



Global Research Trend In Digital Learning: Analysis Using Bibliometrix On The Scopus Database

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ABSTRACT

In today's digital world, there are many studies that apply digital in learning. Researchers feel the need to further analysis related to digital learning. The topic is very relevant to the current trend of Education, which is starting to rely on digital and artificial intelligence. The aims of this article are; a) To analyse the bibliometric keyword "digital learning" related to the research performance which consists of annual scientific production, most relevant source, most relevant author, most relevant affiliation, country scientific production and document. 2) To analyse the bibliometric keyword "digital learning" related to science mapping which consists of Trend Topic, Co-Accurance Network, Thematic Map, Three-Field Plot, Collaboration Network and Collaboration World Map. This study explores the scientific literature, analysing the performance and trends of digital learning topics using bibliometric. The researcher then performs this keyword on Scopus database (Scopus.com). The results of the analysis showed that there were 1711 articles collected. Researcher uses R Program to perform the bibliometric analysis. The results of this study have several implications for the field of digital learning. Firstly, the results highlight the importance of digital learning and its impact on education. Secondly, the emergence of new themes in digital learning, such as game-based learning and virtual reality, presents opportunities for further research in these areas. Finally, the collaboration network analysis highlights the importance of international collaboration in the field of digital learning, as universities from different regions are working together to advance the field.

Keywords: Bibliometric, Bibliometrix, Digital Learning, R Program, Scopus Database

INTRODUCTION

The scientific information generated is increasing day to day (Carmona-Serrano, López-Belmonte, López-Núñez, & Moreno-Guerrero, 2020; Marín-Marín, Moreno-Guerrero, Dúo-Terrón, & López-Belmonte, 2021). In this era of globalization, geographical boundaries have become less significant, allowing for the swift dissemination of information and the continual growth of scientific understanding. Science and technology are developing rapidly (Magomedov, Murzaev, & Bagov, 2020). Countries that can follow those development and keep up the competition achieve a better economic growth and social welfare (Malik, 2018).

Science and technology's progression can be gauged through two primary indicators: 'advanced education and training' and 'publication, collaboration, and scientific citation', as identified by the Foundation (2007). Bibliometric research allows for the analysis of scientific publications, collaborations, and citations (Irwanto, Dianawati, & Lukman, 2022). Bibliometric, scientometrics, informetrics, and librametrics are similar but not identical. The concepts are consisting of the combination between the word of bibliographies, science, knowledge, and libraries, and "metric", respectively (Egghe, 2005). All these concepts are related to the measurement of information.

The term 'bibliometric' is derived from 'biblio', a Greek and Latin term for 'book', and 'metric', signifying measurement (Sengupta, 1992). The term statistical bibliography was first used by E. Wyndham Hulme in 1922 as part of a course at the University of Cambridge (Pritchard & Groos, 1969). However, bibliometric studies date back to the 1890s (Sengupta, 1992). A breakthrough in bibliometric improvement was Garfield's (Garfield, 1955, 1964) development of the Science Citation Index (bibliographic database). Bibliometric data began to be recorded with the Science Citation Index. The purpose of bibliometric is basically to evaluate the scientific literature in the relevant field (Yan & Chen, 2021). Therefore, researchers can apply bibliometric to any field of science (Andrés, 2009).

Due to the rapid publication of scientific research and the number of journals, the quality of scientific publications produced may decrease (Demir, 2018). The increase in the number of publications certainly produces a lot of information that can be dug up further. Large amounts of publications, tending to be very difficult for literature review, tend to use bibliometric analysis for their mapping (Donthu, Kumar, Mukherjee, Pandey, & Lim, 2021).

