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A Retro Perspective on Blended/Hybrid Learning: Systematic Review, Mapping and Visualization of the Scholarly Landscape

ARTICLE

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ABSTRACT

The blending learning model, a combination of onsite and online learning modalities formulated by relevant pedagogies, modalities, and technologies, offers learning experiences that involve the different factors shaping each modality, such as time, space, path, and pace, through sequential or parallel designs. In its relatively short history, this model has attracted much attention in the educational landscape. In this context, the main aim of this study is to conduct a systematic review of blended learning research by applying data mining and analytic approaches to identify the bibliometric trends and patterns and the thematic patterns in blended learning research and to present its intellectual structure. In brief, the results indicated that interest in blended learning research has remained steady, and that this interest peaked during the Covid-19 pandemic, when blended learning was applied to meet the new needs that emerged. Collaboration between social sciences and technology-related fields, as well as between health and medicine fields, has shaped the interdisciplinary approach to the subject. Trend analysis revealed that teacher training is a crucial factor for the success of blended learning adaptation, along with the adoption of appropriate technologies by educational institutions. Social network analysis and text mining identified four thematic patterns: (I) The comparison of online and onsite learning to benchmark the effectiveness and efficiency of modalities, (II) technology-mediated blended learning experiences, (III) teacher training and curriculum development to overcome the challenges of blended learning, and (IV) dominance of the positivist paradigm in blended learning research. From the bibliometric analysis of the intellectual structure of blending learning and the determination of pivotal contributions to the subject, three emerging patterns were identified: (I) widespread theoretical and conceptual discussions, (II) higher education-oriented research, and (III) the tendency to adopt a quantitative research paradigm.

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INTRODUCTION

Educators have long sought to find which learning modality, onsite face-to-face or online virtual, is best, yet both modalities have their own strengths and limitations. In response to this issue, blended learning has been proposed under the argument that a combination of both modalities can incorporate pedagogy, technology, and processes and provide meaningful learning experiences and effective and efficient educational processes.

However, blended learning is not a simple process, as it involves many different approaches and confusing terminology. Irvine (2020) addressed this issue by demonstrating how the term 'blended learning' evolved over time which as a result led to many deviations, making it difficult to understand the concept both semantically and in practice. Likewise, Hrastinski (2019) noted that the relabeled deviations of blended learning have been used interchangeably and rather loosely, further exacerbating the confusion. While this paper applies blended learning (Graham, 2006) as a generic umbrella term, it is important to point out that certain blended learning models, such as flipped learning (Tucker 2012) and HyFlex learning (Beatty 2019), are frequently used to refer to both blended learning and hybrid learning. In other words, these are used as an equivalent of blended learning, and in some cases, may refer to HyFlex practices. To further confuse matters, in many cases, while blended learning and hybrid learning are used interchangeably to refer to the same practices, they are also used to refer to slightly different practices. Moreover, the term is interpreted differently in different geographies (i.e., North America and Europe) due to different educational traditions. Within this framework of confusion and debate about the identity, terminology, and definition of blended learning, the main purpose of this study is to examine the trends and patterns in blended learning research.

LITERATURE

REVISITING THE DEFINITION

One of the most used definitions (Graham 2006) provides a rough description of blended learning, characterizing it as "instruction based on the combination of two historically separate models of teaching and learning: traditional face-to-face learning systems and distributed learning systems" (p.5). However, as noted by Laumakis, Graham and Dziuban (2009), "The relationship between those two anchoring modalities [onsite and online] does not appear to be as straightforward as originally thought" (p. 75) and "The concept of blended learning itself can be thought of as a boundary object" (p. 85). In highlighting the flexible features of blended learning, Bozkurt and Sharma (2021) further argued, "Blended learning refers to combining onsite and online learning by blending the strengths of one modality and neutralizing the weaknesses of the other to provide flexibility to learners, instructors, and educational institutions. The flexibility can be afforded to time, space, path, and pace through sequential or parallel designs" (p. 3). The flexible nature of blended learning appealed to many stakeholders in the educational landscape in the new normal of the post-pandemic world (Bozkurt 2022; Bozkurt & Sharma 2020) as a way to mitigate the disruption of the pandemic and to ensure continuity of delivery of education in current and future crises (Bozkurt & Sharma 2020; Pelletier et al. 2021). Although blended learning had been proposed as the new normal in the educational landscape prior to the pandemic (Dziuban et al. 2018), the pandemic accelerated the adoption of blended learning models to cope with the unique situation (Pelletier et al. 2021). In other words, support for the merits of blended learning was being drummed up before the pandemic due to the technological solutions and capacity increase blended approaches offered in facilitating education. With the increasing appeal of blended learning seen before and during the pandemic, a significant amount of research has been conducted on the blended learning phenomenon. The following section takes a closer at some of the studies on this subject.

