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Decoding Cyberpsychology: Key Trends in Digital Learning-A Bibliometric Insight

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ABSTRACT

This bibliometric study aims to analyze the research literature on Cyberpsychology in learning. Cyberpsychology refers to the study of the impact of technology on human behavior, including learning. A bibliometric analysis of scientific documents published in journals indexed in the Scopus was performed. The study aimed to identify research trends, collaborations between researchers, and locate journals and articles of interest in the thematic area. The results of the study will provide insights into the current state of research on Cyberpsychology in learning and identify potential areas for future research.

Cyberpsychology is the study of the impact of the internet, multimedia, and *virtual reality* on behavior and communities (Connolly et al., 2016; Emond & West, 2003; Gordo & Parker, 1999; Harley et al., 2018; Kaye, 2016). Since Internet technology has become massively widespread around the world, such as web browsers, email, and with the development of social media, it has become clear that Internet technology provides more than just access to large sources of information (*big data*) (Boyd & Crawford, 2012), where it makes all aspects and elements connected in a giant network (Xu et al., 2014). Internet technologies such as social media also support social linkages and build relationships or even polarities of social relationships, as well as create a new order of life that shapes cultural and social behavior (Mantovani, 2001; Sheldon et al., 2019).

Furthermore, Cyberpsychology specifically studies human interaction with other technologies, including the internet, mobile computing, cell phones, game consoles, virtual reality, digital media and other technologies (Singh & Singh, 2019). It is very influential and has the ability to change human behavior by also considering the impact of rapidly growing trends, such as the convergence of technology on individuals (Singh & Singh, 2019). Cyberpsychology also examines human interaction with technology, such as cyborgs, humanoid robots and artificial intelligence.

The term "Cyberpsychology" has its roots in the fields of applied psychology (Barak & Suler, 2008; Kirwan, 2010). The term Cyberpsychology has been around for more than two decades. It emerged in the mid-1990s and was the first research to study online behavior (Suler, 2016). Drawing on previous research, "Cyberpsychology and Behavior" was the first journal to publish the term Cyberpsychology in 1998. The American Psychological Association (APA) simply took the term Cyberpsychology that was first written in an article published in the journal Cyberpsychology & Behavior in 1998 and used it in 2017 (*Cyberpsychology - Wikipedia*, n.d.). Stress and negative impulses are increasing rapidly in human life due to the use of technology (Buglass et al., 2017; Duggan, 2016; Lin et al., 2016; Norman, 2017), and are related to Cyberpsychology as the main subject domain. Other research on Cyberpsychology was conducted by Singh & Singh (2019) who discussed Cyberpsychology trends based on the literature of 300 relevant research papers from 2012 to 2019. Further, bibliometric analysis is a frequently used tool to analyze trends and performance on a particular subject. It provides an objective method to measure the contribution of an article to the advancement of knowledge (Yang et al., 2013). In this study, bibliometric analysis is used to better understand the evolution of Cyberpsychology in Learning in the academic community. The aim is to identify research gaps and novelty as a basis for future research.

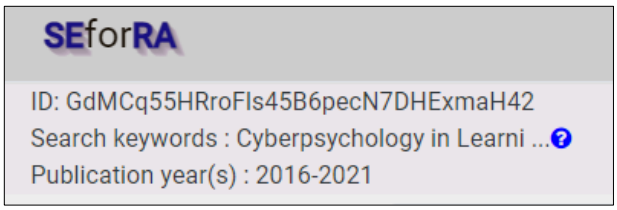
Previous research mentions that bibliometric studies have been conducted by the NASA Institute of Astrobiology in research in the field of collaborative interdisciplinary astrobiology (Taşkın & Aydinoglu, 2015). Literature review of bibliometrics used in the concept of green manufacturing (Setyaningsih et al., 2018). Bibliometric analysis has been conducted in international big data research (Ye, 2018). Research on sustainable development in industry 4.0 with bibliometric analysis has been carried out by Sierra-Henao et al. (2020). In the field of management and organization with bibliometric methods researched by Zupic and Čater (2015). Meanwhile, to determine the trend of osmosis research in desalination and wastewater treatment over the last decade was conducted by Ang et al. (2019). Although research on bibliometric analysis of Cyberpsychology has been conducted by Singh

& Singh (2019) but no one has specifically studied Cyberpsychology in the field of learning. It is interesting to study the bibliometric analysis of Cyberpsychology in the field of learning with a larger and more recent dataset. The aim of this study is to present a bibliometric analysis of journal articles published in the Scopus database on Cyberpsychology literature in learning. The analysis aims to identify scientific gaps as a reference for further research.

METHODS

The method used in this research consists of five stages [26] (Figure 2).

a) Specify search keywords
The research employs the keyword 'Cyberpsychology in Learning' as a reference. Additionally, the year of publication is taken into consideration when searching for articles (see Figure 1). The SEforRA software (Sidiq et al., 2020) is used for article search and mining, with a limitation of the year of publication between 2016-2021. The selected journal article database platform is Scopus (from Q1 to Q4). The selection was based on articles from the Scopus database, which are known for their good quality and international reputation. Scopus is a multidisciplinary database that collects articles from reputable journals published by Elsevier, Springer, Wiley, Taylor & Francis, Emerald, Nature, and others.