The discussion related to the topic above is divided into 2 parts, namely research performance and science mapping (Donthu et al., 2021). Research performance aims to evaluate the performance of research and publications of individuals, institutions and countries. These objectives include objective goals, such as to analyse which institution is most active in conducting research on a particular topic, which author or country discusses the most about the topic and so on. The research performance is aim to measure the performance of research displayed related to the main information, most relevant source, most relevant author, most relevant affiliation, country scientific production and document. Science mapping aims to uncover the structure & dynamism of a study topic. This goal is more inclined to the level of subjective purpose. By using science mapping, researcher can map out a particular topic that have been discussed too many times and do not need to be discussed further. It also provides what kind of topics are still minimally discussed so that researchers need to do more exploration in it. The science mapping analysis displayed in Trend Topic, Co-Accurance Network, Thematic Map, Thematic Evaluation, Co-citation Network, Histogram, Collaboration Network and Collaboration World Map (Donthu et al., 2021).

The Scopus indexing engine is one of the largest publication indexers in the world (Gurunath, Samanta, Dutta, & Kureethara, 2021). Scopus database reaches almost all international journal publications in the world (Pranikuté, 2021). The Scopus academic database was chosen since it provides access to a collection of information commonly used for research and writing, i.e., titles, abstracts, and keywords.

In today's digital world, there are many studies that apply digital in learning (Rahmatullah, Mulyasa, Syahrani, Pongpalilu, & Putri, 2022). Researchers feel the need to further analysis related to digital learning (Baek & Sung, 2020; Kimm, Kim, Baek, & Chen, 2020). The topic is very relevant to the current trend of Education, which is starting to rely on digital. Therefore, the research question of this article are:

- a) To analyse the bibliometric keyword "digital learning" related to the research performance which consists of annual scientific production, most relevant source, most relevant author, most relevant affiliation, country scientific production and document.
- b) To analyse the bibliometric keyword "digital learning" related to science mapping which consists of Trend Topic, Co-Accurance Network, Thematic Map, Three-Field Plot, Collaboration Network and Collaboration World Map.

METHOD

Bibliometric analysis is used to review publications related to the scope of the study to identify the research trends, concepts, and necessary keywords (van Eck & Waltman, 2010). This study explores the scientific literature, analyzing the performance and trends of digital learning topics using bibliometric. The researchers use bibliometric maps to gain a better understanding, and trends in digital learning based on international publication (Arici, Yildirim, Caliklar, & Yilmaz, 2019; Bai, Li, & Liu, 2021). Researcher uses R Program (Biblioshiny) to perform the bibliometric analysis.

Biblioshiny is a web-based user interface that forms part of Bibliometrix, an R package designed for bibliometric analysis. Bibliometrix itself is a tool utilized for bibliometric analysis, a method for measuring and evaluating scientific literature (Aria & Cuccurullo, 2017). Through Biblioshiny, users can engage in more interactive and intuitive bibliometric analysis without the need for in-depth programming knowledge in R. This tool enables the importation of data from various sources like Scopus and Web of Science, performs descriptive analyses providing statistical summaries of datasets, identifies co-citation and co-authorship relationships, and generates effective data visualizations (Aria & Cuccurullo, 2017). Biblioshiny is particularly useful for researchers aiming to analyze trends and patterns in scientific literature, offering ease in processing and examining publication and citation data comprehensively.

The five stages carried out in this study are keyword determination, data search, article selection, data validation, and data analysis. Keyword determination is carried out in accordance with the objectives of this study, namely the study of digital learning in international publications. Therefore, the key word is;

TITLE-ABS-KEY("digital learning") 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)) AND (LIMIT-TO(DOCTYPE, "ar")) AND (LIMIT-TO(LANGUAGE, "English")) AND (LIMIT-TO(SRCTYPE, "j"))

The researcher then performs this keyword on Scopus database (Scopus.com). The results of the analysis showed that there were 1711 articles collected (see Figure 1)

