Jurnal Pena Sains
Jurnal Pendidikan Sains dan Sains Murni
Journal homepage: https://journal.trunojoyo.ac.id/penasains

BLENDED LEARNING RESEARCH TRENDS: A BIBLIOMETRIC REVIEW FROM 2015 TO 2025

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ABSTRACT

Blended learning, which integrates traditional face-to-face (F2F) instruction with online learning, has emerged as a significant pedagogical approach in higher education. As an evolving approach, blended learning still has many under-explored areas, such as new technologies, long-term impact, and applicability in various educational contexts. This study aims to identify research trends, related keywords, potential keywords, key authors, or collaboration patterns between authors so that it can serve as a foundation for future research. The bibliometric analysis was conducted through several systematic stages, including determining research objectives, collecting bibliometric data, validating and completing data, conducting bibliometric analysis, interpreting data, and reporting results The output results from VOS viewer show that blended learning-related research has a wide scope (573 analysed elements) with very diverse topics (58 clusters) The large number of connections (2109) and the high total strength of the relationship (2335) indicate complex relationships between elements, such as keywords or research themes Frequently used keywords. The findings provide a comprehensive overview that not only strengthens the understanding of the current dynamics of blended learning research, but also provides a strategic foundation to steer future research towards greater innovation and relevance.

Article Info	
Article history:	***Keywords:***
Received: January 27, 2025	Blended learning;
Accepted: April 2, 2025	Bibliometric;
Published: April 30, 2025	VOSviewer;
	Publication trends;
	Network visualization

Introduction

Blended learning, which integrates traditional face-to-face (F2F) instruction with online learning, has emerged as a significant pedagogical approach in higher education. A new method of carrying out "higher education" has been brought about by online-based learning, which enables communication between instructors and students via digital platforms. Universities and colleges that formerly relied on in-person sessions have had to adjust to this new approach. One of the most popular strategies to guarantee a seamless teaching and learning process during the pandemic is "blended learning," which blends online and offline instruction (Cahyani & Romadin, 2024). This model not only enhances student engagement but also improves learning outcomes across various disciplines. Research indicates that blended learning fosters a more interactive and enjoyable learning environment, thereby increasing student motivation and achievement (Huda et al., 2022; Mamahit, 2021).

The effectiveness of blended learning is well-documented in the literature. For instance, Huda et al. demonstrate that the application of blended learning, particularly with a community science technology approach, significantly enhances student learning outcomes in higher education settings (Huda et al., 2022). Similarly, Harahap et al. found that students in a blended learning environment exhibited higher achievement levels and improved science process skills compared to those in traditional settings (Harahap et al., 2019). This is corroborated by Kiviniemi, who reported that students in a blended learning course outperformed their peers in a conventional course, highlighting the potential of this approach to elevate academic performance (Kiviniemi, 2014). Moreover, the flexibility of blended learning allows for the incorporation of various instructional strategies, such as problem-based learning and project-based learning, which have been shown to further enhance student engagement and critical thinking skills (Suandi et al., 2024; Tika & Agustiana, 2021). Effendi and Hendriyani's research, who emphasize that interactive blended learning models can cater to diverse learning styles, thus optimizing student engagement and success (Effendi & Hendriyani, 2020).

The integration of Learning Management Systems (LMS) and other digital tools facilitates a seamless blend of online and offline learning experiences, which has been shown to improve both motivation and academic performance (Fauziah et al., 2021; Muhibbuddin et al., 2021). Technologies used in distance learning, such as online learning systems and e-learning platforms, have been proven effective in supporting the teaching-learning process (Cahyani & Romadin, 2024). Furthermore, studies conducted during the COVID-19 pandemic have highlighted the necessity and effectiveness of blended learning as a response to educational disruptions, reinforcing its relevance in contemporary education (Dziuban et al., 2018; Oliveira et al., 2021). In addition, research by Usman emphasised that this model optimises communication in learning, effectively combining live interaction and written communication (Usman, 2019). This is in line with Oktova and Rahmi's findings who note that blended learning can overcome the weaknesses of online and face-to-face learning, resulting in a more enjoyable and efficient learning experience (Oktova & Rahmi, 2021).

