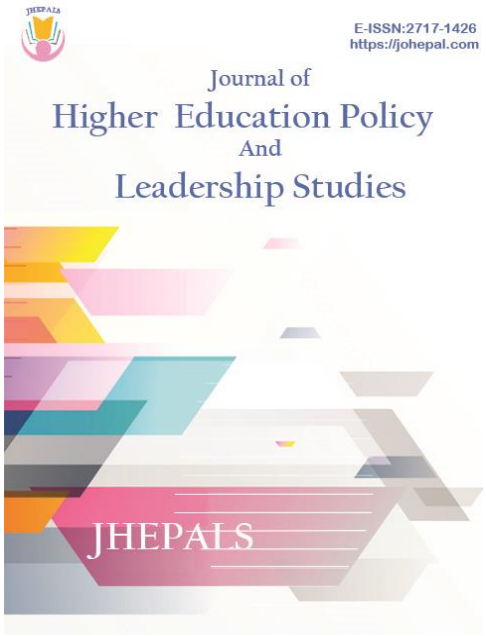
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Exploring Research Trends and Network Characteristics in Blended Learning in Higher Education: Bibliometric Methods and VOSViewer Software Analysis



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Exploring Research Trends and Network Characteristics in Blended Learning in Higher Education: Bibliometric Methods and VOSViewer Software Analysis

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Highlights

- Blended Learning (BL), an innovative, technology-supported pedagogical approach, has gained widespread adoption in schools and universities. Its effectiveness has been scrutinized across various educational domains, including education, computer science, nursing, engineering, and psychology.
- This study examines the major trends in BL research in higher education (HE) through co-occurrence keyword, co-citation, and bibliographic coupling analyses of 1501 studies published between 2004 and 2024 and indexed in the Scopus database core collection. Employing a quantitative approach and visual analytical tool VOS Viewer, the review identifies development trends, influential researchers and institutions, and pivotal studies and topics in the field, informing future progression.
- The findings reveal a significant growth in BL research over the past decade, evidenced by exponential publication and citation increases. Over the past 20 years, the field of BL has coalesced around a conceptual core primarily focused on transforming teaching by integrating face-to-face instruction with IT applications. This underscores the enduring importance of BL at HE in shaping policies and practices in higher education.

Keywords: Blended Learning; Co-occurrence Keyword Analysis; Co-citation; Bibliographic Coupling Analysis; Scopus Database; VOSViewer; Higher Education

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Introduction

Blended Learning (BL) is a teaching approach that integrates traditional teaching methods with E-learning. Higher education exhibits several conducive traits for BL implementation, including high levels of information technology proficiency among learners and educators, as well as widespread technology accessibility. The BL model promotes educational creativity, self-directed learning, and early-stage motivation (Scardamalia & Bereiter, 2003). In today's educational landscape, the flexibility of a BL environment is increasingly indispensable (Chen et al., 2008). Sahin and Shelley's research (2008) highlights the necessity for meticulously designed and thoughtfully implemented online learning environments that effectively address the needs and expectations of students.

Bibliometrics is a statistical methodology used to analyze fundamental document information such as authors, keywords, and references, offering insights into the progression of research topics (Nicolaisen, 2010; Van Raan, 2005). It encompasses various techniques, including citation analysis, bibliographic coupling analysis, co-word analysis, and co-citation evaluation (Leung et al., 2017; Nicolaisen, 2010). Co-citation analysis is employed to uncover the structure of research topics, while bibliographic coupling analysis is utilized to identify potential research opportunities. This study aims to address the following research questions:

RQ 1: What are the predominant topics in the BL in HE literature?

RQ 2: What are the anticipated research trends in BL in HE?

Literature Review

Blended Learning (BL)

The concept of Blended Learning (BL) has garnered significant attention due to its combination of traditional in-person instruction with online learning methods. Graham (2006) explore the term "blended," tracing its historical roots, current status, and future potential in the context of higher education (HE). Numerous factors have influenced the rise and development of BL. Graham et al. (2013) propose a comprehensive framework and matrix for BL implementation within college environments. Furthermore, McGee and Reis discuss the widespread adoption of blended courses in HE, highlighting the critical role of effective course design. According to Garrison and Vaughan (2008), BL is defined as a deliberate integration of face-to-face and virtual learning experiences, enhancing student engagement and flexibility in accessing course materials.