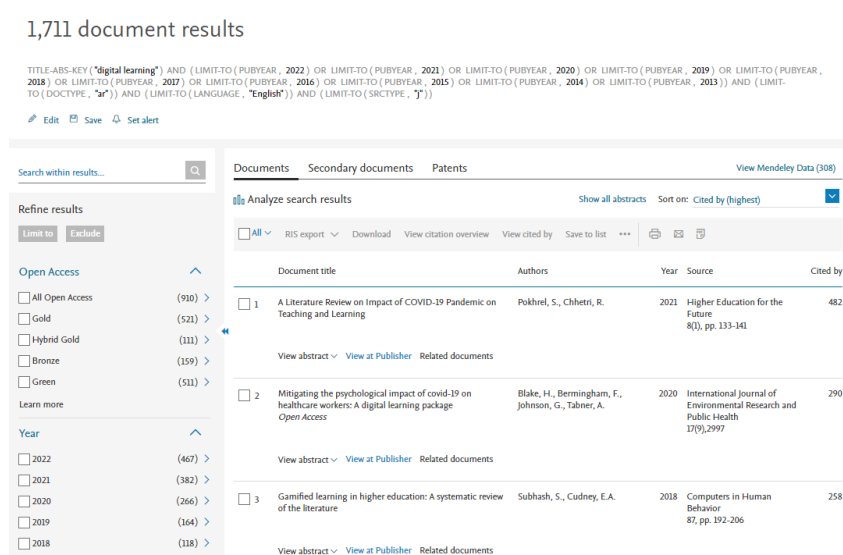


Figure 1. Metadata Mining Results on Scopus database

A search with these keywords on Scopus Database was conducted on 28 January, 2023. The results of the data searching are then selected and validated so that the data can be read and analysed. Both selection and validation are carried out in a form of diagrams and data tables that are categorized into several types. Research performance performed related to Main Information, most relevant Source, most relevant Author, most relevant Affiliation, Country scientific Production and Document. The science mapping displayed are about the Trend Topic, Co-Accurance Network, Thematic Map, Thematic Evaluation, Co-citation Network, Histography, Collaboration Network and Collaboration WorldMap.

ANALYSIS RESULTS

Research Performance

The research performance analysis aims to evaluate the performance of individuals, institutions and countries based on the publications. These objectives include which institutions are most active in conducting research on topic, which author discusses the most about the topic, which country discusses the most about the topic and so on. The research performance displayed in this study is related to Main Information, most relevant Source, most relevant Author, Most relevant Affiliation, Country scientific Production and Document.

Main Information

This section describes the distribution of articles about digital learning in each year. This research is limited to the articles published in 2013 to 2022. The results of the research is shown by Figure 2.

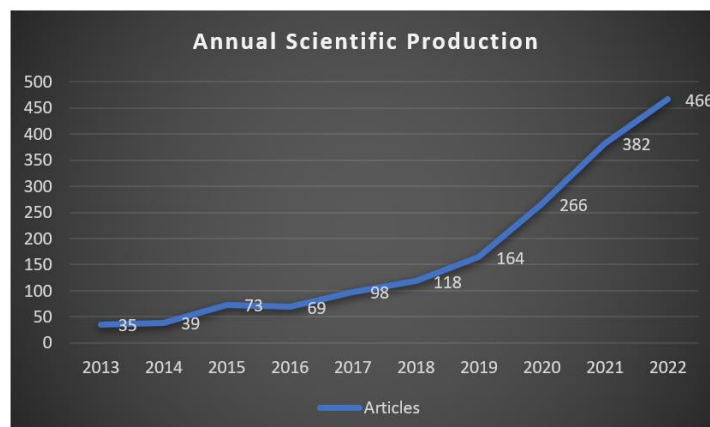


Figure 2. Annual Scientific Production

Data from Scopus shows that the number of articles on digital learning is continuously increasing each year. In 2013, there were only 35 articles discussing digital learning. The following year, in 2014, the number of articles increased to 39. In 2015, 73 articles were published, while in 2016, 69 articles were published and in 2017, 98 articles were published. Since 2018, the number of articles on digital learning has been over a hundred, with 118 articles being published. In 2019, the Scopus database had 164 articles, and in 2020, it had 266 articles. In 2021, 382 articles were published and in 2022, around 466 articles were published. Based on this information, the publication chart on digital learning continues to increase every year. The biggest increase was seen from 2019 to 2022, caused by the Covid-19 pandemic which forced the education world to quickly change and utilize digital technology in the learning process.

