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CONSTRUCTIVISM BASED E-LEARNING: A BIBLIOMETRIC ANALYSIS USING VOS VIEWER

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ABSTRACT

The concept of learning by doing in this digital era is of great importance for educational institutes as well as corporates. The purpose of this paper is to provide an extensive bibliometric literature review on 'constructivism' and 'e-learning'. Total 107 articles found in the Scopus database ranging from 2011 to 2021 were analyzed in this study. In this, study literature has been classified and visualized using VOSviewer software. This study has provided a keyword network, text data network, and network of countries where research on these topics has been carried out through visualizations. Overall, this review provides an appropriate reference point for further research on 'Constructivism' and 'e-learning'.

Keywords: Bibliometric Analysis, Constructivism, E-Learning

1. INTRODUCTION

Constructivism is an approach to teaching and learning based on the premise that cognition (learning) is the result of "mental construction." In other words, students learn by fitting new information together with what they already know. Constructivists believe that learning is affected by the context in which an idea is taught as well as by students' beliefs and attitudes. Constructivism is a learning theory found in psychology that explains how people might acquire knowledge and learn. It, therefore, has direct application to education. The theory suggests that humans construct knowledge and meaning from their experiences. Constructivism is not a specific pedagogy. Piaget's theory of Constructivist learning has had a wide-ranging impact on learning theories and teaching methods in education and is an underlying theme of many education reform movements. Research support for constructivist teaching techniques has been mixed, with some research supporting these techniques and other research contradicting those results. (Bada, & Olusegun, 2015)

Entrenched in learning theories advanced by Dewey (1916), Piaget (1972), Vygotsky (1978), and Bruner (1990), constructivism learning theory is defined as t active construction of new knowledge based on a learner's prior experience. Woolfolk (1993, p. 485) states the following: …

"The key idea is that students actively construct their own knowledge: the mind of the student mediates input from the outside world to determine what the student will learn. Learning is active mental work, not passive reception of teaching."

Koohang and Harman (2005) stated that "e-learning is the delivery of education (all activities relevant to instructing, teaching, and learning) through various electronic media." e-learning has been investigated as ''instructional medium'' (Salas, Kosarzycki, Burke, Fiore, & Stone, 2002), ''instructional strategy'' (Klein, Noe, & Wang, 2006), ''training method'' (Burgess & Russell, 2003), ''training technique,'' or ''learning environment'' (Derouin, Fritzsche, & Salas, 2005a).

"According to the 2019 research report, the demand of global e-learning Market size & share expected to reach to USD 374.3 Billion by 2026 from USD 144 Billion in 2019, at a compound annual growth rate (CAGR) of 14.6% during the forecast period 2020 to 2026"

Accordingly, the academic and professional literature on Construcvtisim based e-learning has increased considerably in the past decade. A variety of topics and issues have been explored and discussed in various studies. Moreover, research on Construcvtisim based e-learning cuts across different disciplines including education; computer science; sociology; psychology, and management, showing the multidisciplinary nature of the field. In this context, there is a need for a thematic overview of related studies for a comprehensive understanding of this broad and diverse research field. This study adopted a bibliometric approach to analyze 107 relevant articles published in academic journals proceedings from 2011 to 2022, to discover the major research themes and knowledge structure of the field.

2. METHODOLOGY

This review of the bibliometric literature is based on a systematic and explicit method (Garza-Reyes, 2015) or a mind mapping method emphasizing the limits of knowledge (Tranfield, Denyer, & Smart, 2003). This research method adopts the five-stage method (Tranfield et al., 2003); Setyaningsih, Indarti, & Jie, 2018) as in Figure 1.

Figure 1 Five-step method bibliometric analysis

2.1. DETERMINE SEARCH KEYWORDS

Literature search literature cited in January 2022 with the keywords 'constructivism' and 'e-learning'. Scopus was selected since it is one of the most reputed databases. The first search included query string as TITLE-ABS-KEY (eLearning OR "e-learning") AND TITLE-ABS-KEY (constructivism) AND (LIMIT-TO (PUBYEAR, 2022) OR LIMIT-TO (PUBYEAR, 2021) OR LIMIT-TO (PUBYEAR, 2020) OR LIMIT-TO (PUBYEAR, 2019) OR LIMIT-TO (PUBYEAR, 2018) OR LIMIT-TO (PUBYEAR, 2017) OR LIMIT-TO (PUBYEAR, 2016) OR LIMIT-TO (PUBYEAR, 2015) OR LIMIT-TO (PUBYEAR, 2014) OR LIMIT-TO (PUBYEAR, 2013) OR LIMIT-TO (PUBYEAR, 2012) OR LIMIT-TO (PUBYEAR, 2011)) AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (SRCTYPE, "p") OR LIMIT-TO (SRCTYPE, "j"))

2.2. INITIAL SEARCH RESULTS

This search is specific to, 'title, abstract and keywords only in the English language, and the. 276 articles were found during the initial search. The results are compiled in CSV format to include all important article information such as paper titles, author and affiliation names, abstracts, keywords, and references.