Search limitations in SEforRA

b) Initial search result
The results of searching and mining articles with *SEforRA* software resulted in 1708 journal articles with publication years between 2016-2021. The article dataset is in RIS, HTML, and txt formats (containing DOI and corpus data).

c) Filtering the search result data to match the information needed.
The collected article dataset is in HTML format, RIS file and txt file containing article DOI data. From the dataset with HTML format, a resume of 1708 articles in Scimago Journal Rank is obtained; from RIS files and text files will be directly input to VOSviewer for further analysis. The results of the journal data resume in Scimago Journal Rank are processed with Microsoft excel to be visualized in graph format.

d) Collect and compile statistical data on search results
After the article data is collected, processed data is produced, including a graph of the last six years of articles on the Scimago Journal Rank (2016-2021) and a txt format dataset containing metadata in DOI related to author name information, journal name, article title, abstract, keywords etc.

e) Conduct data analysis (bibliometrics)
Bibliometric analysis was conducted using VOSviewer software. VOSviewer is efficient with large amounts of data and provides attractive data visualization, analysis, and investigation tools [28]. It can compile publication, author, or journal maps based on co-citation networks or display keyword maps based on shared networks (Nees Jan van Eck & Waltman, 2010, 2014).

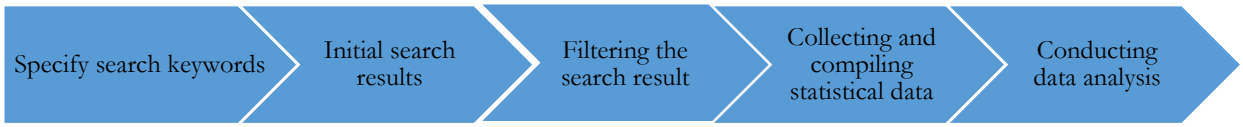


Figure 2. Five Steps of Bibliometric Analysis Method

RESULTS & DISCUSSION

Scimago Journal Rank

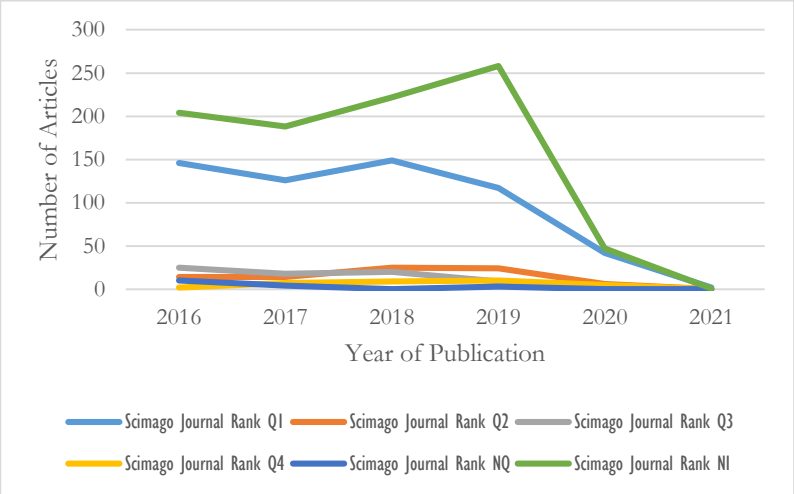
The SEforRA software presents the Scimago Journal Rank resume results in Table 1 and Figure 3. Scimago Journal Rank measures the scientific influence of scholarly journals by considering both the number of citations received by a journal and the importance or prestige of the journal from which the citations originate. A journal's SJR is a numerical value that represents the weighted average number of citations received per document published in that journal over the past three years. The SJR value is an indicator of the journal's prestige, with a higher value indicating higher prestige. SJR values are denoted by the notations Q1 to Q4, while NQ is for journals with an H-index of at least 1 and NI is for journals with an H-index of 0.

According to Figure 4a, the Journal in N1 had the highest average number of publications with 153.3 articles from 2016-2021, while the Journal in NQ had the lowest average number of publications with 2.8 articles. Additionally, there was an

increasing trend in the number of published articles from 2016-2019. The open access movement (*About Sherpa Romeo - v2.Sherpa*, n.d.; *Budapest Open Access Initiative | Ten Years on from the Budapest Open Access Initiative: Setting the Default to Open*, n.d.; *Directory of Open Access Journals (DOAJ)*, n.d.; Björk, 2017; Tupan, 2016) has been identified as one of the causes for the massive increase in scientific article publications worldwide. However, after 2019, there was a drastic decline due to the Covid-19 outbreak that affected the entire world (Figure 4b).

Table 1. Quartile Distribution (Q) in Scimago Journal Rank

Year	Scimago Journal Rank						Sub Total
	Q1	Q2	Q3	Q4	NQ	NI	
2016	146	14	25	2	10	204	401
2017	126	14	18	7	4	188	357
2018	149	25	20	9	0	222	425
2019	117	24	9	10	3	258	421
2020	42	6	1	5	0	47	101
2021	2	0	0	0	0	1	3
Total results							**1708**