From the student perspective, there are some recommended best practices for blended learning implementation. These include consistency in team teaching, timeliness in posting materials, and the use of structured active learning. In addition, it is important for instructors to use feedback from student preparation and integrate student feedback into course design (Margolis et al., 2017). Blended learning has significant transformational potential in higher education. It can support deep and meaningful learning and improve the effectiveness and efficiency of the learning experience (Garrison & Kanuka, 2004). However, the implementation of blended learning also faces challenges, especially in terms of teacher attributes required to adopt this approach. Teachers need to have adaptive abilities such as creatively connecting technology with the learning process (Bruggeman et al., 2021).

As an ever-evolving approach, blended learning still has many unexplored areas, such as new technologies, long-term impacts, and applications in various educational contexts. This study aims to identify research trends, related keywords, potential keywords to be discussed in future research, lead authors, or patterns of collaboration between authors so that it can serve as a basis for future research. The urgency of this research is to map research trends and key topics, so as to provide a comprehensive overview of blended learning including quantitative analysis

10.21107/jps.v12i1.29039 Cahyani & Munawwarah E-ISSN: 2527-7634

and visualisation of the global knowledge network. The use of VOSviewer as a bibliometric analysis tool has shown significant trends in understanding and overcoming these problems. VOSviewer allows researchers to visualise the relationship between publications, authors, and keywords, which provides deep insights into research developments in a particular field (Cahyani et al., 2024). This research not only provides theoretical contributions, but also generates practical insights that can be applied by various parties. Academics, educators, policy makers, and educational institutions can utilise the results of this research to improve the quality of blended learning and support the transformation of education in the digital era.

There are several studies that are relevant to this topic including Pakaya et al. (2024) research that highlights students' perceptions, in contrast, the novelty of the proposed research aims to analyse blended learning trends globally without limiting the focus to one variable. The research conducted by Putri et al. (2024) only mentioned the relationship of blended learning with personnel training and academic performance briefly, without further exploration. The novelty of the proposed research aims to identify broader areas, including technology, pedagogy, and implementation of the latest innovations in blended learning. The research conducted by Maridueña et al. (2024) focused on heuristic approaches, research skills, and teaching, and limited the scope to higher education. In contrast, the novelty of the proposed research covers different levels of education and thematic trends of blended learning in general.

The research conducted by Irwanto & Rini (2024) was limited to the field of chemistry education, whereas the novelty of the proposed research aims to provide a holistic view of blended learning across various disciplines. Research conducted Ishmuradova et al. (2024) the time coverage of this research ends in 2023, while the novelty of the proposed research covers the time span up to 2025, providing more relevant updated data.

Research Methods

This study employs bibliometric analysis through systematic stages. First, research objectives were defined, and bibliographic data was collected from Scopus using the keywords ‘blended learning’ (2015-2025) with relevant criteria. Data cleaning was conducted to remove duplicates, standardize author names, and validate relevance, ensuring only peer-reviewed English articles and conference papers were included.

Next, bibliometric analysis was performed using quantitative methods to assess publication distribution and network analysis (co-authorship, co-occurrence) to identify collaboration patterns. Thematic analysis was also conducted to detect major research trends. Data visualization tools like VOSviewer were used to illustrate findings through graphs and network maps.

Result and Discussion

Publication Trends

Blended learning has become one of the research topics that has received increasing attention in the field of education, as technological developments encourage the integration of online and face-to-face learning. Analysing these publications is important to understand their patterns, contributions and innovations, and to identify under-explored research areas.

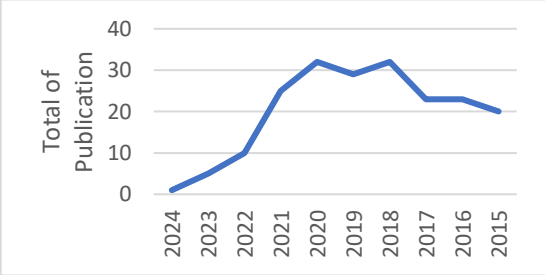

Figure 1. Publication trends

Figure 1 reveals the trend number of publications related to blended learning over the decade, with a significant increase in 2018 and 2020. This trend correlates with the proliferation of online learning technologies and the increasing focus on hybrid models in education, as well as the COVID-19 pandemic in 2020, which forced education to embrace distance learning. Figure 1 illustrates the annual growth in publications.