2.3. REFINEMENT OF SEARCH RESULTS

Appropriate and indexed articles in the database are filtered and 'published', 'journals' from the year '2011-2022' were taken. This data does not include proceedings, newspapers, books, book reviews, and book chapters. Only -107- journal articles were selected. Then to make the appropriate improvements, the file is saved in the form of a CSV file. CSV data is imported into VOSviewers software. The resulting CSV file is used for further data analysis.

2.4. COMPILE PRELIMINARY DATA STATISTICS

The data collected were stored in the form of CSV. At the initial stage, the complete components of the journal articles (publication year, volume, number, page, etc.) were checked and we added required information if there were some incomplete data found. Data analysis was carried out so that articles could be classified by year and source of publication and publisher.

2.5. DATA ANALYSIS

The bibliometric analysis in this study done through the Scopus analysis tool as well as to analyse and visualize bibliometric networks, Vosviewer software is used (Martinez-López, Merigó, Gázquez-Abad, & Ruiz-Real, 2019; Shukla, Merigó, Lammers, & Miranda, 2020). VOSviewer is used because of its ability to work efficiently with large data sets and provide a variety of interesting visuals, analyses, and investigations (van Eck & Waltman, 2010). Vosviewer can also create publication maps, author maps, or journal maps based on co-citation networks or build keyword maps based on shared networks.

3. RESULTS

3.1. PUBLICATIONS AND CITATION STRUCTURES

The output is analysed trough the VOSviewer software to determine the most frequently appeared keywords. However, the number of the most frequently-appearing keywords is adjusted to the needs of the data collection and analysis. VOSviewer is used to visualize bibliometric maps. This software shows bibliometric mapping on three different visualizations namely, network visualization, overlay visualization, and density visualization.

107 articles were grouped from the Scopus database. This data has been verified well on the Scopus database from 2011-2022 with the keywords 'Construcvtisim' and 'e-learning'. 107 articles are obtained in results with 1561 citations (141.90 citations/year). The complete results of metric data comparison from search can be seen in Table 1.

Table 1 Search metrics

Metrics data	**Search results**
Source	'constructivism' and 'e-learning'
Publication year	2011-2022
Papers	107
Citations	1561
Cites/year	141.90

Cites/paper	14.58
Author/paper	1,49
h_index	16

The researcher tries to present the most relevant contributions in this study. The step taken is to take 107 articles with the word "Construcvtisim" and “E-Learning” in the article title, abstract, or keyword which has the highest citation score (top 10 articles cited). Obtained results as in Table 2.

Table 2 Top 10 cited articles

No	Publication Year	Author	Title	Journal	Cites	Publisher
1	2011	Mikropoulos T.A., Natsis A.	Educational virtual environments: A ten-year review of empirical research (1999-2009)	Computers and Education	461	Elsevier Ltd
2	2014	Gillani N., Eynon R.	Communication patterns in massively open online courses	Internet and Higher Education	143	Elsevier Ltd
3	2016	Cheng G., Chau J.	Exploring the relationships between learning styles, online participation, learning achievement and course satisfaction: An empirical study of a blended learning course	British Journal of Educational Technology	91	Blackwell Publishing Ltd
4	2014	Knox J.	Digital culture clash: "massive" education in the E-learning and Digital Cultures MOOC	Distance Education	90	Routledge
5	2014	Cheong C., Filippou J., Cheong F.	Towards the gamification of learning: Investigating student perceptions of game elements	Journal of Information Systems Education	70	Journal of Information Systems Education
6	2014	Xu D., Huang W.W., Wang H., Heales J.	Enhancing e-learning effectiveness using an intelligent agent-supported personalized virtual learning environment: An empirical investigation	Information and Management	64	Springer Science and Business Media, LLC
7	2011	Alonso F., Manrique D., Martinez L., Vines J.M.	How blended learning reduces underachievement in higher education: An experience in teaching computer sciences	IEEE Transactions on Education	55	IEEE Education Society
8	2016	Kevan J.M., Ryan P.R.	Experience API: Flexible, Decentralized, and Activity-Centric Data Collection	Technology, Knowledge, and Learning	42	Kassel University Press GmbH
9	2014	Lau K.H.V.	Computer-based teaching module design: Principles derived from learning theories	Medical Education	40	Wiley

10	2011	Tsai P.-S., Tsai C.-C., Hwang G.-J.	The correlates of Taiwan teachers' epistemological beliefs concerning Internet environments, online search strategies, and search outcomes	Internet and Higher Education	33	Elsevier

The top 5 publishers who publish articles on this topic are presented in Table 3.

