Bibliometrics and visual analysis: Trends in instructional design in a blended learning environment in the post-pandemic era

Feng Yuanyuan[1], Rajendran Nagappan[2]

1Faculty of Arts, Communication & Education, Infrastructure University Kuala Lumpur, Jalan Ikram-Uniten, 43000, Kajang, Selangor Darul Ehsan, Malaysia
Email: 213923005@s.iukl.edu.my
2Adjunct Professor of Education, University of Cyberjaya and Infrastructure University Kuala Lumpur
Email: rajensaratha@gmail.com

Abstract

Blended learning has been a major trend since the early 2000s, combining the advantages of online and face-to-face teaching[1,2]. Blended learning has the potential to provide learners with choice and flexibility to participate in the online portion of the course[3].In particular, the COVID-19 pandemic has significantly increased the prevalence of blended learning teaching models, which many expect to continue to increase even after the COVID-19 pandemic is over[4,5]. The main goal of this study was to use advanced analytical tools, in particular VOSviewer and Scimago Graphica, to conduct a comprehensive analysis of academic articles on this critical topic of instructional design in mixed environments for the period from 2020 to April 2024. A rigorous screening process was meticulously carried out, ultimately identifying 67 relevant articles from the highly respected Web of Science database, subject to specific conditions set by the researchers. The main result of this study is to comprehensively examine and identify the outstanding research hotspots in the field of instructional design under the blended learning environment. The results of this research investigation are expected to make a significant contribution to the existing body of knowledge, provide valuable insights, and facilitate further understanding of current research and subsequent developments in the field.

Keywords— blended learning、instructional design、Vosviewer、Scimago Graphic、Post-pandemic Era

I. INTRODUCTION

Blended learning is a type of learning that combines both online and offline teaching[6]. More specifically, it combines synchronous and asynchronous learning[7]. Blended learning not only preserves the integrity of traditional learning, but also promotes the application of online learning, mobile technology, and active learning methods[8].

Blended learning has emerged to enhance the learning experience for students while increasing their flexibility and convenience. With the outbreak of the COVID-19 pandemic, the need for blended learning in higher education has become more apparent[9]. In 2020, COVID-19 spread across the globe and was declared a global pandemic by the World Health Organization, with an unprecedented impact on all areas of life, including education[10,11]. In order to protect the safety of students and continue teaching activities, educational institutions have to turn to online learning[12]. Blended learning has been a common modality during the COVID-19 pandemic, especially after the first spike in infections and widespread vaccination in some countries[13].

Due to the urgency of the pandemic, e-learning efforts are mainly focused on digital transformation, through instructional design and technology application to achieve learning goals[14]. In this process, key factors such as domain objectives, appropriate methodology, and cultural and practical considerations are often overlooked or deviated from[15,16]. In order to meet the different needs in the education and training environment, as well as advances in information technology, learning sciences, brain sciences, and other related fields, new teaching methods are constantly being developed[17]. Teachers are asked to apply different teaching strategies that are appropriate for online Settings[12]. Teachers are encouraged to design and implement a variety of blended learning strategies to address student diversity[18].

Two key terms "blended learning" and "instructional design" are discussed in this study. VoSviewer and Scimago Graphica graphical interfaces for data analysis on the Web of Science. The remaining research is organized as follows. The second part introduces the research methods and data collection. The third part gives the result of the visualization analysis. In the fourth part, the results of the visualization analysis are discussed. The fifth part is about the summary and limitations of the research.

To modify the header, double-click in the Header section at the top of this page. Fill in the author and article titles.

To insert images in Word, position the cursor at the insertion point and either use Insert | Picture | From File or copy the image to the Windows clipboard.

II. METHODS AND DATA COLLECTION

2.1 Methods

In this bibliometric analysis, a systematic literature review is conducted to explore the research development trends of instructional design in blended learning since the beginning of the pandemic (starting in 2020). The researchers used VOSviewer and Scimago as tool software for visual analysis and bibliometrics. In this study, VOSviewer and Scimago graphics software are used to analyze bibliometrics and generate bibliometrics knowledge maps.