Lead Author and Institution

Figure 2 is a visualisation of the co-authorship network in blended learning research, created using VOSviewer software. The size of the node indicates how often the author's name appears in the network (number of publications or connections with other authors).

10.21107/jps.v12i1.29039 E-ISSN: 2527-7634

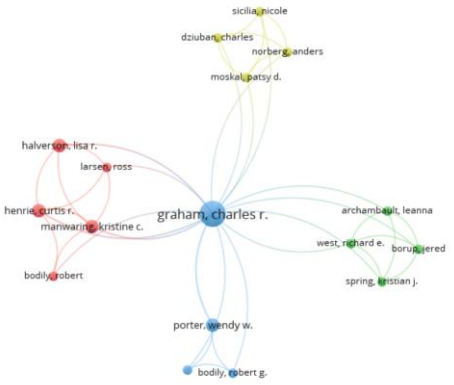

Figure 2. Visualisation of the co-authorship network in blended learning research

Lines connecting the nodes indicate collaboration between authors. The thicker the line, the stronger the collaborative relationship (could mean more co-publications). The colour of the nodes indicates a particular group or cluster. These clusters usually describe groups of authors who have close collaborative relationships with each other. For example, blue and green colours indicate different groups. Charles R. Graham from Brigham Young University in Provo, Utah, USA is a central figure in blended learning research and has many collaborations with other authors such as Patsy D. Moskal, Lisa R. Halverson and others. This network shows the structure of researcher collaboration, where some clusters indicate groups of authors working together on specific subtopics in blended learning. The output of this visualisation can identify who are the key researchers in the field of blended learning, close collaborations, or trends in the timing of collaborations.

Most Frequently Discussed Topics

The output results from VOSviewer show that blended learning-related research has a wide scope (573 analysed elements) with very diverse topics (58 clusters). The large number of connections (2109) and high total strength of relationships (2335) indicate complex relationships between elements, such as keywords or research themes. The diversity of clusters (58) indicates that the topic of blended learning has various dimensions that can be further explored, such as technology, pedagogy, implementation, or student perceptions. This result reflects the complexity and depth of the blended learning literature, as well as the opportunity to identify key subthemes in research in this area.

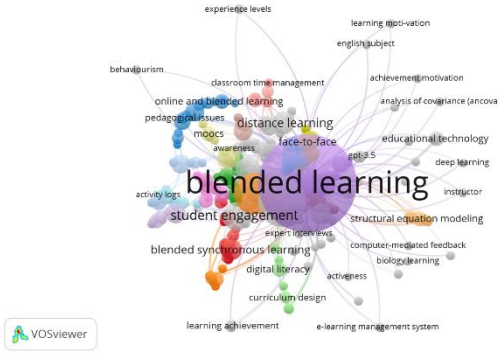

Figure 3. Visualisation of the co-occurrence network in blended learning research

The visualisation map in Figure 3 shows the linkages or relationships between keywords as a representation of the research and activities taking place. With the help of VOSviewer, the strength of the relationships can be seen as a network map, where the strength of the relationships is indicated by the thickness of the lines connecting the nodes. Researchers can more easily read data and understand complex relationships in scientific literature thanks to this depiction (Cahyani & Fadly, 2024).

Blended learning as the keyword with the highest link frequency is reasonable considering the search keywords used use the word Blended learning. The keywords with the strongest links based on the VOS viewer can be seen in table 1.