Most Relevant Source

This section serves which journals are most prolific in publishing articles related to digital learning. The following figure shows the results obtained.

Table 1. Most Relevant Sources

SOURCES	ARTICLES
Education And Information Technologies	41
Education Sciences	33
Computers And Education	32
Sustainability (Switzerland)	32
British Journal Of Educational Technology	31
Interactive Technology And Smart Education	26
Educational Technology Research And Development	24
Interactive Learning Environments	24
Frontiers In Psychology	23
International Journal Of Emerging Technologies In Learning	22

Table 1 displays the top 10 journals that have published the most articles regarding digital learning. The most productive journal was the Journal of Education and Information Technologies, with a total of 41 articles. The Journal of Education Sciences came in second place with 33 articles. Computers And Education placed third with 32 articles, followed by the Journal of Sustainability (Switzerland) and British Journal Of Educational Technology, with 32 and 31 articles. Interactive Technology and Smart Education came in sixth place with 26 articles. Educational Technology Research and Development and the Journal of Interactive Learning Environments both had 24 and 22 articles respectively. The final two journals on the list are the International Journal of Emerging Technologies in Learning with 22 articles and Frontiers in Psychology with 23 articles.

Most Relevant Author

This section describes the most productive authors in writing articles related to digital learning. Figure 3 presents the results of the analysis obtained.

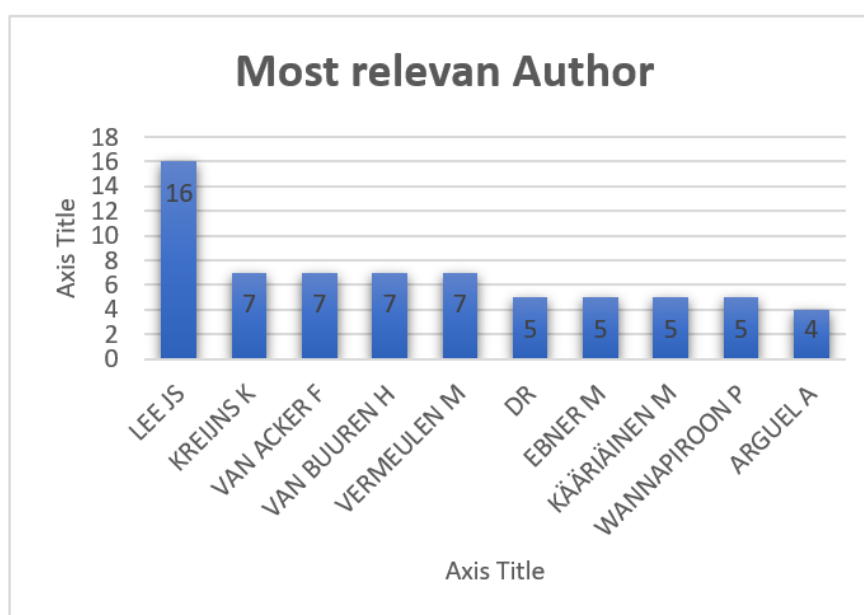


Figure 3. Most Relevant Author

This table lists the authors who have published articles on digital learning and the number of articles they have published. The author with the highest number of articles published is LEE JS with 16 articles, followed by

Kreijns K with 7 articles, Van Acker F with 7 articles, Van Buuren H with 7 articles, and Vermeulen M with 7 articles. The authors listed in the table have published between 5 and 16 articles on digital learning.

Most Relevant Affiliation

This section describes the most productive affiliations in term of producing digital learning-related articles. The results are presented by Table 2.

Table 2. Most relevant Affiliation

AFFILIATION	ARTICLES
Universitas Pendidikan Indonesia	39
Monash University	33
University Of Helsinki	30
Universiti Teknologi Mara	27
University Of California	27
University Of South Australia	25
University Of Oslo	23
University Of Oulu	23
Oslo Metropolitan University	22
University Of Nottingham	21

In this study, the data shows that some universities have a significant number of publications related to digital learning. Universitas Pendidikan Indonesia leads with a total of 39 publications. Monash University takes second place with a total of 33 publications. The University of Helsinki is in third place with a total of 30 publications. Universiti Teknologi Mara is in fourth place with a total of 27 publications. The University of California is in fifth place with a total of 27 publications. And so on, as shown in the table above. This provides an overview of the distribution of publications on digital learning by certain universities.