RELATED STUDIES

There have been many earlier attempts to examine and understand the research on blended learning. For example, Park and Shea (2020), in their study, examined blended learning research over a period of two decades and found that the research interest first focused on distance education and on learners' discourse in asynchronous discussion, followed by a shift of focus to online learners' satisfaction and self-regulation, informal learning, and learning through MOOCs. Anthony et al. (2020: 531), in their study, reviewed theoretical perspectives

and reported that "the ad hoc technology acceptance model, the information system success model, the unified theory of acceptance and use of technology, and the diffusion of innovations theories" were mostly used to understand the interest in blended learning research. A meta-aggregative systematic review study conducted by Ashraf et al. (2021: 1538) found that blended learning, from the perspective of psychological outcomes, "can enhance students' self-regulation toward learning, satisfaction and engagement while learning in different domains, especially in health"; while from the perspective of behavioral outcomes, blended learning supports students' academic performance. Focusing on the challenges in the online modality of blended learning, Rasheed, Kamsin and Abdullah (2020) conducted a systematic review study wherein they reported that self-regulation challenges for learners and challenges related to the use of educational technology were the leading difficulties faced by both learners and instructors. The same study further stated that for institutions, the provision of suitable instructional technology and training of instructors were the main challenges they faced. Drysdale et al. (2013), in their study, systematically analyzed 205 doctoral dissertations and masters' theses and found that the research topics were concentrated around 9 thematic topics, namely learner outcomes, dispositions, instructional design, interaction, comparison, demographics, technology, professional development, and other issues. Pima et al. (2018), in their study, conducted a thematic review on blended learning in higher education and reported that instructional design, disposition, exploration, learner outcomes, comparison, technology, interactions, and professional development were the major themes. It is important to highlight here that both Drysdale et al. (2013) and Pima et al. (2018) focused mainly on instructional design issues in blended learning research. Drysdale et al. (2013: 97) also called attention to the "need for more theoretical contributions unique to the context of blended learning". Furthermore, the reviews conducted by Drysdale et al. (2013) and Spring and Graham (2017) confirmed that most of the research has focused on higher education settings, showing less interest in K-12 settings. Short et al. (2021), in their study, examined blended learning research in the K-12 context and reported that while the number of publications increased by the second decade of the 2000s, the number of articles focusing on blended learning in the K-12 context was relatively lower compared to the number of articles focusing on the subject in the higher education context.

Halverson et al. (2014) highlighted in their study that there was a lack of theoretical cohesiveness in blended learning research, while Drysdale et al. (2013) noted that most of the blended learning research is approached through a distance education-related theoretical lens (e.g., Community of Inquiry, Transactional Distance, Community of Practice, Transformational Learning Theory, etc.). This finding aligns with that reported by Halverson et al. (2012), who conducted a bibliometric analysis and found that "Most of the explicit conversations about blended learning are taking place in journals that focus on research related to educational technology and that welcome both distance education research as well as technology integration research" (p. 396) and many of the leading researchers working in the field of distance education have published in these journals.

In addition to systematic reviews and bibliometric analyses, some studies have examined the effectiveness of blended learning. For example, Müller and Mildenberger (2021), in their meta-analysis, found equivalent learning outcomes between the modalities of blended learning. In another study by Rasheed, Kamsin and Abdullah (2020), it was reported that in terms of achievement outcomes, blended learning excelled over onsite classrooms. Bernard et al.'s (2014) and Vallée et al.'s (2020) meta-analysis also reported that blended learning yielded better learning outcomes.