Table 1. Top 10 keywords that are closely related to blended learning

Keyword	Occurrences	Total Link Strength
Blended learning	131	569
Higher education	32	149
Online learning	24	120
E-learning	11	55
Student engagement	11	49
Distance learning	7	43
Flipped classroom	9	43
Hybrid learning	7	35
Distance education	5	34
Self-efficacy	6	29

Based on the keywords with the strongest linkages, the following relationships can be drawn: Blended learning has become an increasingly popular approach in highereducation to address the challenges ofdistance education and increasingstudent engagement. This model combines the advantages ofonline learning with face-to-face interaction to create a more flexible

10.21107/jps.v12i1.29039 E-ISSN: 2527-7634

and adaptive learning environment. One example of its application is through the use of the flipped classroom, where students study material independently through an e-learning platform before attending class to discuss concepts in greater depth. This approach not only enriches the learning experience, but also increases students'self-efficacy in managing time and resources independently. In addition, technologies such as Learning Management Systems (LMS), such as Moodle, have made it easier to manage content and assessment in an integrated manner in hybridlearning models. However, while blended learning offers flexibility, its implementation requires systematic learning design and continuous evaluation to ensure its effectiveness. For example, lecturers need to consider how to blend online and face-to-face elements to fulfil students' pedagogical and psychological needs. Going forward, further research is needed to evaluate the role of technology in supporting this model, particularly in local contexts, as well as to develop more holistic strategies to improve learning outcomes.

Future research recommendations

In the bibliometric review of blended learning, the use of relevant and innovative keywords plays an important role in understanding research trends, gaps and opportunities. Potential keywords can provide new insights into under-explored areas and contribute to the development of more comprehensive research. The size of the sphere can reflect the frequency of the keywords, i.e. the larger the sphere size, the higher the frequency or the more frequently the keywords are discussed in scientific articles. The smaller the sphere size, the lower the frequency or the less frequently the keywords are discussed in scientific articles (Auliah et al., 2024).

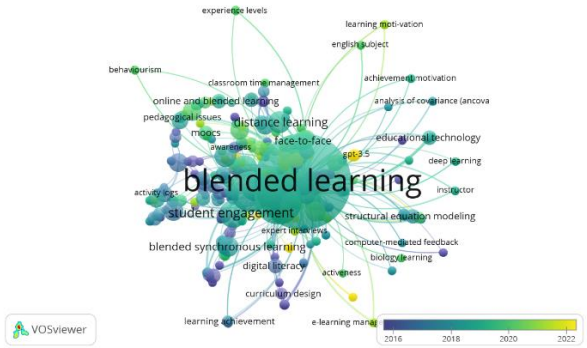

Figure 4. Overlay visualization network in blended learning research

Recent and rarely discussed keywords in scientific articles related to blended learning are as follows: self-regulatory progress, knowledge construction, chatbot generalised pre-train, blended learning adoption and, teaching and learning in digital, student perspective, student attitude, willingness to communicate, scaffolding, active research, sustainability, chatgpt, artificial intelligence, game-based learning, gpt 3,5, gpt 4, architecture, secondary, virtual learning, student perception, scope review, convention for inner coordinates, self-learning skills, learning attitude, mandatory environment, e-learning system, updated d&m success model, covid-19 experience, covid-19 adaptation.

The following is a description of potential keywords that have not been widely discussed but have great relevance in the development of blended learning.

Self-Regulation Progress and Self-Study Skills

These buzzwords refer to students' ability to manage their learning process independently, including planning, monitoring, and evaluating their learning. In the context of blended learning, the development of these skills is crucial as students often have to manage a combination of online and face-to-face learning. Research on self-regulation progress can explore how blended learning approaches help students develop this skill.

Knowledge Construction

This keyword focuses on how students construct knowledge through their learning experience. In blended learning, technology enables various tools to support the knowledge construction process, such as discussion forums, simulations, and collaborative learning. Research in this area can answer how blended learning facilitates this process compared to traditional learning methods.

Generalised Pre-Trained Chatbot (ChatGPT, GPT-3.5, GPT-4)

The emergence of artificial intelligence-based chatbots such as ChatGPT brings great opportunities in blended learning. They can be used as virtual tutors, mentors, or adaptive learning tools. Research can explore the impact of chatbots on student learning outcomes, teaching

10.21107/jps.v12i1.29039 Cahyani & Munawwarah E-ISSN: 2527-7634

effectiveness, and student acceptance of this technology.

Blended Learning Adoption

This keyword highlights aspects of blended learning adoption in various educational contexts, whether in secondary schools, colleges, or professional training. Research can focus on factors that influence blended learning adoption, such as technology readiness, teacher training, and student acceptance.