Country Scientific Production

This section discusses the most productive countries in producing digital learning-related articles. The data shows that the USA has the highest frequency with 763 articles, followed by Germany with 478 articles, China with 401 articles, Australia with 319 articles, and the UK with 299 articles. The other countries listed in the table also have significant numbers of articles, with Indonesia having 282 articles, India having 219 articles, Malaysia having 193 articles, Spain having 152 articles, and Canada having 140 articles. This table provides insight into the distribution of digital learning related articles across different regions of the world. The following figure (Figure 4) shows the results of the analysis.

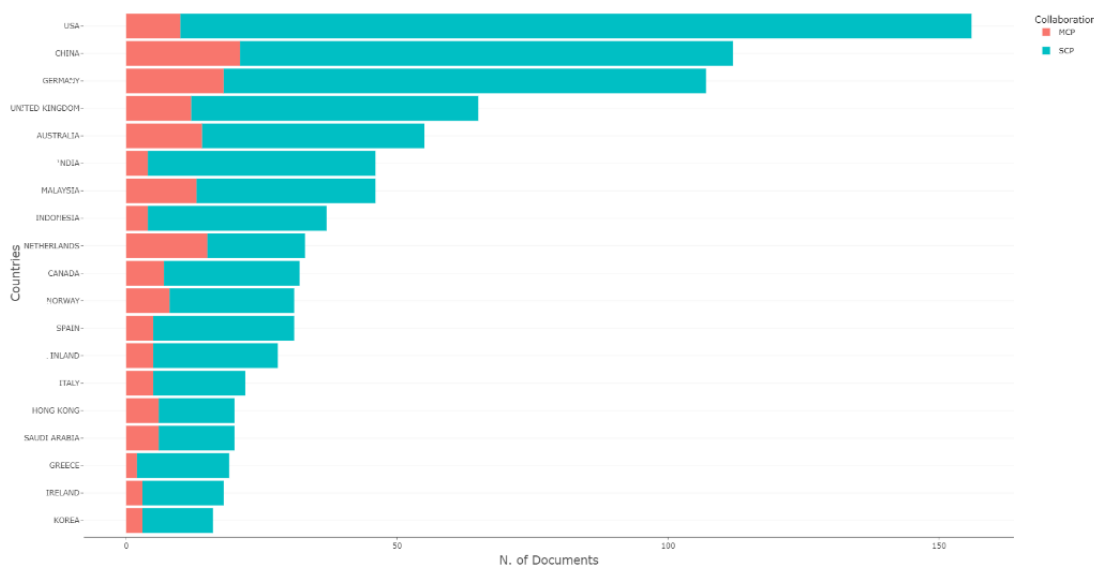


Figure 4. Country Scientific Production

Document

This section provides the information about the most cited documents related to digital learning. Table 3 presents the results obtained.

Table 3. Most Global Cite Documents

Paper	Doi	Total Citations
Pokhrel S, 2021, Hig Edu Future	10.1177/2347631120983481	482

Blake H, 2020, Int J Environ Res Public Health	10.3390/ijerph17092997	290
Subhash S, 2018, Comput Hum Behav	10.1016/j.chb.2018.05.028	258
Teräs M, 2020, Postdigit Sci Educ	10.1007/s42438-020-00164-x	175
Kumar Basak S, 2018, E-Learning Digit Media	10.1177/2042753018785180	170
Lin M-H, 2017, Eurasia J Math Sci Technol Educ	10.12973/eurasia.2017.00744a	147
Mulenga Em, 2020, Contemp Edu Tech	10.30935/cedtech/7949	115
Kreijns K, 2013, Comput Hum Behav	10.1016/j.chb.2012.08.008	113
Blau I, 2017, Comput Educ	10.1016/j.compedu.2017.07.014	111
Sousa MJ, 2019, Future Gener Comput Syst	10.1016/j.future.2018.08.048	108

