson, & Johnson, 2009).

For the past twenty years, research related to chemistry teaching has shown most chemistry students, irrespective of the level, including graduates, Learning the basics of chemistry through repetition, Using and addressing chemistry questions using algorithms. Numerous students perform satisfactorily in examinations, however, the interviews conducted showed large misconceptions about chemical phenomena on the part of students. The increasing problems encountered while sourcing for effective teaching techniques, with regard for individual differences, are therefore significant to educators (Bodner & McMillen, 1986). Meanwhile, several studies have emphasized the significance of the student's role in learning (Brown & Campione, 1986; Yager et al., 1986). Based on constructivism, inter-student interaction, and interactions with teachers or learning material, are crucial for optimum learning (Bishop, 1985; Clement, 1991; Jaworski, 1992; Webb, 1991).

Cooperative learning refers to instructional strategies or grouping arrangements, where students are split into heterogeneous groups for the purpose of completing instructional activities. This way, every group A community member is contributing to the initiative (Artawan, 2020). Various roles are also delegated to individual participants; however, the group activity is performed collectively. Furthermore, this learning technique emphasizes both academic and social development, because the interaction between group members stimulates cooperation and collective success, and this success is dependent on learning the relevant concepts and information (Fauzi et al., 2017). Cooperative learning composes four vital components these are, (a) positive interdependence, where every member participates Achieving the mutual target. (b) Accountability for persons, where all members are accountable for individual learning, thus contributing to collective target. (c) cooperation, where the Students address the issue, cooperate, and clarify problems, also (d) evaluation, where each member reviews the ability to cooperate optimally and perform any requires changes (Paulson, 1999).

Cooperative learning therefore, utilizes student grouping and cooperation to augment both individual and group learning (Mufarizuddin, 2018). Students are grouped, given instructions, and assigned with a task gives directions and an assignment. Subsequently, the team members collaborate until the group completely understands and has performed the task at hand (Johnson DW & Johnson, R, T., 1991). This cooperation benefits all group members. The mantra is "we sink, or swim together", and positive interdependence is a major result of this learning technique. In the words of Emile Durkheim, the father of sociology, "A group is only as strong as the weakest member" The concept of positive

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interdependence states the students are bound to succeed in cases where the entire team's goals are achieved (Deutsch, M., 2002; Johnson & Johnson, 2005) No one member is self-sufficient, as success is dependent on individual and group effort alike, and this is a major basic concept.

The cooperative learning strategy is useful for abstract chemistry concepts including energy, matter, and atomic structure. For optimal results, the teacher ought to emphasize on the roles of group members, to ensure better interpersonal interactions. This way, problem-solving and idea representation will provide the necessary confidence for accomplishing assigned tasks. This study uses independent variables of teaching methods, including Conference-discussion and collective learning, based on "Numbered-Heads-Together model". Subsequently, two chemistry material (problem, and power, as well as Atomic Composition) were introduced by researchers. The technique of lecture-discussion was used in one group, while the remaining groups utilized the strategy of "Numbered-Heads-Together". Meanwhile, the dependent variable group comprised student cognitive achievements, self-efficacy as well as attitudes towards Chemistry (Lago, M.R.G., and Nawang, 2007).

2. Method

This study uses a literature review method. Literature review is a systematic, explicit and reproducible method for identifying, evaluating and synthesizing research results and ideas that have been produced by researchers and practitioners. The data collection method used in this research is secondary data documentation method. The documentation method is a method of collecting data by finding or extracting data from the literature related to what is meant in the formulation of the problem. The data analysis used in this study was annotated bibliography analysis. Annotation means a simple conclusion from an article, book, journal, or some other written source, while bibliography is defined as a list of sources from a topic. From these two definitions, bibliographic annotation is defined as a list of sources used in a study, in which each source is given a conclusion regarding what is written in it. This study used a Bibliometric review in five measures method. These five steps describe the keyword of the search as cooperative learning chemistry, initial search results, improvement of these results, collection of initial data statistics and data analysis. In the process of this initial search, the range of years where not included, in order to enable researchers, discover the time the term was coined. The oldest journal utilities (from 1975), was discovered to be irrelevant, with regard to include the term cooperative learning language. Table 1 shows the remaining ten articles obtained from the initial search. The oldest documents (not contained in table 1) meeting the criteria, were published in 1995.