Trend of articles in Scimago journal rank

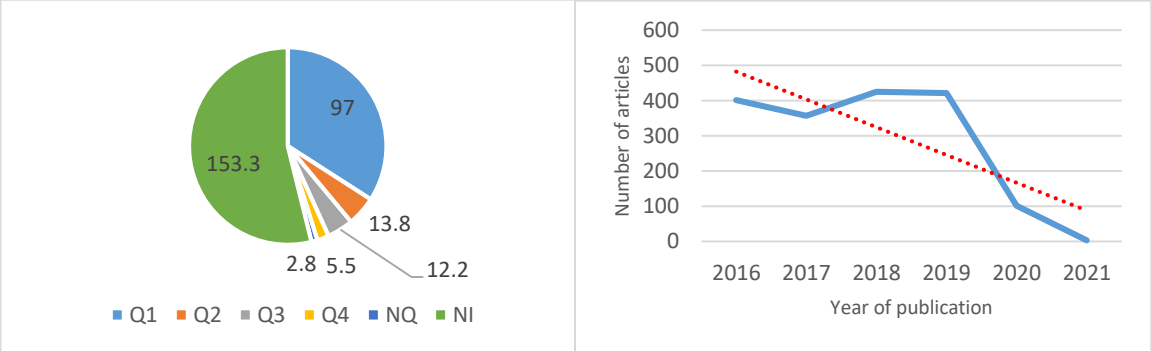


Figure 4. (a) Average SJR publications 2016-2021; (b) Decline in number of publications

Co-Authorship Analysis

Once the article retrieval process is complete using SEforRA software, a dataset in txt format will be downloaded. This dataset will serve as input data for VOSviewer to perform bibliometric analysis, including co-authorship analysis.

Co-authorship analysis is a useful tool for identifying relationships between different studies based on research documents produced by researchers. The co-authorship network can reveal the direction of collaboration and identify researchers and institutions that lead research (E Fonseca et al., 2016). Additionally, co-authorship network analysis can make substantial contributions to scientific development (Morel et al., 2009).

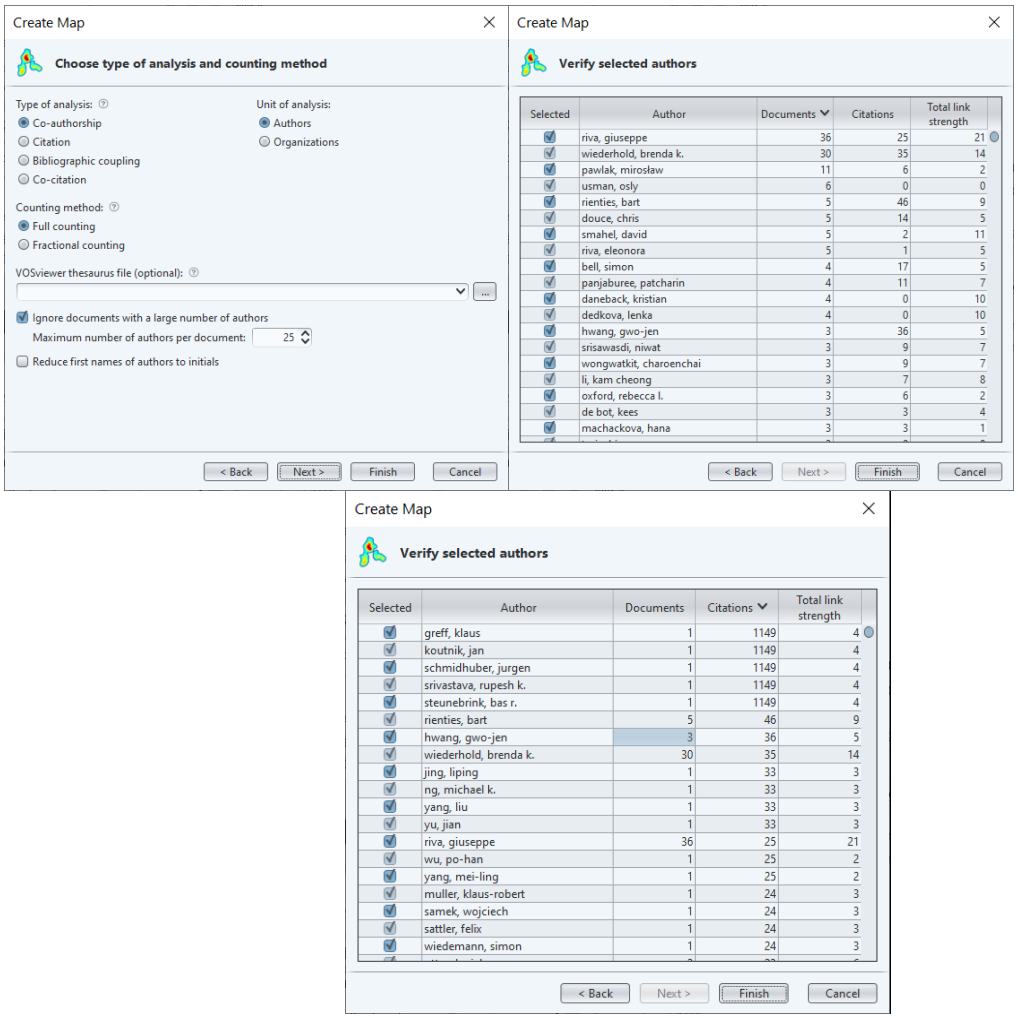


Figure 5. Initial setting of co-authorship analysis

The co-authorship analysis type is initially set as shown in Figure 5, with the author unit of analysis. This analysis examines the author's collaboration with other authors, and the results are visualized based on the author's name. Based on the number of published documents, it is known that the author with the most documents is Giuseppe Riva with 36 articles, while based on the most citations, five authors with 1149 citations are Klaus Greff, Jan Koutnik, Jurgen Schmidhuber, Rupesh K Srivastava, and Bas R Steunebrink (Figure 5). Figures 6 and 7 show the two authors with the highest number of articles, namely Giuseppe Riva with 36 articles and Brenda K Wiederhold with 30 articles. Both authors have their own networks, but they are also interconnected in a joint research as shown by the connecting lines between them. Very clearly shown in Figure 7 the density color is getting brighter yellow is evidence that both authors have the most number of published articles.