This table presents a list of 10 research papers related to digital learning, along with their respective Digital Object Identifier (DOI), author, publication year, and total citations. The papers are ranked based on the number of citations they have received, with the first paper, Pokhrel S (2021), having the highest number of citations (482). Each paper is unique in its contribution to the field of digital learning, but all have received recognition for their impact, as reflected in the number of citations they have received.

Science Mapping

Science mapping aims to uncover the structure and dynamism of a study topic. This goal is more inclined to the level of subjective purpose. Science mapping is beneficial to map out the topics that have been discussed a lot, so that the researcher does not need to discuss any further. The map also provides information about what topics are still minimally discussed so that the researchers need to explore it further. The science mapping analysis includes the Trend Topic, Co-Accurance Network, Thematic Map, Three-Field Plot, Collaboration Network and Collaboration World Map.

Trend Topic

The trend topic analysis provides an insight into the development of research topics over time. By examining the trend of research themes for each year, we can identify which topics are gaining popularity and which topics are becoming less relevant in the field of digital learning. The results of the analysis are presented in Figure 5, which displays the trend of research themes over time. This information can be valuable in determining the direction of future research in the field, as well as identifying the current state of the field. Additionally, it can help researchers to identify the most relevant topics in their field and stay up-to-date with the latest developments. The trend topic analysis can also provide a historical perspective on the development of research themes, which can be useful for researchers who want to study the evolution of the field and its key drivers.

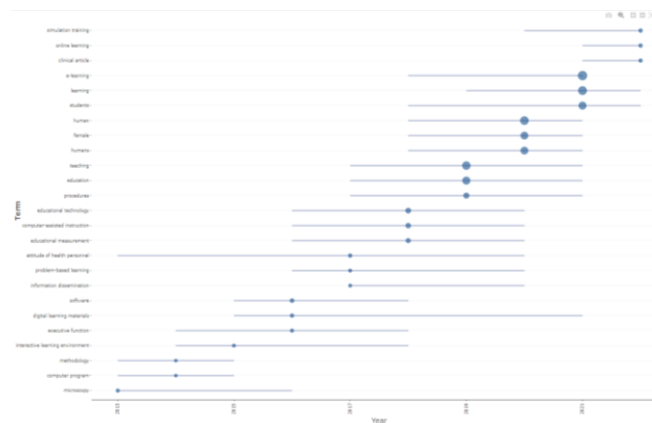


Figure 5. Trend Topic

The Trend Topic analysis is an important aspect in understanding the progression of research in a particular field. This is particularly true in the field of digital learning where there has been rapid advancements and changes in technology. The trend topics provide a glimpse into the most popular and in-demand themes in the field over a specified period. By analyzing the trend topics in digital learning, researchers and practitioners are able to understand the current state of the field and make informed decisions about future research and development. Figure 8 provides a clear representation of the trending topics in digital learning from 2013 to 2022. The data shows that simulation training, online learning, clinical articles, e-learning and learning are the most popular themes in 2022. However, it is important to note that this data is based on the number of published articles and may not reflect the true popularity of a certain topic. Nevertheless, the trend topic analysis provides valuable insights for researchers and practitioners in digital learning to make informed decisions about future research and development.

Co-Accuracy Network

The Co-Accurance Network analysis provides a visual representation of the interconnected relationships between themes in the field of digital learning. It helps to identify the topics that tend to be researched together

researched and studied topics with high centrality and density, such as digital learning environment and educational technology. The bottom right quadrant, referred to as "Basic themes," is considered a central theme but with low density, making these topics still suitable for research, such as instructional design and digital learning objects. The bottom left quadrant, referred to as "Emerging or declining themes," may contain themes that are either starting to decline or rise. To determine this, further study of the script is required. Examples of these themes include game-based learning and informal digital learning of English. Finally, the top left quadrant, referred to as "Niche themes," contains custom themes that are not very central but have a high density, such as virtual reality and augmented reality.