Table 3 Top 5 publishers who publish 'constructivism' and 'e-learning' topics.

No	Publisher	Articles
1	Kassel University Press GmbH	11
2	Springer	9
3	IGI Global	8
4	Elsevier	7
5	Inderscience Publishers	5

The top 3 Journals that have relevant articles are presented in Table 4.

Table 4 Top 3 journals that have relevant articles on 'constructivism' and 'e-learning' topic

No	Journal	Total Articles	Cites
1	International Journal of Emerging Technologies in Learning	9	58
2	Education and Information Technologies	4	50
3	Education Sciences	3	10

The data network visualization display on Scopus data related to the word "Construcvtisim" and "E-Learning" in Article title, abstract or keyword in search with co-occurrence of keyword for minimum 3 times can be seen in Figure 2, overlay visualization can be seen in Figure 3, and visualization of density in Figure 4.

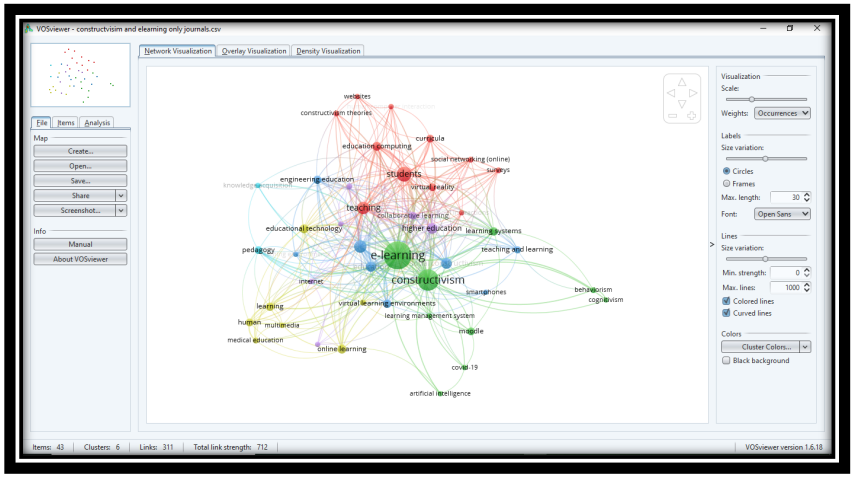

Figure 2 Network visualization on Scopus database

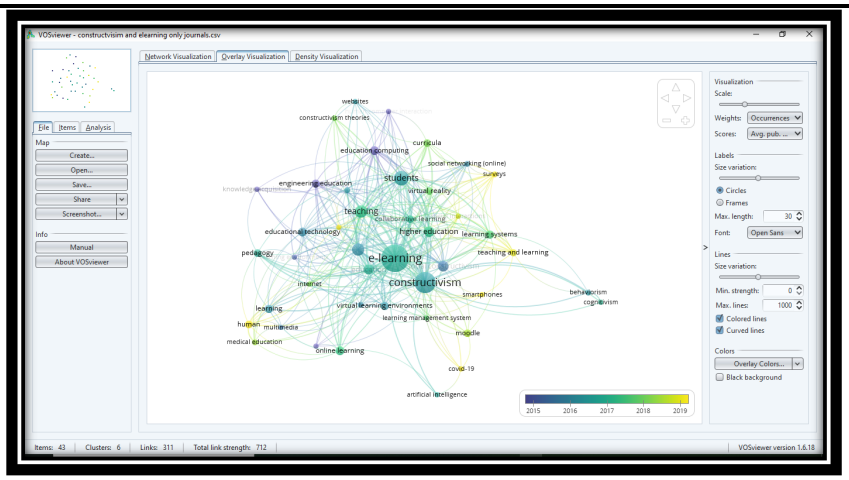

Figure 3 overlay visualization of Scopus database

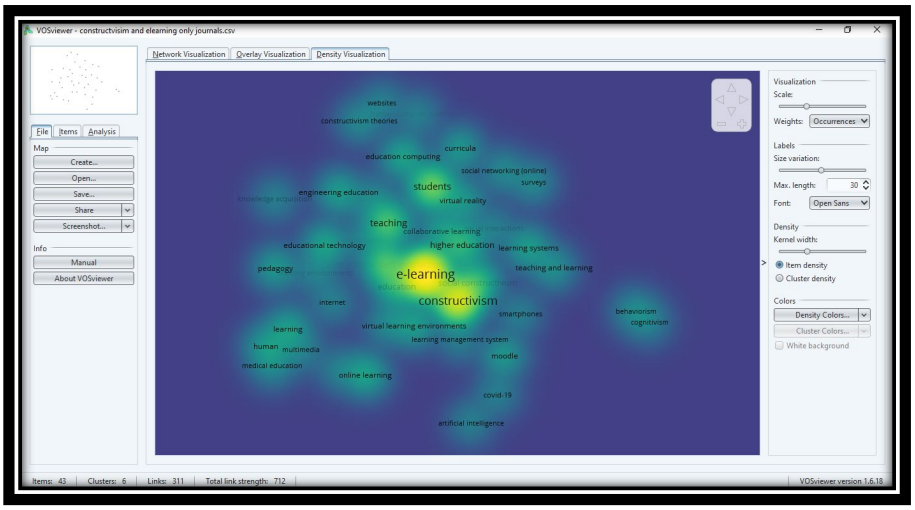

Figure 4 Density visualization of Scopus database

This result was extracted from the title, keywords, and abstract with the full calculation of the minimum number of events set to 3. About 43 items were found that met the criteria of 681 items. Common words are excluded in this item. Each item representing the keyword is added, which is indicated by the size of the node. In other words, the node size indicates the co-occurrence frequency of the keyword. Six groups are identified here. The keywords that appear in each cluster represent the flow of study in 'constructivism' and 'e-learning' can be seen in Table 5.

Table 5 Keyword representing each cluster

No	Cluster	Element
1	The first cluster (red)	Constructivism theories (4), curricula (6), education computing (8), human-computer interaction (3), social interactions (3), social networking (online) (4), students (22), surveys (4), teaching (16), virtual reality (6), websites (3).
2	The second cluster (green)	Artificial intelligence (3), behaviorism (4), cognitivism (3), constructivism (45), covid-19 (3), e-learning (78), learning management system (3), learning systems (7), moodle (6).