Students' Perspective and Students' Attitude

These two keywords relate to how students perceive and feel about their experience in blended learning. Attitude is expressions of likes or dislikes and expressions of accepting or rejecting an object (Kurniawan et al., 2019). Research can explore the factors that influence students' perceptions and attitudes and how they impact learning outcomes.

Willingness to Communicate

In blended learning, communication plays an important role in collaborative learning. This keyword refers to students' readiness to communicate in both online and face-to-face learning environments. Research can identify factors that influence willingness to communicate and strategies to improve student engagement.

Scaffolding

The concept of scaffolding involves providing support to students during the learning process until they can learn independently. In blended learning, scaffolding can be applied through technology such as adaptive learning tools or online teacher-student interaction.

Game-Based Learning

The integration of game elements in blended learning has the potential to increase student engagement. Research can explore how game-based learning can be integrated with blended learning methods and its impact on student motivation and learning outcomes. Based on research results, game-based learning media has been proven to have an effect on student learning achievement (Irhad et al., 2023).

Virtual Learning

This keyword covers learning experiences that take place in virtual environments, such as online classrooms or technology-based virtual worlds. Research can focus on how blended learning can integrate virtual learning elements to enhance student interaction and experience. For example, in the field of chemistry education, it is necessary to develop an interactive virtual chemistry laboratory as an alternative solution to online practicums and to optimise and maintain students' laboratory skills (Antrakusuma et al., 2021). For example, in the field of physics, the Physics Virtual Lab (PVL) needs to be developed. This application is a simulation explicitly designed for physics practicums that is accessed using a mobile phone. The implementation of the Physics Virtual Lab (PVL) can build student integrity and responsibility (Berlianti et al., 2021).

COVID-19 Experience and COVID-19 Adaptations

The COVID-19 pandemic accelerated the adoption of blended learning worldwide. Research on experiences and adaptations during the pandemic can provide insights into challenges and opportunities in future blended learning implementations.

Sustainability in Blended Learning

This keyword refers to how blended learning can be implemented sustainably, in terms of technology, cost, and environmental impact. Research can explore learning models that support long-term sustainability.

Updated D&M IS Success Model

The updated information system success model (DeLone and McLean) can be used to evaluate the success of blended learning implementation. Research can utilise this model to analyse factors such as system quality, information quality and user satisfaction in the context of blended learning.

The keywords that have been identified cover various innovative aspects of blended learning that are still under-explored. By examining these keywords, research can make a significant contribution to the development of more effective, inclusive and sustainable blended learning. A focus on new technologies, such as artificial intelligence-based chatbots, and

10.21107/jps.v12i1.29039 Cahyani & Munawwarah E-ISSN: 2527-7634

pedagogical approaches such as scaffolding or game-based learning can also address the increasingly complex needs of future education.

Conclusion

Based on the results of the bibliometric analysis, this study successfully identified the main trends in blended learning research, including the temporal distribution of publications over a decade, dominant themes, and major contributions in this topic. Frequently used keywords, such as blended learning, higher education, online learning, e-learning, student engagement, distance learning, flipped classroom, hybrid learning, distance education, and self-efficacy indicate a focus on approaches, technologies, pedagogies, and variables that impact blended learning implementation. While potential keywords, such as self regulation progress, knowledge construction, chatbot generalised pre-traine, blended learning adoption and, teaching and learning in digital, students‘ perspective, students’ attitude, willingness to communicate, scaffolding, active research, sustainability, chatgpt, artificial intelligence, game-based learning, gpt 3,5, gpt 4, architecture, secondary, virtual learning, students' perception, scoping review, conventions for coordinates in, self-study skills, learning attitudes, mandatory environments, e-learning systems, updated d&m is success model, covid-19 experience, covid-19 adaptations open opportunities for further exploration in the future. The key author found, Charles R. Graham from Brigham Young University in Provo, Utah, USA, is a central figure in blended learning research and has many collaborations with other authors, providing important insights into existing research networks, enabling wider collaboration opportunities. The findings provide a comprehensive picture that not only strengthens the understanding of the dynamics of current blended learning research but also provides a strategic foundation to steer future research towards greater innovation and relevance.

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