Three-Field Plot

The Three-Field Plot (Sankey diagram) is an effective tool for visualizing the distribution of research topics based on the keywords, countries, and affiliations. This diagram was created using the Bibliometrix software, which is a tool used to perform a bibliometric analysis of a large data set. The results of the analysis show that the USA is the leading country in terms of digital learning research. The University of California is the most active affiliation in this area, producing a significant number of digital learning research papers. Meanwhile, Indonesia is also a significant contributor to the research in this area, with the majority of digital learning research being produced by Universitas Pendidikan Indonesia.

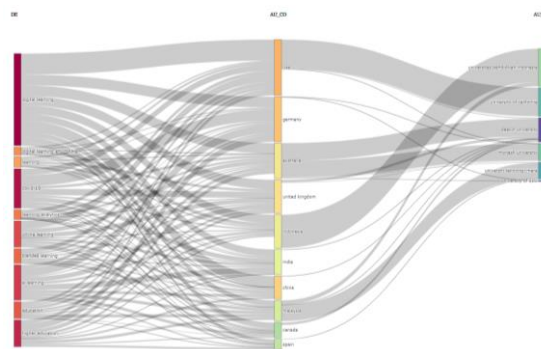


Figure 8. Three-Field Plot (Keyword, Country and Affiliation)

The Three-Field Plot provides valuable information on the distribution of research topics within each country and affiliation. This information can be used by researchers to identify areas of strength and weakness and to determine which countries and affiliations are at the forefront of digital learning research. It can also help institutions and organizations to develop strategies for enhancing their research and collaboration efforts in the digital learning field. The results of the analysis should be interpreted with caution, however, as they are based on the available data in the Scopus database, which may not include all relevant research articles. Nevertheless, the Three-Field Plot provides a useful starting point for further research and analysis.

Collaboration Network

The analysis of the network collaboration showed that there are 6 distinct clusters related to digital learning keywords. These clusters contain affiliations that are interrelated and have collaborated in producing research in the field of digital learning. The collaboration network was represented in the form of a graph in Figure 9, with each node representing an affiliation and the edges connecting the nodes showing the collaboration relationships between the affiliations. The different clusters were formed based on the level of collaboration between the affiliations and demonstrate the various collaboration patterns and networks in the field of digital learning. The presence of these distinct collaboration clusters provides important insights into the research landscape in digital learning and highlights the relationships between the different affiliations in terms of collaboration.

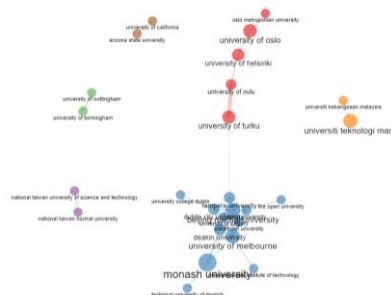


Figure 9. Collaboration Network

A Collaboration Network analysis was performed, and the results showed that there are 6 distinct clusters of universities. Cluster 1 consists of universities in Finland including University of Helsinki, University of Oulu,

and University of Turku among others. Cluster 2 includes universities from various countries such as Monash University in Australia, Deakin University, and Technical University of Munich in Germany. Cluster 3 is comprised of the University of Nottingham and the University of Birmingham in the UK. Cluster 4 consists of universities in Taiwan including National Taiwan Normal University and National Taiwan University of Science and Technology. Cluster 5 includes advanced technology universities and National University of Malaysia. Finally, Cluster 6 consists of the University of California and Arizona State University.

Collaboration World Map

The results of the Collaboration World Map show a network of collaboration between countries related to digital learning research trends. The thicker the lines formed, the more frequent the researches performed together. The more lines to country, the more productive the country in doing research collaboration. The results of the analysis show that countries such as the USA, Australia, UK, Germany, China, and Canada are having a lot of collaboration between countries (See Figure 10).