Co-occurrence Keyword Analysis

Keyword co-occurrence analysis plays a pivotal role in identifying thematic patterns within the BL research corpus. The frequency with which word pairs appear together across multiple articles determines the strength of the connection between them (Radhakrishnan et al., 2017). This technique highlights frequently occurring keywords, indicating shared topics among documents (Lozano et al., 2019). By mapping the co-occurrence of keywords within BL and HE research, scholars can reveal related topics, prominent research themes, and emerging trends in the field (Zupic & Čater, 2015). This approach also enables rapid analysis of large datasets, facilitating the creation of knowledge maps and the identification of critical research areas before undertaking a detailed review (Radhakrishnan et al., 2017).

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Identifying Significant Keywords in Bibliometrics

Choi et al. (2011) categorize efforts to identify important publication keywords into two main strategies: popularity-based approaches, which focus on keyword frequency, and network-based approaches, which rely on centrality measures. High-frequency keywords often signify critical research themes and serve as focal points in bibliometric analysis. These keywords are frequently filtered by predetermined thresholds to ensure only the most significant topics are highlighted.

Co-citation Analysis

In academic writing, scholars cite existing research to support their work, acknowledging the novelty and impact of previous studies (Case & Higgins, 2000). The frequency of citations is widely regarded as an indicator of research importance (Merton, 1973). Co-citation occurs when two distinct publications are referenced within the same paper. This co-citation pattern reveals a scholarly connection, as authors tend to cite papers that cover topics relevant to their own research (Small, 1973). Co-citation analysis can uncover prominent research topics, identify influential publications, and provide a structured view of the field (Chen et al., 2010; Kuo & Yang, 2012).

Through cluster analysis, co-citation patterns are grouped into clusters, with papers in the same cluster sharing thematic similarities (Kaufman & Rousseeuw, 2009). This combination of cluster analysis and visualization offers insights into the structure of research networks. Additionally, co-citation analysis identifies emerging trends by detecting papers and topics that have recently gained prominence (Chen, 2006).

Bibliographic Coupling

Bibliographic coupling measures the relationship between two papers based on the number of shared references, referred to as the "coupling strength" (Martyn, 1964). The more citations two articles share, the stronger their coupling strength. Although some studies argue that co-citation analysis provides a more accurate representation of research structures (Bichteler & Eaton, 1980), bibliographic coupling remains a valuable method for identifying potential research areas (Zhao & Strotmann, 2008). It complements co-citation analysis by providing a historical perspective on the intellectual connections between documents in the BL research landscape.

Research Methodology

Search Criteria and Source Identification

Scopus was selected as the primary database for this study due to its rigorous and consistent inclusion criteria for indexed papers. It also provides a broader range of publications, particularly in social sciences and education, compared to the Web of Science (Hallinger & Chatpinyakoop, 2019). The search encompassed journal articles, books, book chapters, and conference proceedings, with no restrictions on publication date. The relevant studies published between 2004 and 2024 were retrieved.

Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2010), 2,891 documents (including journal articles, book chapters, conference papers, and books) were initially identified. The search used the

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keywords “Blended learning” and “higher education,” refined to ">2004 AND PUBYEAR 2024" across titles, abstracts, and keywords to ensure precise selection. The query used was: “TITLE-ABS (Blended learning in higher education*) AND PUBYEAR >2004 AND PUBYEAR 2024*.” A final dataset of 1,501 documents related to blended learning in higher education (BL in HE) was selected for bibliometric analysis.

Data Analysis

The metadata of selected documents from 2004 to 2024 were exported from Scopus and processed using VOSviewer, a bibliometric mapping tool (Van Eck & Waltman, 2014). VOSviewer allowed analysis of both author and document citation patterns, as well as author co-citation relationships. Co-citation analysis, which measures how frequently two authors are cited together, helps identify intellectual linkages among researchers (White & McCain, 1998; Small, 1973). The study visualized these linkages using co-citation counts, enabling the construction of a network map of the scholarly domain.