Table 1. Top ten papers from PoP found (unrefined search)

Author/s	Title	Year of publication
RL Oxford	Cooperative learning, interactive learning and interaction: Three language classroom communicative threads that improve	1997
B Kramarski, ZR Mevarech	Enhancing mathematical Classroom reasoning: The consequences of voluntary behavior learning and metacognitive training	2003
RM Felder, R Brent	Effective strategies for cooperative learning	2001
Z Dörnyei	Psychological processes in cooperative language learning: Group dynamics and motivation	1997
F Van den Bergh, AP Engelbrecht	Cooperative learning in neural networks using particle swarm optimizers	2000
LR Antil, JR Jenkins, SK Wayne	Cooperative learning: Prevalence, conceptualizations, and the relation between research and practice	1998

Author/s	Title	Year of publication
RE Slavin, R Cooper	Improving partnerships between groups: Lessons learnt from cooperative learning projects	1999
F Ke, B Grabowski	Gameplaying for learning mathematics: cooperative or not?	2007
DW Johnson, RT Johnson	Cooperative Learning: Strengthening university education by drawing on validated theory in practice	2014
M Tsay, M Brady	A shared learning and teamwork pedagogy case study: Does working in teams make a difference?	2010

All articles deemed unsuitable based on the screening criteria, were excluded. Table 2 depicts the screening results. The articles deemed noteworthy were required to be at least 20 years old, to be utilized.

Table 2. Criteria for comprehensive search screening (see online version for colors)

Search screening	Number of articles
Not relevant (physics, mathematics, biology, language)	902
Not in English (Indonesia)	22
None from Scimago list	55
Q1-Q4	19
Total	998

Table 3. Ratio metrics

Data Metrics	Initial search	Refinement search
Query	Journal, cooperative learning chemistry	Journal, cooperative learning chemistry
Source	Google Scholar	Google Scholar
Papers	998	19
Citations	55,527	1,548
Cites/Year	1233.93	61.92
Cites/Paper	55.64	70.36
Authors/Paper	2.02	1.95
h-index	120	16
g-index	188	22
hI,norm	93	14
hI, annual	2.07	0.56

A total of 19 papers were selected out of 998 reputable journals (Q1, Q2, Q3, and Q4) obtained from Scimagojr website. Tables 3 show 976 articles were excluded after screening, and the initial search result metric data comparison, as well as the refined search results, respectively. The refined exploration results were download, save at Zotero software, also converted to RIS format, in order Inclusion of all important article-related advice, including title, names of writer(s), keywords, Abstract, and specifications of the journal (publication journal, Year of Release, issue, volume, and page numbers). These data subjected to analyses to categorize the articles based on year, publication source, and publisher. According to the maximum time range query, POP obtained 998 published between 1975 and 2020. Table 4 shows the results of the subsequent verification of reputability (as ranked by Scimagojr) selection based on screening criteria. Just 20 years of papers were published in the journals Q1, Q2, Q3, OR Q4. (1995-2020). In study performs Analysis of bibliometric for 'Cooperative Learning Chemistry' From the servers for GS. This was performed using the Software for PoP, developed and released by Tarma Research Software Pty Ltd-Melbourne (Heersmink et al., 2011) Version 7 was utilized, and this was carried out on 20 November, 2020. Subsequently, 998 papers with 55,527 citations

(1233.93/year), were initially obtained. After refining these results, 22 articles, 1,548 citations (61.92/year), were obtained.

3. Result and Discussion

Results

Based on the results, Q1, Q2, Q3, Q4 journals have considerable impact on citation-related metrics. Table 6 depicts the frequently cited articles as well as the authors. The report by Bowen, titled “A quantitative literature review of cooperative learning effects on high school and college chemistry achievement”, published during 2000, in the “Journal of Chemical Education” was discovered to have been cited by 357 authors, and is therefore the Article most often cited utilized in study. Meanwhile, the second article Cited most often in this article, is was the report of a study by Paulson (1999). This article It was published in the 'Chemical Education Journal' in 1999 and has been cited by 240 separate scholars. The second most quoted post was a report by (Fahimnia et al., 2015; Towns, 2013) on cooperative learning in physical chemistry. After the metrics, including citation frequency, were all accounted for, the results from the PoP software were subjected to analysis by the VOSviewer software, to discover the most frequently occurring. The keywords frequency is often regulated as described by 1, 5, 10, and 20, as well as other occurrences. The VOSviewer tool was developed by Van Eck and Waltman in 2010. It is used for bibliometric map visualization.