Figure 10. Collaboration World Map

DISCUSSION

In today's digital world, there are a lot of studies in digital learning. Researchers feel the need to further analysis related to the topic because it is very relevant to the current trend of Education which is starting to rely on digital (Martin, McMaster, & Carey, 2020; Yan & Chen, 2021). This dependence also is keep increasing especially during the pandemic. This article aims to analyse the research performance related to the annual scientific production, most relevant source, most relevant author, most relevant affiliation, country scientific production and document. Another goal of the study is to analyse the keyword "digital learning" related to science mapping consisting of Trend Topic, Co-Accurance Network, Thematic Map, Thematic Evaluation, Collaboration Network and Collaboration World Map.

Digital learning article manuscripts continue to increase from year to year, the peak was in 2021. The source analysis section displays the 10 journals that publish the most articles on the topic. In the trend topic section sorted by the latest trends in 2022. In 2022 the trending topics are simulation training, online learning, clinical articles, e-learning and learning. The results of bibliometric analysis for the Co-Accurance Network shows that there are 10 clusters produced. Based on the analysis of network collaboration, there are 6 clusters related to digital learning keywords. The 6 clusters contain interrelated and collaborating affiliates. The results of the Collaboration World Map analysis show a network of collaboration between countries related to digital learning research trends. The thicker the lines formed, the more frequency and the more lines to each country, the more lines to each country, the more productive the country is doing research collaboration. The results of the analysis show that countries such as USA, Australia, UK, Germany, China, and Canada are having a lot of collaboration between countries.

The findings of the analysis of the global research trend in digital learning using the Bibliometrix on the Scopus database provide valuable insights into the current state of the field. It is observed that there is an increase in research activities in the field of digital learning, with a focus on topics such as digital learning environments, educational technology, and instructional design. This highlights the growing importance of digital learning as a tool for improving education and the need for further research in this area.

This research is the importance of universities and academic institutions to be aware of the latest trends and developments in the field of digital learning. This will help them to stay ahead of the curve in terms of the latest teaching and learning methodologies, which will in turn benefit their students. In addition, this research can also be useful for policymakers in the education sector, helping them to make informed decisions about the allocation of resources and the development of new policies and initiatives related to digital learning.

CONCLUSION

This article analyzed the research trend of digital learning using bibliometrics on the Scopus database. The results of this study have several implications for the field of digital learning. Firstly, the results highlight the importance of digital learning and its impact on education. The emergence of new themes in digital learning, such as game-based learning and virtual reality, presents opportunities for further research in these areas. Finally, the collaboration network analysis highlights the importance of international collaboration in the field of digital learning, as universities from different regions are working together to advance the field. The results of this study provide a valuable overview of the global research trend in digital learning. The study highlights the importance of digital learning and the emergence of new themes in the field. Additionally, the collaboration network analysis highlights the importance of international collaboration in the field of digital learning. Further research is recommended to expand the scope of the analysis and better understand the global research trend in digital learning.

Research Limitations

Despite the valuable insights provided by this research, there are also some limitations that must be considered. Firstly, the data used in this study is limited to the Scopus database, which may not be a comprehensive representation of the global research trend in digital learning. Additionally, the Bibliometrix method used in this study is subject to various limitations, such as the difficulty in accurately quantifying the impact of a particular research paper or the difficulty in accurately measuring the impact of certain research areas. The effectiveness of this bibliometric study has not been fully realized due to various constraints imposed by the researchers. For instance, the search for terms within abstracts can be broadened by incorporating synonyms, like using 'e-learning' as an alternative term. The scope of this study was limited to journal articles only. However, other forms of publications, such as book chapters and conference papers, are also viable for inclusion in bibliometric analyses. This particular research was confined to examining publications from the period 2013 to 2022, thereby excluding works from other years. Future studies could benefit from extending the timeframe of analysis. Additionally, by not limiting the search to only articles on Scopus but also including other types of documents like book chapters and conference proceedings, a more comprehensive research can be conducted across varied data sets, such as those available on Web of Science (WoS).

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