Results

Research Question 1: What are the predominant topics in the BL in HE literature?

As depicted in Table 1 and Figure 1, alongside the keyword "Blended learning" (appearing 910 times), other prominent keywords include "Higher education" (594 times), "Online learning" (246 times), "Teaching" (162 times), and "Learning" (150 times). The keyword table below highlights several areas that BL research within higher education encompasses.

Table 1.
Visual representation of Keywords network in the research area of BL from 2004-2024 (Source: Authors’ own elaboration, using VOS viewer)

No.	Keywords	Number of occurrences	Total link strength
1	Blended learning	910	3537
2	Higher education	594	2517
3	teaching	162	1615
4	Learning	150	1614
5	human	144	1570
6	student	103	1552
7	article	187	1482
8	Online learning	246	1456
9	Covid 19	78	1257
10	Human experiment	82	881

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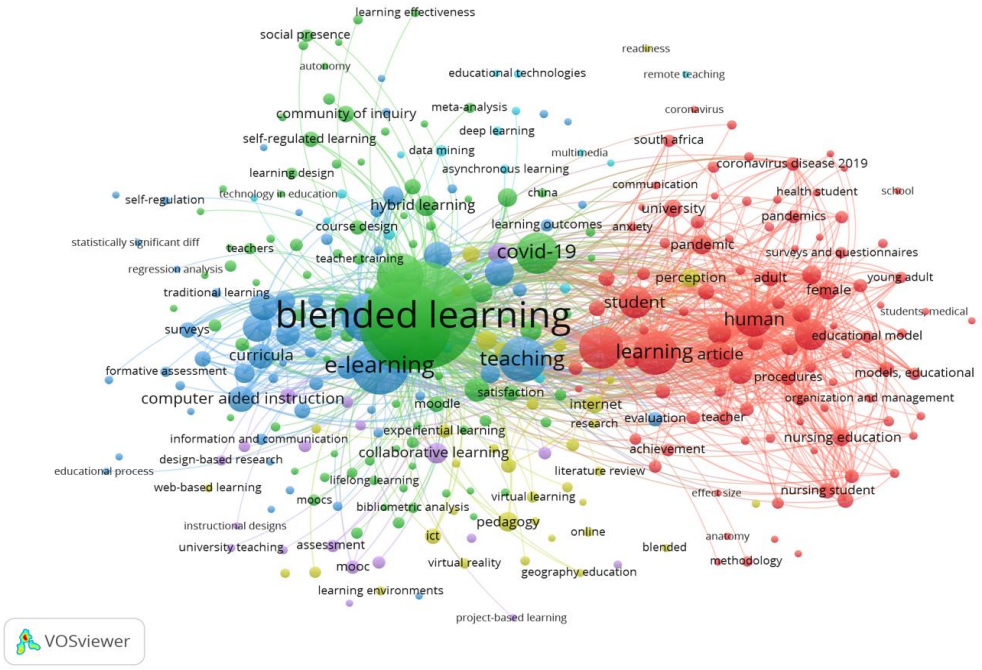


Figure 1. Co - occurrences Keyword about BL at HE (Minimum number of occurrences of a keyword: 5)

Research Question 2: What are the anticipated research trends in BL in HE?

Co-citation:

This study analyzed co-citations from these 1501 articles. Furthermore, the smart local moving algorithm method, as described by Van Eck and Waltman (2014), was employed to explore the structure of BL research in higher education (HE). The co-citation network of BL research in HE is visualized in Figure 2, where the size of the bubbles represents the number of standardized citations received by the articles, and the thickness of the lines denotes the strength of citation relations. Each color represents a theme to which the publication is linked, with author names and publication years labeled on each bubble (Van Eck & Waltman, 2014).