PURPOSE OF THE STUDY

The interest in blended learning research remains strong and has received even greater attention in the wake of the pandemic due to the flexible learning opportunities blended learning offers. To better understand the research on blended learning, this study examines scholarly papers on blended learning to identify trends and patterns by conducting a systematic review of the related literature through data mining, analytics, and visualization techniques. The following research questions were developed to guide this aim:

- What are the bibliometric trends and patterns?
- What are the thematic patterns?
- What is the intellectual structure of blended learning research?

METHODS

RESEARCH MODEL AND DESIGN

Due to the large volume of data the research involved, data mining and analytic approaches (Fayyad, Grinstein & Wierse 2002) were used to systematically review (Petticrew & Roberts 2008) the papers on blended learning. In addition to conventional bibliometric analysis techniques (Ellegaard & Wallin 2015), the study also used social network analysis (Hansen, Shneiderman & Smith 2010) and text-mining (Feldman & Sanger 2007) to identify trends and patterns in blended learning research. The rationale behind the use of multiple data analysis approaches is that it allows for the triangulation of the research data (Thurmond 2001) and thus stronger validity and reliability of the findings and that it provides multiple angles from which to explore the subject in question. The visual analysis resulting from the use of data mining and analytic approaches was supported by textual explanations, which is helpful in examining and interpreting a large volume of research data.

SAMPLING, RESEARCH CORPUS, AND INCLUSION CRITERIA

This study used the Scopus database, the largest database and home to a wide range of publications from different research areas (Scopus n.d.), to collect the sample publications. The publications sampled in this research were identified by using relevant search strings (Title: "blended learning" OR "blended teaching" OR "blended education"). The justification for including only those articles identified through these said search strings in their title was to build a more concentrated, robust research corpus by identifying the most representative findings that reflect the state of blended learning research. Adopting the PRISMA Framework (Page et al. 2021), a total of 1,986 articles that met the inclusion criteria were included in the research corpus (Figure 1).

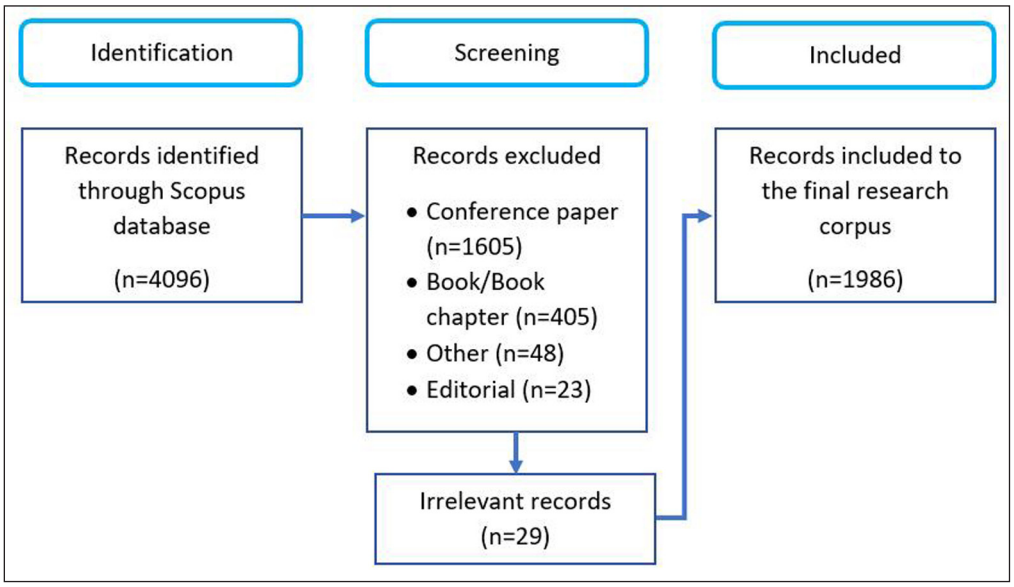


Figure 1 Prisma Diagram of the creation of the final research corpus.