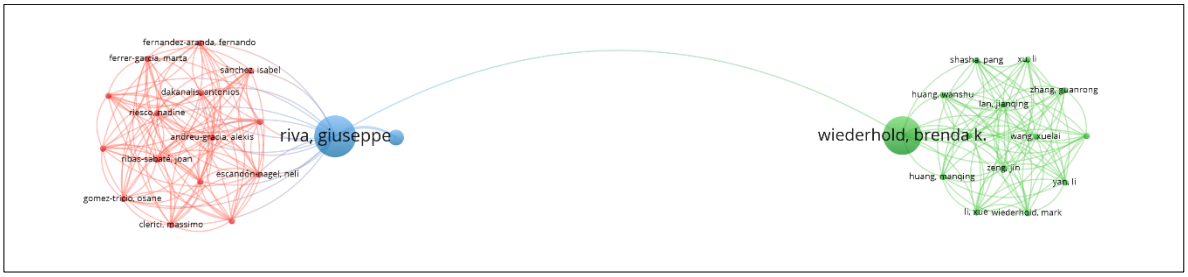


Figure 6. Network Visualization

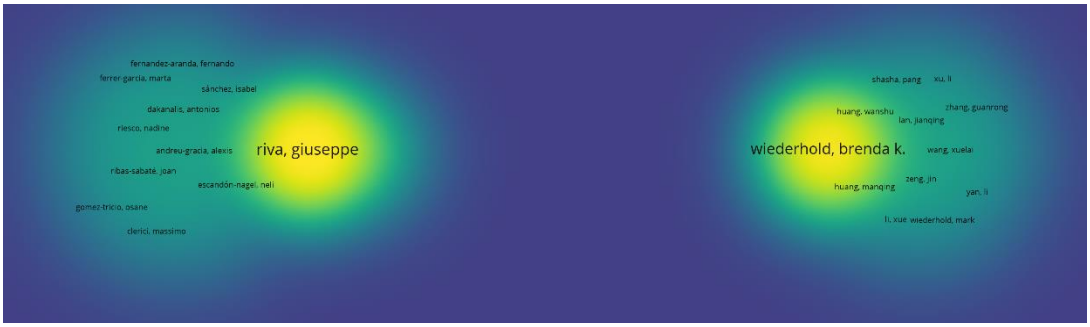


Figure 7. Density Visualization

Citation Analysis

Citation analysis visualizes the relationships between observed documents by linking them to other equally observed articles that they cite. This analysis is useful for showing citations between documents and can also reveal author self-citation. Figures 8 and 9 depict the initial setup of the citation analysis and its results with two units of analysis: documents and sources.