VOSvivewer is a Java-based application that can be used to generate maps based on network data, as well as to visualize and examine those maps. While there are many programs and tools for bibliometric analysis, VOSviewer has excellent visualization capabilities and can efficiently handle data import and export from a variety of sources[19]. VOS offers the possibility of using text mining capabilities to build A co-concurrent network of important terms extracted from a corpus of scientific literature. Therefore, this paper provides a way to use VOSviewer to manage text and generate a visual map of data sets.

Scimago Graphics is a specialized tool created to facilitate data visualization and exploratory research[20].

2.2 Data Collection

In this study, the identified dataset is from the Web of Science. The researchers identify the Topic = as "blended learning" and "instructional design", and not document types = "Review Article" or "Proceeding Paper" or "Book Chapters". And 67 articles were selected.

After the data collection is completed, the data is preprocessed. The initial phase is to remove duplicate parts of the data. No duplicate data was found. Cleaning and summarizing the data is the next stage. Prior to keyword co-occurrence analysis, a clean keyword summary helps researchers to better extract research frontiers and trend analysis[21].

Figure 1 shows the year of publication of this study. The year of publication shows that 2020 is the year with the most research on instructional design for blended learning. Although there was a decline in research in 2021, the following two years saw an upward trend in research in this area, and the number of studies has been maintained. This shows that researchers continue to explore and pay attention to the teaching design under blended learning.
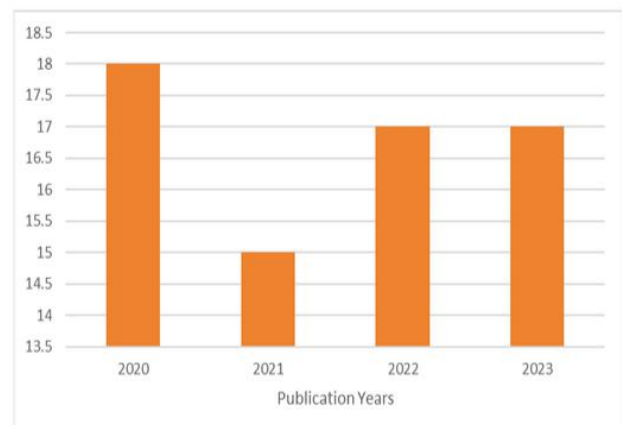

Fig.1: Publication Years

The references to these 67 Web of Science articles are shown in Table 1. The data showed that more than 50% of the articles (34 articles) came from ESCI, about

40% (27 articles) from SSCI, and more than 25% (17 articles) from SCIE.

Table 1. Web of Science Index

Web of Science Index	Record Count	% of 67
Emerging Sources Citation Index (ESCI)	34	50.746
Social Sciences Citation Index (SSCI)	27	40.299
Science Citation Index Expanded (SCI-EXPANDED)	17	25.373

Figure 2 shows the top 5 journals. Journal papers published in the top 5 publications accounted for almost 69 percent of all published papers. Springer Nature topped the list with 24 percent, 9 percentage points ahead of Elsevier (15 percent). "Sage" and "Taylors & Francis" tied for third place with 9%. Springer Nature (No. 1) and Elsevier (No. 2) together publish more articles than the third - to fifth-ranked publishers combined. Specifically, Springer Nature, the most widely distributed journal, provided articles that accounted for nearly a quarter of the data. This also reflects that it is perhaps the most prominent journal that focuses most on this area of research.
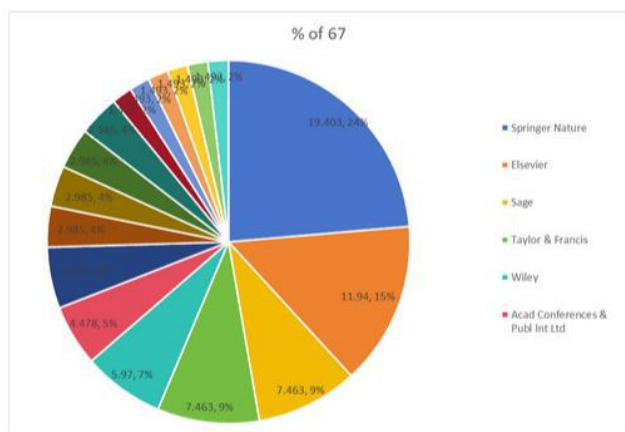