DATA COLLECTION AND ANALYSIS PROCEDURES

For the bibliometric analysis (time trend, subject area, and discipline), descriptive statistics (frequency, percentage) were used, and the data were visualized. In conducting the trend analysis of the key terms and conceptual evolution (Aria & Cuccurullo 2017), a matrix was developed to visualize the data, along with a visual of the emerging trends, to better explain the change and evolution in a time series. For the text-mining, titles and abstracts were analyzed according to the lexical relationships and the co-occurrence of textual data to create a thematic concept map (Smith & Humphreys 2006) and identify major themes emerging from the research corpus. Finally, in the social network analysis (Scott 2017), each keyword

represented a node and their cooccurrences represented a relationship to better identify thematic clusters and significant nodes with strategic positions in the keyword network.

Of the 3,499 keywords identified in the corpus of 1,986 articles, a total of 184 met the threshold of a minimum co-occurrence of five, as determined through the social network analysis. For the text-mining, 32,908 lines of textual data, which equaled 391,157 words, were examined based on their lexical relationships and cooccurrences. In the analysis of the references, a total of 73,070 references from 1,986 articles were analyzed to map the intellectual structure and identify pivotal contributions to blended learning research.

STRENGTHS AND LIMITATIONS

It is important to note that this study did have certain strengths and limitations. Starting with the strengths, this study presented its findings through data visualization techniques, which facilitates the opportunity for other researchers to further interpret the findings. Moreover, the different analysis techniques used to examine the data offer a more comprehensive view of the subject in question. Regarding the limitations of the study, only the publications indexed by Scopus were used to create the study corpus, and though Scopus is the largest database and allowed for a large volume of data to be analyzed, the findings are still partial, considering that no publications from the grey literature were examined. Additionally, this paper also acknowledges that publications in the grey literature could provide complementary insights to better understand the state of blended learning research. Lastly, this study adopted generic terms as search queries in building the research corpus, but a more detailed search involving the use of additional keywords could lead to different search results.

FINDINGS AND DISCUSSION

BIBLIOGRAPHIC ANALYSIS

This section presents the results of the bibliometric time-trend analysis, subject area distribution, and interdisciplinary approach of the blended learning papers.

TIME TREND

The time-trend analysis (Figure 2) applied in this study started with the year 2001, as this was when the use of online technologies really started to become more widespread in every segment of life, including education. The first study in the corpus was conducted by Voci and Young (2001) and focused on the implementation of blended learning in a leadership development program. The top three most cited references were from studies conducted in 2004 and 2008 (see Garrison & Kanuka 2004; Rovai & Jordan 2004; So & Brush 2008) that covered issues like the transformative potential of blended learning in higher education, sense of community, collaborative learning, social presence, and satisfaction. Considering that blended learning involves the combination of onsite and online learning, it is noteworthy that these aspects strongly correspond to the online learning dimension of blended learning.

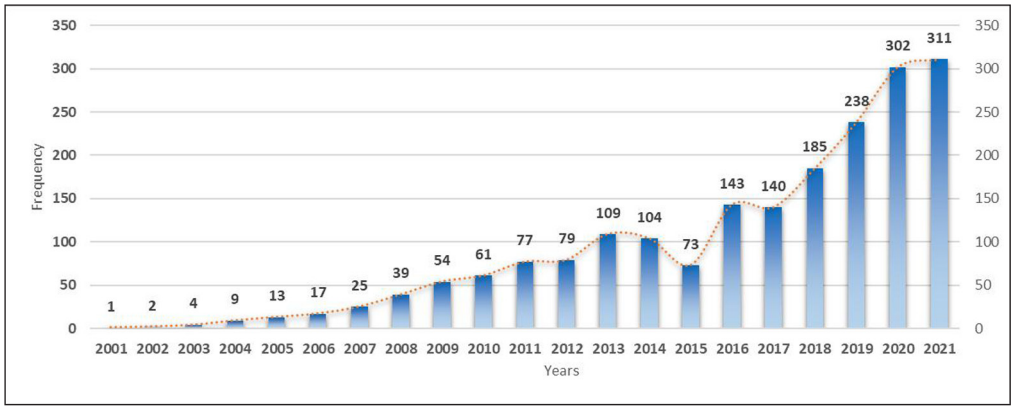


Figure 2 Time trend of the publications on blended learning.