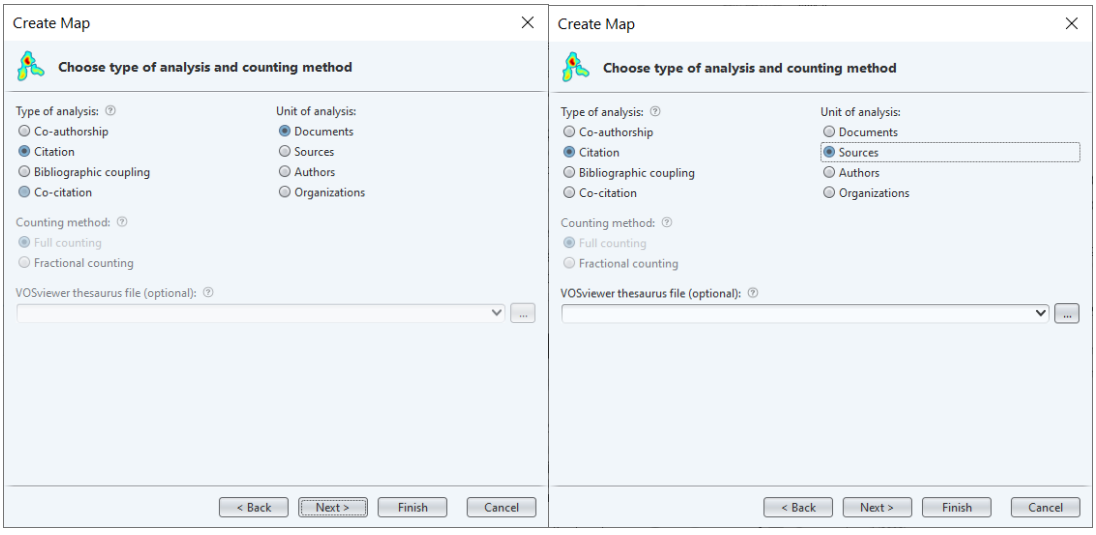


Figure 8. Citation analysis with two units of analysis, documents and sources

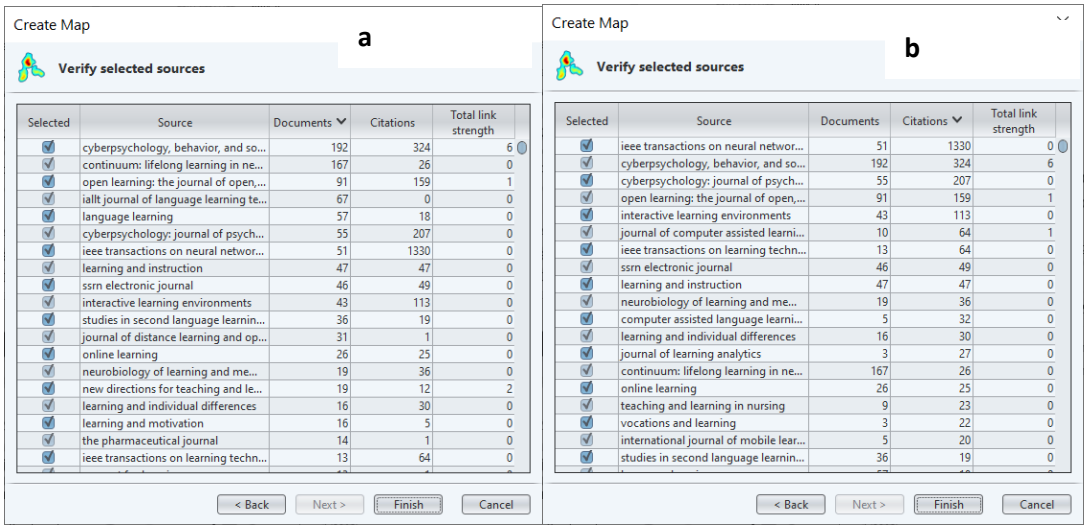


Figure 9. Results of setting two units of analysis (documents and sources)

Referring to Figure 9 (a,b), it can be explained as follows.

1. Based on the number of documents (a) that jointly refer to the journal Cyberpsychology, behavior, social networking is 192, followed by the journal Continuum: Lifelong Learning in Neurology with 167 documents and then the third is the journal Open Learning: The Journal of Open, Distance and e-Learning with 91 documents.
2. Based on the number of citations (b) referring to the journal IEEE transactions on neural networks with 1330 citations, then in the journal Cyberpsychology, behavior, social networking with 324 citations, and the third in the journal Open learning: Open Learning: The Journal of Open, Distance and e-Learning with 207 citations.

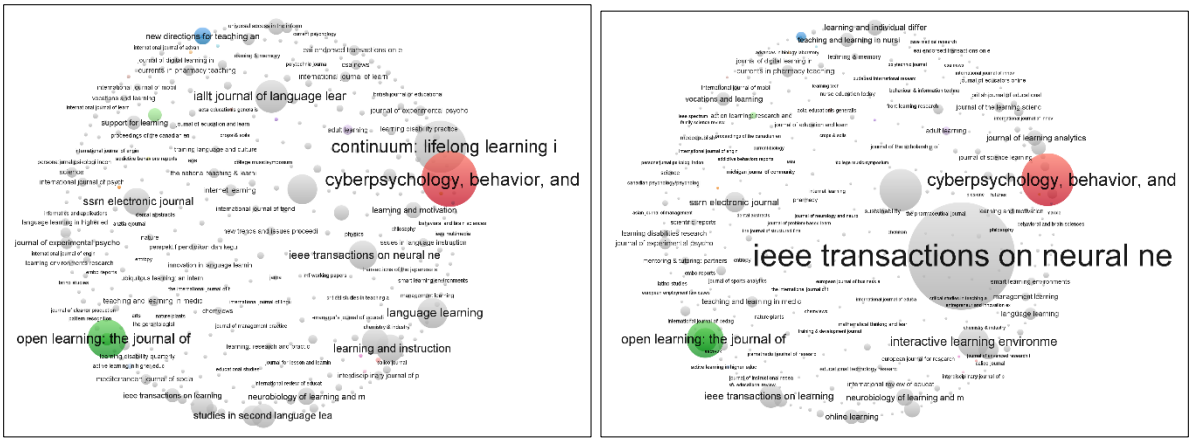


Figure 10. Visualization of citation analysis

Co-Citation Analysis

Co-citation will visualize the references used by the tested/observed documents. References will be linked if they are used in the article together. In other words, co-citation analysis can show what references are most popular. Figure 11 shows the co-citation analysis with the cited references unit of analysis (Figure 10). An example is the reference a.n. Higgins et al. (1987) which is linked to Erikson, e (1950); this means that references will be linked if they are used in the same article (Figure 12). Then another example is the Journal of computers & education referenced together with the journal of educational psychology in an article, as they are connected by a line (Figure 12).