3	The third cluster (blue)	Computer-aided instruction (16), education (10), engineering education (7), learning environments (3), smartphones (3), social constructivism (12), teaching and learning (5), virtual learning environments (7).

4	Fourth cluster (yellow)	Activity theory (4), educational technology (8), human (6), learning (7), medical education (4), multimedia (3), online learning(8).
5	the fifth cluster (purple)	Blended learning (4), collaboration (3), collaborative learning (6), higher education (12), internet (3), web-based learning (3).
6	The sixed cluster (Sky blue)	Knowledge acquisition (3), pedagogy (6).

3.2. TERM CO-OCCURRENCE MAP BASED ON TEXT DATA

Analysis of term co-occurrence map based on text data can be seen in Figs. 5. This network map has been created including the terms which were occurred a minimum of 10 times among all terms. 45 terms out of 2817 met the threshold and the same has been selected to create a network map. In this network, each node represents the term occurrence. Many different dimensions can be integrated into this analysis to visualize groups and associations between terms or time changes. Figure 5 shows an analysis of the term co-occurrence network seen year-wise. In this case, the relationship of the terms can be classified as their annual relationship. From the map, we can see that 'learning' is the term with maximum link strength with other terms.

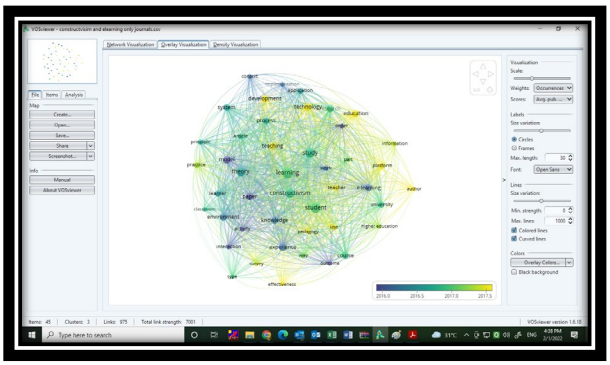

Figure 5 Visualization of overlay: Term co-occurrence map based on text data

3.3. BIBLIOMETRIC COUPLING USING COUNTRIES AS A UNIT OF ANALYSIS

Map of Bibliographic coupling using countries as the unit of analysis was made using VOS viewer. In this map, we have only taken countries from which a minimum of 2 documents were there and the minimum number of citations should be 5. Out of the total 45 countries, only 19 met the threshold and only 18 countries have connected in terms of bibliometric coupling. Figure 6 presents the Bibliometric coupling using countries as a unit of analysis. In this map, each node represents the number of documents from the country and each link represents the link between countries in terms of the documents reference list.