Fig2.: Publishers

III. RESULTS AND DISCUSSION

Table 2 describes the top five research categories for the 67 publications in the study. According to Table 2,

we believe that the distribution of research categories is mainly concentrated in the field of education, in which teaching and educational research published 35 articles, accounting for more than 50% of the total. This result shows that related research has great development potential in this field, and also reflects the main application sites and needs. It was closely followed in education and science. In computer application, nursing, management, and other fields, the research has also been involved and expanded, and the future may be extended to a wider range of application scenarios.

Table 2. Web of Science Index

Web of Science Categories	Record Count	% of 67
Education Educational Research	35	52.239
Education Scientific Disciplines	6	8.955
Computer Science Interdisciplinary Applications	4	5.97
Nursing	4	5.97
Management	3	4.478
Computer Science Information Systems	2	2.985
Information Science Library Science	2	2.985
Medicine General Internal	2	2.985
Multidisciplinary Sciences	2	2.985
Social Sciences Interdisciplinary	2	2.985

Figure 3 statistics show that 67 publications have authors from 32 countries and territories. As can be seen from Figure 3, research in this field is mainly concentrated in North America, Europe, Asia, Southeast Asia and other regions. However, only a few countries and regions in Africa and Central Asia have relevant studies.

Fig.3: The Publication Countries

This study uses VOSviewer visual analysis software to investigate and describe the hot spots and future trends in instructional design research in blended learning environments. The first part examines the co-emergence of research terms for instructional design in all blended learning environments. Secondly, the word cloud image display in this study is discussed.

In this section, the researchers used all keywords (including author keywords and keyword +) for co-occurrence analysis. Figure 4 depicts a research term co-occurrence network for blended learning and instructional design. The researchers set the minimum number of keyword occurrences to two. Thirty-four of the 308 keywords passed the criteria.

In the keyword co-occurrence network, 10 clusters are displayed. Analysis of the importance of the co-occurrence data shows three important clusters. The first is the yellow cluster, including a total of 5 keywords, keywords, and other clusters that produce the most co-occurrence data. There are three keywords. The first keyword is blended learning (Total link strength= 53, Occurrences=38). The second is higher education (Total link strength=22, Occurrences=10). The third term is design-based research (Total link strength= 4, Occurrences=2). The second cluster, the purple cluster, contains a total of three keywords, the important one of which is instructional design (Total link strength=24, Occurrences=20). The third cluster is the red cluster, which also contains the most keywords, a total of 8 keywords. The most important keyword was covid-19 (Total link strength=13, Occurrences=6). The rest include the green cluster, a Total of 6 keywords, mainly to show the emergence of online learning (Total link

strength=12, Occurrences= 5) as a keyword. Blue cluster, a Total of 5 keywords, the most important keyword is collaborative learning (Total link strength=4, Occurrences=2).
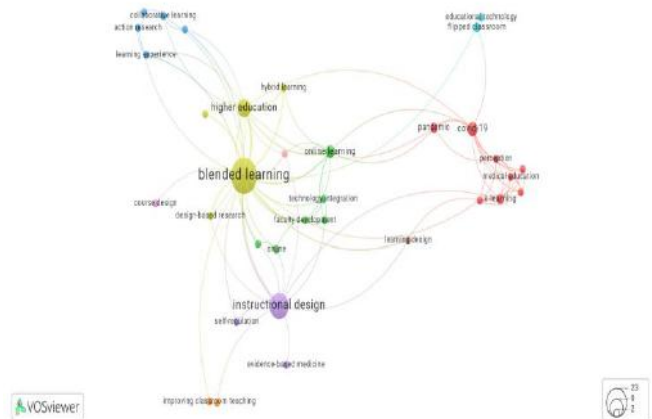

Fig.4: Keyword Co-Occurrence Network.