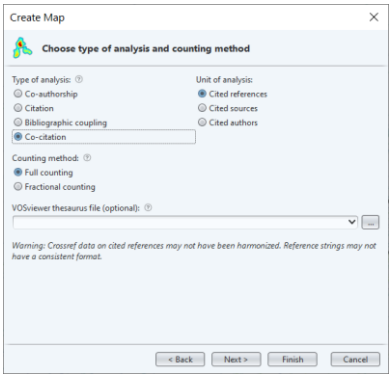


Figure 11. Co-citation analysis with cited references and sources unit of analysis

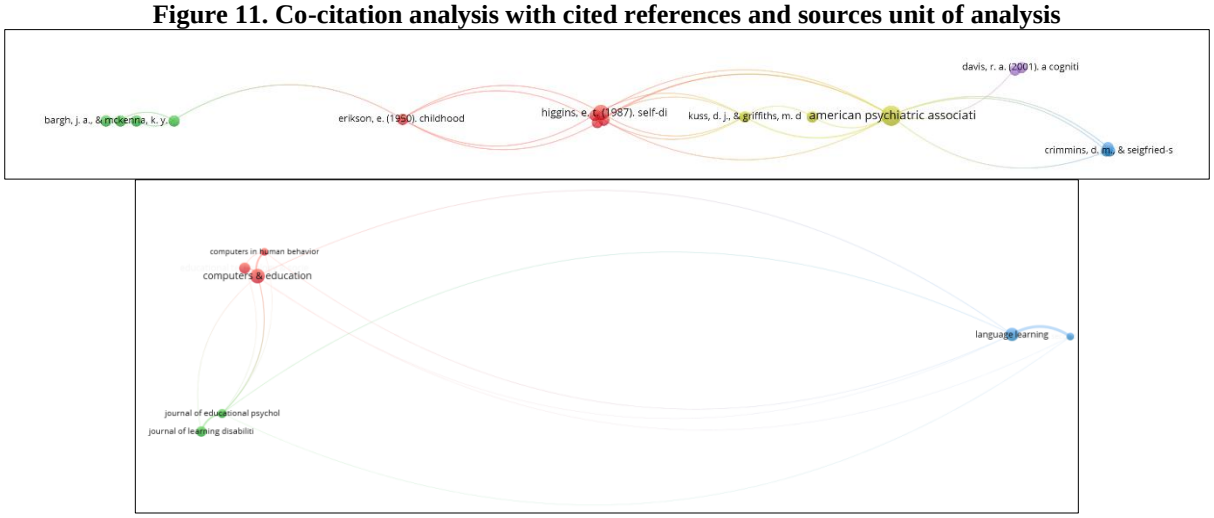


Figure 12. Co-citation analysis with reference citation analysis unit

Bibliographic Coupling Analysis

The articles tested/observed will be visualized and networked, if they have common references. This analysis shows the closeness of studies between connected documents. This network on bibliographic coupling shows that one document and another connected document have the same reference. If they have the same references, then there is a possibility of document similarity. For example, Newman (2017) is related to Carvalho (2018); meaning that there is a close study between the two because they have the same reference (Figure 13). The next example is between Open Learning: The Journal of Open, Distance and e-Learning is connected to Adult Learning, which shows that the two journals also have a close study (Figure 13).

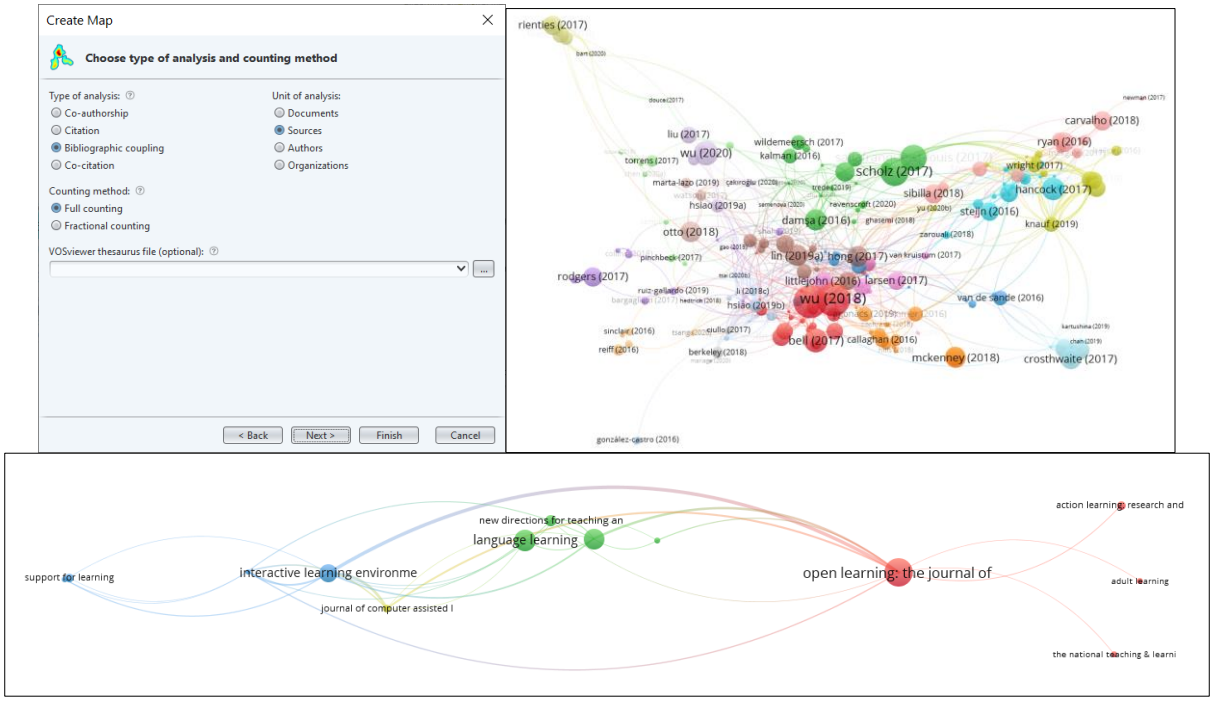


Figure 13. Bibliographic Coupling Analysis

Occurence Analysis

Co-Occurrence analysis results based on keywords serve as a reference for mapping the co-occurrence of important or specific terms in a particular article. In other words, Occurrence Analysis displays a visualization of the network between keywords. Knowledge mapping is a method of visualizing a field of knowledge in bibliometrics. This is achieved by creating a landscape map that displays the topics of science (Royani et al., 2013).