The frequency of blended learning publications remained relatively steady until 2019, with only a slight decrease seen in 2015. A sudden increase started in 2019, and the interest in blended learning reached a peak by 2020 and 2021. This time trend matches that reported by Spring and Graham (2017) and Short et al. (2021). The peak coincided with the Coronavirus

(Covid-19) pandemic, a time marked by increased interest in the flexibility offered by blended learning (Bozkurt & Sharma 2021), where educators combined the best features of onsite and online learning (Singh, Steele & Singh 2021) to conform to the new normal of social distancing (Bozkurt & Sharma 2020) and to facilitate the implementation of remote teaching through educational technologies as pragmatic solutions (Jandrić et al. 2021).

SUBJECT AREA AND DISCIPLINES

The distribution of subject areas and interdisciplinary approaches in blended learning were examined according to the classification of the Scopus database (Figure 3). Accordingly, social sciences, for which education is a subfield, was the leading subject area (44.1%), followed by computer science (15.7%), engineering (7.8%), medicine (5.8%), and arts and humanities (5.4%). Other subject areas constituted 21.8% of the total. The demonstrated interest in blended learning shown by technology-related areas (e.g., computer science and engineering), being second to that of social sciences, indicates the presence of a strong relationship between technology-based delivery methods and blended learning practices. Though not dominant, medicine and arts and humanities, which are applied fields, proved to be interdisciplinary interests that likely stemmed from their capacity to deliver applied instruction through the onsite modality of blended learning.

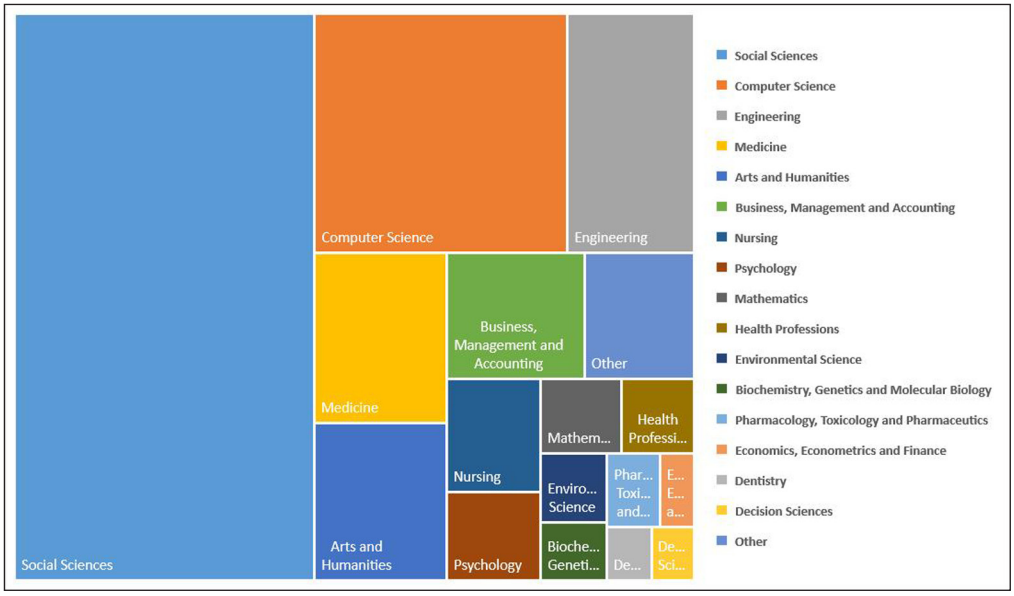


Figure 3 Distributions of the subject areas of the publications on blended learning (one publication can be categorized in more than one area).

The related literature includes studies on the implementation of blended learning for applied teaching, or vocational education. Bernard et al. (2014), for example, examined the effectiveness of blended learning in their meta-analysis study and found that in terms of achievement outcomes, blended learning conditions excelled over classroom instruction conditions significantly. Vallée et al. (2020) compared blended learning and onsite, face-to-face learning in medical education in the meta-analysis study they conducted and reported that blended learning had better effects on learning outcomes. It is particularly interesting that the current literature tends to focus on comparing blended learning with traditional onsite face-to-face learning, as this suggests that the literature acknowledges onsite face-to-face education to be the gold standard by which to determine the effectiveness of blended learning. Moreover, the meta-studies also indicate that there tends to be interest in blended learning by areas that use applied education as a part of the curriculum.