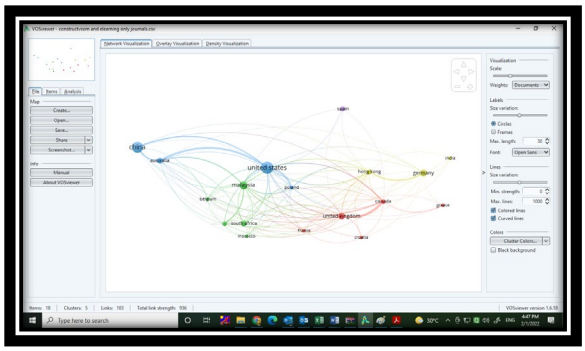

Figure 5 Network Visualization: Bibliographic coupling of countries

4. DISCUSSION AND CONCLUSION

The most relevant contribution in this study is the number of citations. Based on table 2, the highest citations indexed by the Scopus database is an article from Mikropoulos T.A., Natsis A. in 2011. In that study, a ten-year critical review of empirical research on the educational applications of Virtual Reality (VR) has been conducted. This article is cited in more than 450 research articles. Meanwhile, there is one publisher with the highest frequency of citation based on the data, namely Elsevier.

In addition, the publisher who contributed the most articles to this study was also analyzed. Of 107 articles published, 11 articles were published from major publishers namely Kassel University Press GmbH, followed by Springer 9 articles, IGI Global 8 articles, Elsevier 7 articles, and Inderscience Publishers 4 articles. For other publishers, an average of 1.39 articles is published on this topic.

In addition to the number of articles per publisher, it is also analyzed based on the relevance of the journal. The results were obtained in the top 3 journals that contain this topic. Some journals have the most citations, namely Computers and Education. This shows that articles with subjects related to 'constructivism' and 'e-learning' are scattered in certain journals, although there are also other journals.

Analysis overlay visualization and visualization of density are used to identify key themes in each study or scope of knowledge. This result is done by measuring the co-occurrence of keyword pairs (Liu, Yin, Liu, & Dunford, 2015; Nagy, 2018) and the co-occurrence of terms. The analysis was made with the help of Vosviewer software. It can be identified that each cluster connects to other keywords. This can be indicated that the development of research on this subject is related.

Articles about 'constructivism' and 'e-learning' can be found scattered around the United States, China, Malaysia, United Kingdom, Germany, and Australia. The geographical distribution of this article shows that research on 'constructivism' and 'e-learning' is still dominated by a few major economies, especially the United States and China. Overall this data allows this paper to answer the question of what research trends in the field of 'Construcvtisim' and 'e-learning' in the past 10 years. Some words that are not used can be linked and examined in further research. Therefore, many more topics can be developed based on these keywords such as affiliations, sources, and organizations. Those aforementioned elements could provide a more comprehensive analysis.

The current study reviews journal articles whose themes related to the word 'Construcvtisim' and 'e-learning'. Articles are collected from the Scopus database. Than 107 of these articles published in the period 2011 to 2022 were selected from a larger original set of 276 articles. To meet the objectives of this study, all articles found were classified by author, year of publication, name of the publisher's journal, cites, authors, and co-authorship relations and affiliation statistics. In the context of this study, it was concluded that the studies related to 'constructivism' and 'e-learning' and majorly conducted in the United States and China. The gap in this research shows the direction for the future agenda that how Construcvtisim theory is being used to develop e-learning for education as well as corporates. Overall, from year to year, studying the concept of 'Construcvtisim' and 'e-learning' tends to increase. This is also required for more inter-regional research collaboration involving researchers from developed countries and other developing countries in certain areas.

5. SUGGESTIONS AND LIMITATIONS

This study has two limitations. First, this study is generally based on a limited set of keywords and is also potentially limited by the narrow database (Scopus) used for article collection. Second, although this study uses formal software as tools (VOSviewer, Microsoft Excel) the subjective assessments of the author occur and still possibly lead to errors. Future studies are recommended to use a larger sample by expanding the keywords used and the more accessible databases. It also can use a comparison of different and recommended bibliometric analysis results (such as BibExcel and HistCite). It is recommended that further related studies provide more elaborate explanations for that there is a limited number of studies discussing constructivism and e-learning.

CONFLICT OF INTERESTS

None.

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None.

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