VOSviewer will display keywords/topics based on the title and abstract of Cyberpsychology articles in learning, a total of 7360 keywords with a minimum of 5 occurrences appearing so that those that meet the value limit are 478. By default VOSviewer will display 60% (Nees Jan van Eck & Waltman, 2013) By default VOSviewer will display 60% (Nees Jan van Eck & Waltman, 2013) of the 478 keywords, i.e. 287 but in this analysis it is determined that all 478 terms will be displayed. The top ten most frequently occurring terms are *learning* (371), *student* (304), *study* (274), *research* (156), *effect* (136), *use* (112), *outcome (*109), *environment* (103), *strategy (*101), *experience* (101) (Figure 14).

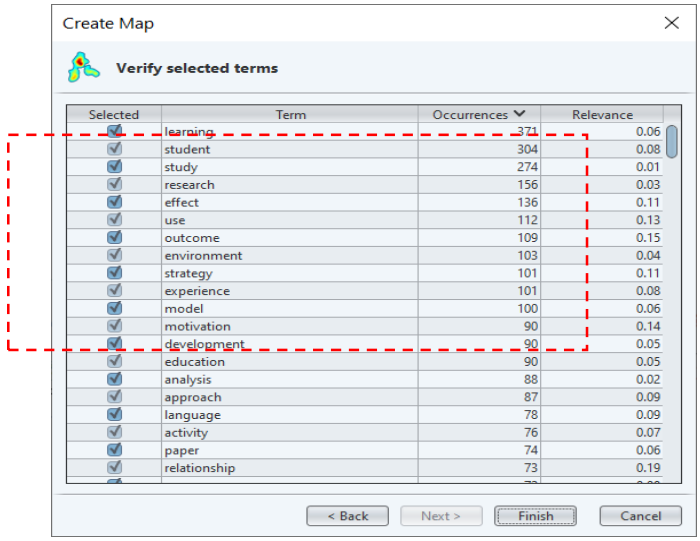


Figure 14. Frequently occurring terms/keywords

After the keywords/topics are displayed by VOSviewer, then VOSviewer displays a network visualization based on the keywords/topics (Figure 14). Some important findings of Co-Occurrence analysis discussed in *Cyberpsychology in Learning* are as follows.

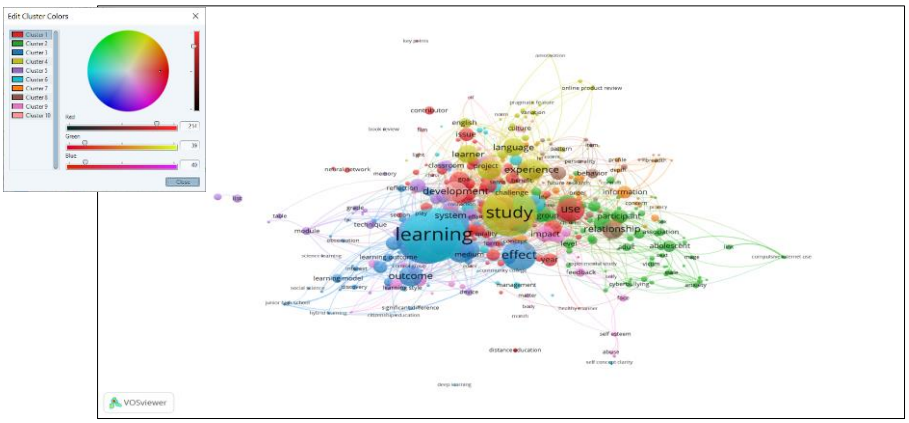
(1) *Learning* and *student* are keywords/topics that frequently appear and are used in *Cyberpsychology in Learning* research, characterized by large nodes compared to other terms.

(2) The text describes a collection of 10 term clusters, each marked with a different color. (Figure 15).

(3) The overlay visualization (Figure 16) displays the publication year of each article based on its keywords/terms with a color gradation from dark blue to bright yellow. This provides a trace of research history from year to year. For instance, research on 'learning and study' is colored bright yellow. It can be inferred that these two keywords were published in 2020, making them relatively new articles by the author. An in-depth analysis of each yellow keyword/term in the overlay visualization will reveal the latest trends in Cyberpsychology research in the field of Learning.

(4) The visualization of density illustrates the emphasis of the study group (Nees Jan van Eck & Waltman, 2013) (see Figure 17). Density can be used to identify research topics that have not been extensively studied. The color of the visualization indicates the frequency of research on a particular topic, with faded/blurred colors indicating less research and brighter yellow colors indicating more frequent research. In Figure 17, the circled topics are still rarely researched. The underlying color of these two topics is very faded and almost invisible. As the keywords/topics *deep learning* and *hybrid learning* have a high probability of generating novelty if research is conducted, while topics with the keywords *learning* and *study are* experiencing research saturation because they have been very much researched as shown by the bright yellow color.