Figure 5 shows the term co-occurrence overlay network. Using an overlay network, the researchers found the top five terms that have appeared recently and have a high proportion. The most important term is blended learning (Total link strength= 53, Occurrences=38). The second is instructional design (Total link strength=24, Occurrences=20). The third is higher education (Total link strength=22, Occurrences=10). The fourth is the COVID-19 pandemic (Total link strength=13, Occurrences=6). The fifth is online learning (Total link strength=12, Occurrences= 5). However, in terms of time, the term that comes closest to the study is technology integration (Total link strength= 4, Occurrences=2), MOOC (Total link strength=3, Occurrences=2), pre-service teachers (Total link strength=4, Occurrences=2) and stem (Total link strength=5, Occurrences= 2), the emergence of these terms may represent the latest research direction in this research field and bring new perspectives for future research.

Figure 6 depicts the frequency of concurrent term clusters in instructional design research in blended learning environments. Blended learning, instructional design, higher education, and online learning are the most common terms in this cluster. Other terms with a relatively high frequency include outbreaks and case studies. These results provide useful insights into the main focus areas and themes of blended instructional design research.
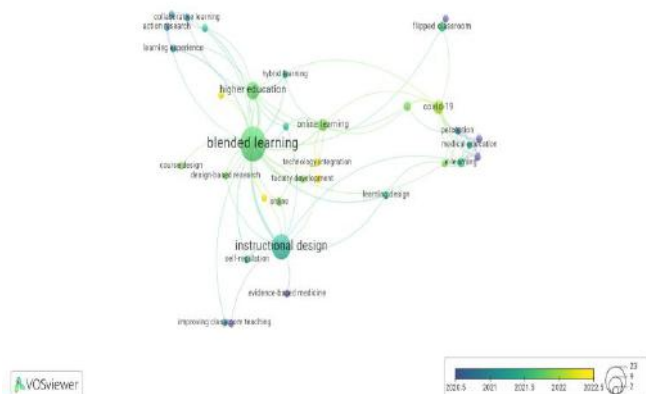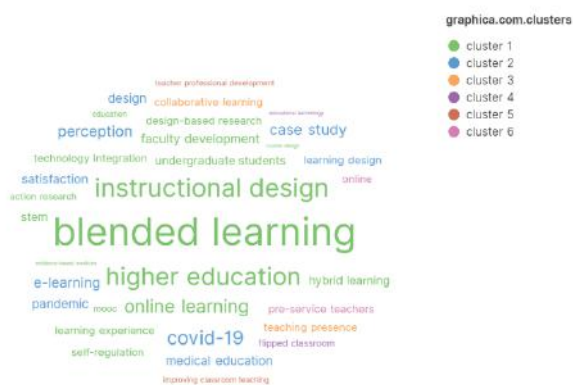
Fig.5: Keyword Co-Occurrence Overlay

Fig.6: Keyword Cloud Map

IV. CONCLUSION AND LIMITATIONS

This report examines the research hotspots of instructional design in the blended learning environment. All publications were published between January 2020 and April 2024 in journals obtained by the Web of Science. These analyses include the year of publication analysis, journal-level analysis, journal cluster analysis, and author country distribution analysis.

The researchers also carried out keyword co-occurrence analysis, including keyword cluster analysis and keyword burst analysis. Using this integrated approach, it is possible to gain important insights into research dynamics and trends in the field in the post-pandemic period. In the analysis of keyword co-occurrence, there are three main types of clusters, which embody blended learning, instructional design, epidemic, and other related research terms. In this

process, new hot spots such as technology integration and pre-service teachers were also found, which expanded a new perspective for future research.

This study received a total of 67 publications from the Web of Science, ensuring a high level of scientific rigor. Still, there are certain limitations. The first is that relying only on a single database can lead to serious distortion of the results. The second is that the sample size reflects only a specific time and stage. To overcome this, future studies should use more sources and a variety of data sets to achieve a more comprehensive and balanced study. It is also possible to compare pre - and post-pandemic studies to explore more comprehensive insights.