The bibliometric mapping was seen by this program on three separate visualizations, network, visualization (Figure 1), overlay visualization, also density visualization (Figure 2). In different clusters, the VOSviewer may identify keywords, while bullets reflect the strength of the keyword’s occurrence, thus providing an answer for the first question. After extracting from Titles of related papers and abstracts with a minimum of 2 occurrences, 195 terms were obtained, while only 25 items met the requirements. Subsequently, six clusters were identified. The first cluster comprised 5 items, and the term ‘performance’ was discovered to be the most frequently occurring (4). Meanwhile, the second cluster contained 4 elements, with ‘chemistry’ as the modal term (23), and the third comprised 4 items, with ‘quantitative literature review’ being the most frequently occurring term (3). In addition, the fourth cluster identified 4 frequently occurring elements, with ‘study’ being the modal term (7). The fifth cluster has 3 items and includes ‘experiment’ (3). The last identified 3 others words that occurred such as ‘strategy’ (5).

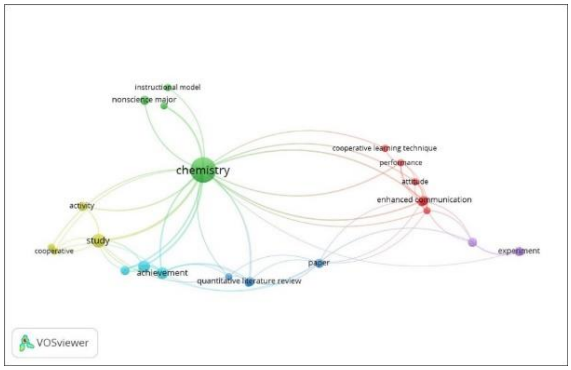

Figure 1. Network visualization mapping

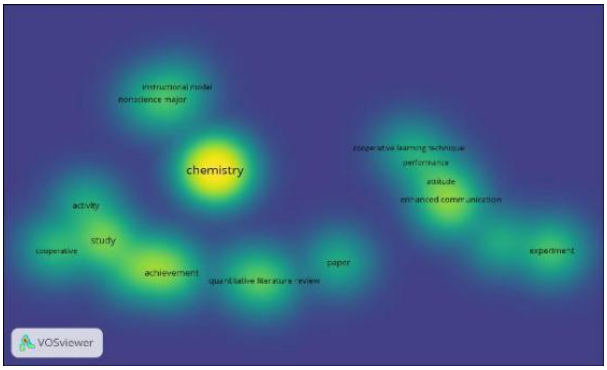

Figure 2. Visualization mapping

Each cluster identified keywords representing a chemistry cooperative learning-related research stream, and also depicted the related trends in these studies. These trends are also presented through the occurrence of certain specific term, therefore, providing answers for this study’s second main question, on the trend of cooperative learning chemistry research. ‘Student performance’, ‘chemistry’, quantitative literature review’, ‘study’, ‘experiment’, and ‘strategy’ are the most common words; ‘website’, ‘attitude’, and ‘project’ are

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rarely used words, and therefore, have potential for examination by future studies. These keywords are possibly even adopted in developing numerous topics (Towns, 2013). Table 4 shows articles with 40 or more citations.