To identify the novelty of a study, it is crucial to identify a new and previously unconnected relationship between terms in the network. The keywords represented by white circles were previously separate and had no connection. When two or more of the circled keywords/topics are linked in the same research, it indicates a novel approach to the study by establishing new connections with prior research. This may lead to new discoveries.



Network Visualization and Cluster Colors

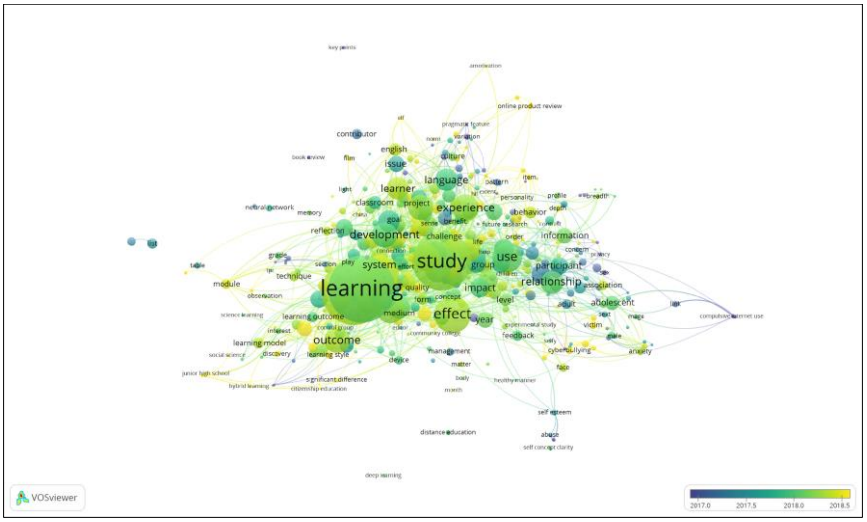


Figure 16. Overlay Visualization

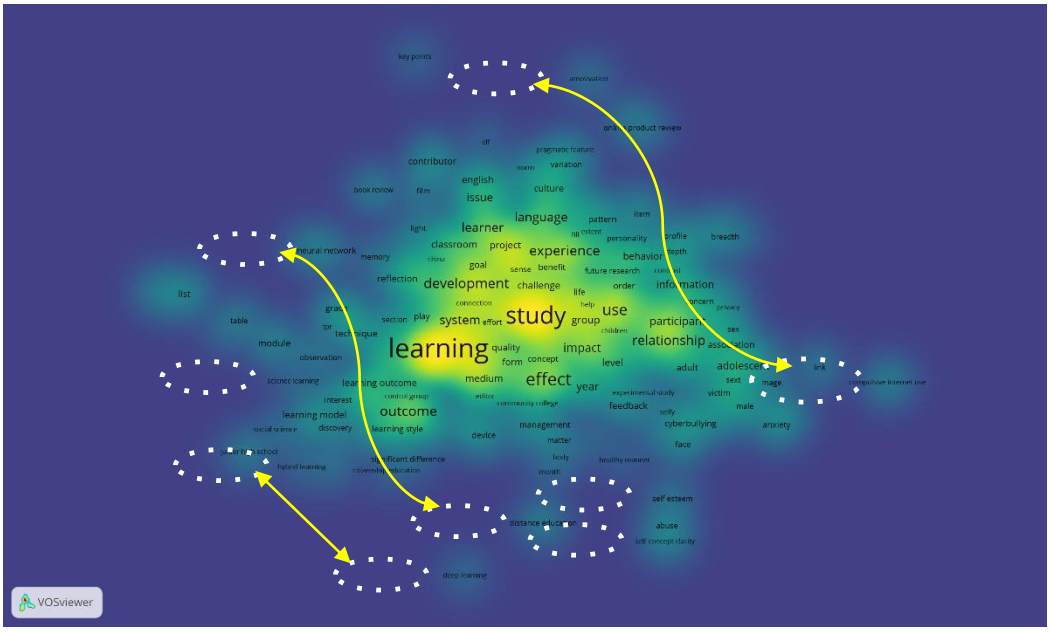


Figure 17. Density Visualization

CONCLUSION

From 2016 to 2019, Cyberpsychology in Learning research experienced an increasing trend. However, after 2019, it experienced a drastic decline due to the Covid-19 outbreak that affected the world. Data on the development of Cyberpsychology in Learning research can be obtained from the Scopus database from 2016 to 2021. This includes the quartile distribution (Q) of 1708 journal articles in the Scimago Journal Rank, the average number of published articles per quartile from 2016 to 2021, and the trend in the number of publications from 2016 to 2021. It is important to conduct a detailed analysis using VOSviewer.

VOSviewer allows for various bibliometric analyses to be visualized, such as co-authorship, citation, co-citation, bibliographic coupling, and co-occurrence analyses. These analyses provide an overview and understanding of specific topics that can be further researched. The analysis also yields keywords and themes that can serve as a foundation for future research. Additionally, to enhance the results of the literature review, it is recommended to utilize a larger and reputable database and to refine the selected keywords by comparing, analyzing, and elaborating on them. Other useful tools such as Citespace can also be employed, which offers features such as visual exploration of a research field, structural and temporal overviews, identification of hot topics and emerging trends, cascading citation expansion, systematic visual analysis of scientific literature, and an intellectual landscape of a knowledge domain. It is also important to stay up-to-date on the research topic.

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