REFERENCES

[1] Allen I E, Seaman J. Sizing the opportunity: The quality and extent of online education in the United States, 2002 and 2003.[J]. Sloan Consortium (NJ1), ERIC, 2003.

[2] Graham C R. Blended learning systems[J]. The handbook of blended learning: Global perspectives, local designs, 2006, 1: 3–21.

[3] Owston R O N. Empowering learners through blended learning[A]. International Journal on E-Learning[C]. Association for the Advancement of Computing in Education (AACE), 2018, 17(1): 65–83.

[4] SiRiPongdee K, Pimdee P, Tuntiwongwanich S. A blended learning model with IoT-based technology: effectively used when the COVID-19 pandemic?[J]. Journal for the Education of Gifted Young Scientists, 2020, 8(2): 905–917.

[5] Yang H, Cai J, Yang H H, et al. Examining key factors of beginner's continuance intention in blended learning in higher education[J]. Journal of Computing in Higher Education, 2023, 35(1): 126–143.

[6] Cubric M. Wiki-based process framework for blended learning[A]. Proceedings of the 2007 international symposium on Wikis[C]. Montreal Quebec Canada: ACM, 2007: 11–24.

[7] Nurrijal, Punaji Setyosari, Dedi Kuswandi, et al. Creative Problem Solving Process Instructional Design in the Context of Blended Learning in Higher Education[J]. Electronic Journal of e-Learning, 2023, 21(2): 80–97.

[8] Moskal P, Dziuban C, Hartman J. Blended learning: A dangerous idea?[J]. The Internet and Higher Education, 2013, 18: 15–23.

[9] Alammary A S. How to Decide the Proportion of Online to Face-to-Face Components of a Blended Course? A Delphi Study[J]. SAGE Open, 2022, 12(4): 215824402211384.

[10] Cheng L, Lam C Y. The worst is yet to come: the psychological impact of COVID-19 on Hong Kong music teachers[J]. Music Education Research, 2021, 23(2): 211–224.

[11] Joseph D, Lennox L. Twists, turns and thrills during COVID-19: music teaching and practice in Australia[J]. Music Education Research, 2021, 23(2): 241–255.

[12] Chang Y, Lee E. Addressing the challenges of online and blended STEM learning with grounded design[J]. Australasian Journal of Educational Technology, 2022: 163–179.

[13] Lapitan L DS, Tiangco C E, Sumalinog D A G, et al. An effective blended online teaching and learning strategy during the COVID-19 pandemic[J]. Education for Chemical Engineers, 2021, 35: 116–131.

[14] Brittz K, Madisa M, Lizemari Hugo-Van Dyk, et al. A Cost-Effective Work-Based Interprofessional Collaboration Program for Healthcare Professionals:[J]. International Journal of Online Pedagogy and Course Design, 2022, 13(1): 1–16.

[15] Adedoyin O B, Soykan E. Covid-19 pandemic and online learning: the challenges and opportunities[J]. Interactive Learning Environments, 2023, 31(2): 863–875.

[16] Dhawan S. Online Learning: A Panacea in the Time of COVID-19 Crisis[J]. Journal of Educational Technology Systems, 2020, 49(1): 5–22.

[17] An Y. A History of Instructional Media, Instructional Design, and Theories[J]. International Journal of Technology in Education, 2020, 4(1): 1.

[18] Sanusi M S. Action research to reassess the acceptance and use of technology in a blended learning approach amongst postgraduate business students[J]. Cogent Education, 2022, 9(1): 2145813.

[19] Moral-Muñoz J A, Herrera-Viedma E, Santisteban-Espejo A, et al. Software tools for conducting bibliometric analysis in science: An up-to-date review[J]. El Profesional de la Información, 2020, 29(1).

[20] Eck N, Waltman L. Citation-based clustering of publications using CitNetExplorer and VOSviewer.[J]. Scientometrics, 2017, 111(2).

[21] Li L. Big data visualisation in regional comprehensive economic partnership: a systematic review[J]. Humanities and Social Sciences Communications, 2023, 10(1): 868.