Bibliographic Coupling:

This study analyzes bibliographic coupling in 1501 articles. The smart local moving algorithm method is also utilized to forecast the direction of future research in bibliographic coupling analysis (Van Eck & Waltman, 2009). The bibliographic coupling of the BL at HE research is visualized in Figure 3. The results of bibliographic coupling analysis show that BL at HE publications formed nine themes corresponding to nine clusters when analyzing 1501 works using VOSviewer. The first group of topics involves studies assessing student participation and readiness in online learning at higher education institutions. The next topics pointed out include: identifying and validating the effectiveness of hybrid semester application models for teachers and higher education institutions; Improving the effectiveness of blended semesters in higher education across countries; research on the development and validation of a hybrid semester acceptance measurement tool in higher education; Demographic

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factors influencing the usefulness of online learning tools in higher education; The impact of hybrid semesters on students' academic performance and their attitudes toward the use of hybrid semesters in higher education. Research on online student engagement in hybrid semester environments; Research factors affecting the learning process and designing a combined semester program in the context of the Covid-19 epidemic; Research on strategies to increase student interest in blended learning courses.

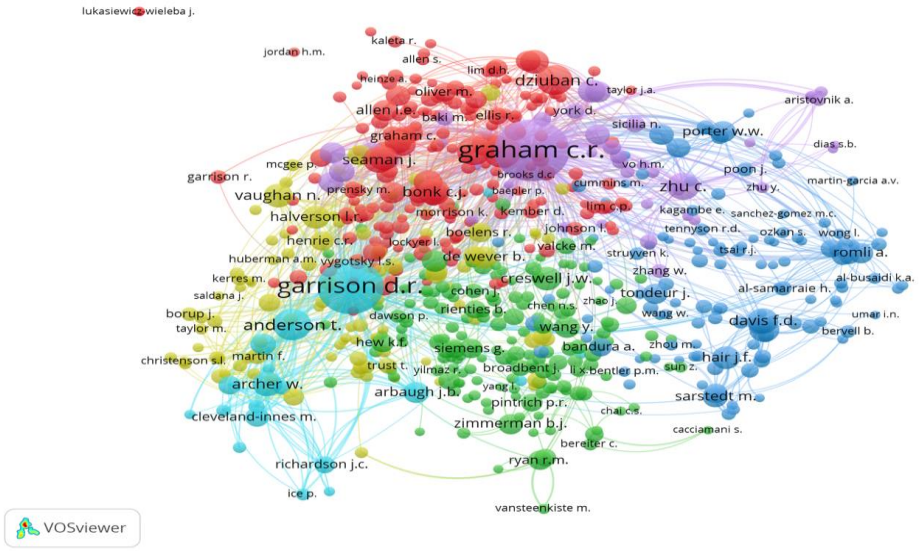


Figure 2. Co-citation Cited authors (minimum number of citations of an author: 20)