Table 4. Articles with 40 or more citations

Citations	Per Year	Authors	Title	Year	Publication	Publisher
358	17.90	Bowen, C.W.	A quantitative literature review of cooperative learning effects on high school and college chemistry achievement	2000	Journal of Chemical Education	ACS
241	11.48	Paulson, D.R.	Active learning and cooperative learning in the organic chemistry lecture class	1999	Journal of Chemical Education	ACS
118	4.67	Dougherty, R.C., et all	Cooperative learning and enhanced communication: Effects on student performance, retention, and attitudes in general chemistry	1995	Journal of Chemical Education	ACS
111	4.63	Wright, J.C	Authentic learning environment in analytical chemistry using cooperative methods and open-ended laboratories in large lecture courses	1996	Journal of Chemical Education	ACS
102	4.25	Felder, R.M	Incorporation of a cooperative learning technique in organic chemistry	1996	Journal of Chemical Education	ACS
77	4.53	Carpenter, S., McMillan, T.	Incorporation of a cooperative learning technique in organic chemistry	2003	Journal of Chemical Education	ACS
63	2.74	Bowen, C. W., Phelps, A. J.	Demonstration-Based Cooperative Testing in General Chemistry: A Broader Assessment-of-Learning Technique	1997	Journal of Chemical Education	ACS
54	2.35	Dougherty	Grade/performance contracts, enhanced communication, cooperative learning and student performance in undergraduate organic chemistry	1997	Journal of Chemical Education	ACS
46	11.50	Warfa, A.R.M	Using cooperative learning to teach chemistry: A meta-analytic review	2016	Journal of Chemical Education	ACS

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Discussion

The results showed that the influence of cooperative journals on learning outcomes was the most sought-after and quoted as many as 357 authors. The majority of cooperative learning in quantitative research is experimental quantitative. The results showed that more than 75% of cooperative learning has a significant effect on learning outcomes. The learning model is an external factor that affects learning outcomes. The learning model refers to the approach to be used, including learning objectives, stages in learning activities, learning environment, and classroom management (Shachar & Fischer, 2004). Choosing a cooperative learning model by the teacher is a progressive step that has the courage to try new learning models to increase student activity and learning outcomes (Kyndt et al., 2013). The results showed that the majority of the research used was experimental with a quasi-experimental type by comparing it with other methods or conventional methods. Several other methods used as comparisons include the expository learning method, active learning, and problem-based learning (Sawyer et al., 2017). The results show that when compared to other methods, cooperative learning has several advantages in improving learning outcomes and learning activities in chemistry subjects. Children tend to be more active and communicative in learning when they form groups (Casey & Goodyear, 2015). When compared with the expository learning model, cooperative learning with the jigsaw type or STAD can improve the quality of children's personalities in terms of cooperation, mutual respect for other people's opinions, tolerance, critical thinking, and discipline. Cooperative learning also provides fostering a positive and constructive competitive spirit, because in the group, each student will be more active and really work.

The effectiveness of cooperative learning in increasing activities and learning outcomes cannot be separated from the several advantages of the method itself (Nam & Zellner, 2011). Students' cooperative learning methods do not rely too much on the teacher, but can increase confidence in their own thinking skills, find information from various sources, and learn from other students (Jalilifar, 2010). Cooperative learning can develop the ability to express ideas or ideas verbally and compare them with the ideas of others (Yusof et al., 2012). The cooperative learning model can help children to respect others and realize all their limitations and accept all differences (Oludipe & Awokoy, 2010). In chemistry lessons, children will think critically and problematic problems in chemistry (Warfa, 2016). The cooperative learning model can develop students' ability to test their own ideas and understanding, receive feedback (Canelas et al., 2017). Students can practice solving problems without fear of making mistakes, because decisions made are the responsibility of the group and can improve students' ability to use information and abstract learning skills to become real (Taştan Kirik & Boz, 2012). Furthermore, there are at least two limitations to this study. Firstly, the study is limited by the use of only a few keywords and a constrained database (GS) used to obtain articles. In addition, this research used structured applications (PoP software, VOSviewer, Zotero, Microsoft Excel), but the authors' tests are vulnerable to errors being added. Future experiments can also improve the sample size by expanding the keywords used and the database used. Also, the use of numerous software for bibliometric research, including BibExcel and HistCite, to compare the results of data analysis, is highly recommended for improved results.

4. Conclusions and Suggestions

This study reviewed 19 different publications related to the theme of Cooperative chemistry learning and chemistry learning articles were acquired with PoP software, from the GS database. The articles were obtained after screening the 998 articles initially collected and consist of article from Q1, Q2, Q3, and Q4 based on Scimagojr database. The disparities observed in this study provide directions for future cooperative learning techniques in chemistry, and reiterate and supports this study’s essential findings. Generally, the practice of cooperative learning in chemistry is being widely accepted. However, there is a need for further research, and Collaborations on inter-regional studies involving Asian scholars and developed nations in particular regions. The results showed that more than 75% of

cooperative learning has a significant effect on learning outcomes. The learning model is an external factor that affects learning outcomes.

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