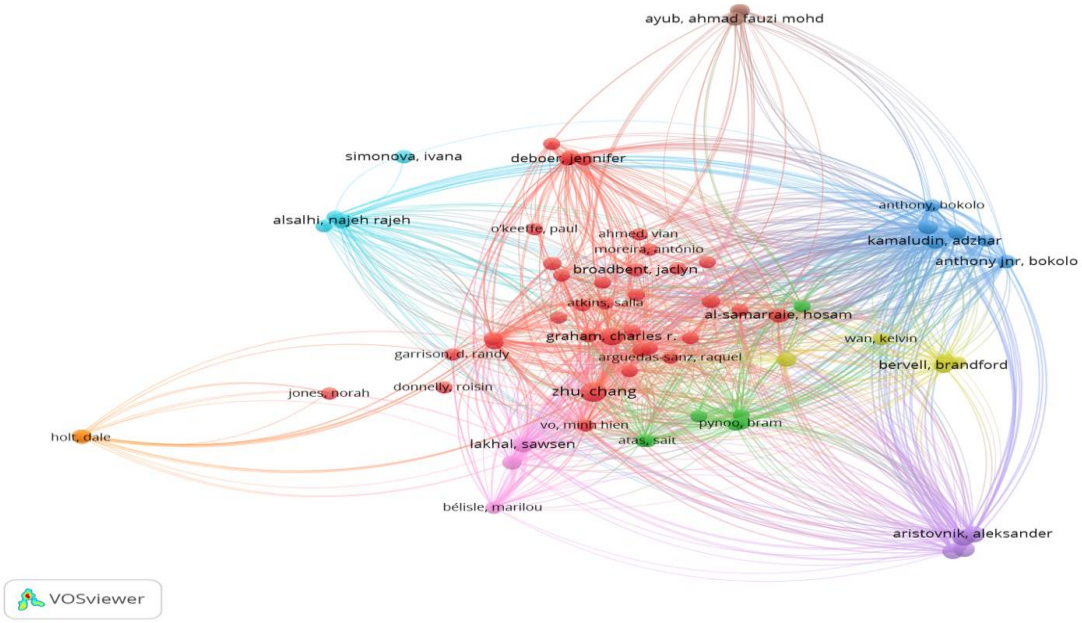


Figure 3. Bibliographic coupling – Authors (maximum number of authors per document: 25; minimum number of documents of an author: 3)

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Discussion of Findings

The primary theme identified through co-citation and bibliographic coupling analysis exhibits connections to themes in the co-citation analysis (see table 2). The findings from bibliographic coupling analysis indicate a prevalent trend of reviewing BL at HE studies. Notably, there exists a similarity between themes related to factors promoting and inhibiting the adoption of blended semesters in higher education, demographic factors influencing the usefulness of online learning tools, research on strategies to increase student interest in blended courses, the use of methods and technology to promote student responsibility and awareness, and student engagement and readiness in online learning in higher education institutions. Emerging topics encompass new trends in BL associated with assessing the effectiveness of BL on student learning outcomes. BL in its development trend also explores aspects related to activities associated with students' active learning, such as willingness to participate in BL courses and student interaction in BL courses. Additionally, the current situation of applying BL in specific contexts such as Covid-19 also requires more research to evaluate the effectiveness of BL courses. Bibliographic coupling themes research also shows that there is a need for tools to standardize BL in HE teaching.

Table 2.
The comparison of co-citation themes and bibliographic coupling themes

Themes	Bibliographic coupling themes	Co–citation themes
1	Student engagement and readiness in BL at HE institutions	Diversity in BL course design methods
2	Identification and testing of the effectiveness of BL application models for teachers and HE institutions	Research, application, and evaluation of BL models for students
3	Enhancing the effectiveness of BL in HE across countries	Examination of motivating and discouraging factors in implementing BL in HE
4	Study on the development and validation of a BL acceptance measurement tool in HE	Explore and define the essence of the BL
5	Demographic factors influencing the utility of online learning tools in HE	Analysis of the influence of demographic factors on BL implementation in HE
6	The impact of BL on students' academic performance and their attitudes toward its use in HE.	impact of course length on developing research communities, exploring the transformative potential of BL in HE, institutional change and leadership related to blended semester initiatives through two case studies, the impact of artificial intelligence on the academic purpose, the transformation of education through online learning, and changes in teaching and learning within online learning spaces through an investigation of an education department's online
7	Study of online student interaction in a BL environment	Utilizing methods and technology to foster accountability and consciousness among students.
8	Researching factors affecting the learning process and designing a BL program in the context of the Covid-19 epidemic	
9	Research on strategies to increase student interest in BL courses	

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Conclusion

Studies on BL between 2004 and 2024 reveal certain observable trends. The rapid increase in publications during this period indicates a significant interest in BL at HE within the scientific community. In terms of BL research, the United States and the United Kingdom stand out as the countries with the most significant and influential research articles. Scholars from Asia and Africa have observed a transition of BL from a mere topic in literature to a focus on innovation and policy in education within their respective continents. While countries, institutions, and scientists have established networks during this time, further research is necessary to fully comprehend or expound upon these networks. It is evident that governance issues have garnered considerable attention globally and are likely to continue to do so in the future, especially as core BL principles become more prevalent in developed nations and gradually integrate into the educational systems of developing nations.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest to be cited here.

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Human Participants

There are no human participants in this research. Other ethical considerations are observed in alignment with the authors' institutional policies as well as JHEPALS ethical guidelines.

Originality Note

The author s confirm that the manuscript is their original work, and if others' works are used, they are properly cited/quoted.

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