TREND ANALYSIS

This section presents the results of the trend analysis from two perspectives: key terms and conceptual evolution. The analysis of the strategic key terms in the sampled publications (Figure 4) showed that for a long period of time, training (2009–2019), teaching (2013–2020), and teacher training (2010–2020) were the foci of blended learning research. For instance, it has been reported that one of the challenges for blended learning is that teachers and other educational professionals need training and institutional support to effectively implement blended learning (Rasheed, Kamsin & Abdullah 2020). Furthermore, the training of preservice

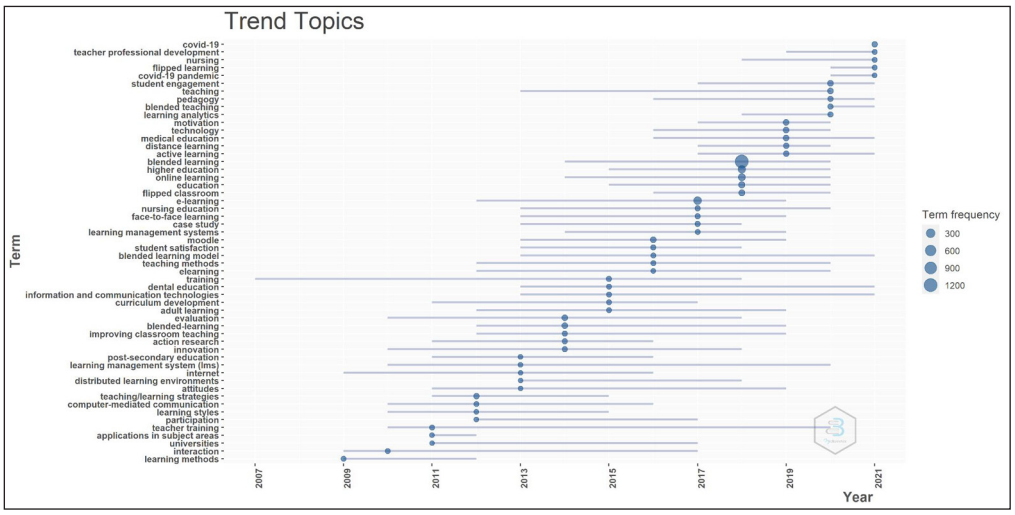


Figure 4 Trend analysis of the strategic terms in blended learning research.

teachers on how to effectively implement technology in their teaching is considered an important issue to consider (Ma'arop & Embi 2016). Yet, beyond being simply a teaching tool, technology also functions as a key part of the blended learning infrastructure. Learning management systems (2010–2020), information and communication technologies (2013–2021), and e-learning (2012–2019) were other major issues addressed in blended learning research. It was further found that "computer anxiety, personal innovativeness, system quality, information quality, management support, incentives policy, and training were key factors in instructors' level of satisfaction" with the technological infrastructure, or more specifically, learning management systems (LMS) (Al-Busaidi & Al-Shihi 2012: 18). The critical components of LMS (e.g., technology experience, service quality, system quality, and information quality) were reported to affect students' acceptance of and satisfaction with the LMS (Al-Busaidi & Al-Shihi 2012). Lastly, the most recent research trend, that of 2021, has been the role of blending learning during Covid-19, particularly in terms of the flexibility offered by blended learning (Bozkurt & Sharma 2021; Singh 2011).

The trend analysis of conceptual evolution (Figure 5) covers five distinct periods. In the first period, from 2001 to 2009, which witnessed conceptual and theoretical discussions, the focus was on blended learning in higher education. In the second period, from 2010 to 2012, the conceptual discussions expanded, where issues such as technology affordance (e.g., from web-based learning, use of information and communication technologies), curriculum development, and assessment and evaluation became more prevalent. In the third period, from 2013 to 2015, research on the effectiveness of blended learning and online modalities (e.g., distance education, online learning) gained more attention. In the fourth period, from 2016 to 2018, technology-mediated blended learning environments (e.g., computer-mediated communication, learning management systems) and student-related factors (e.g., self-efficacy, engagement, and motivation) came to the forefront in blended learning research. In the fifth and final period, from 2019 to 2021, in addition to student-related factors and

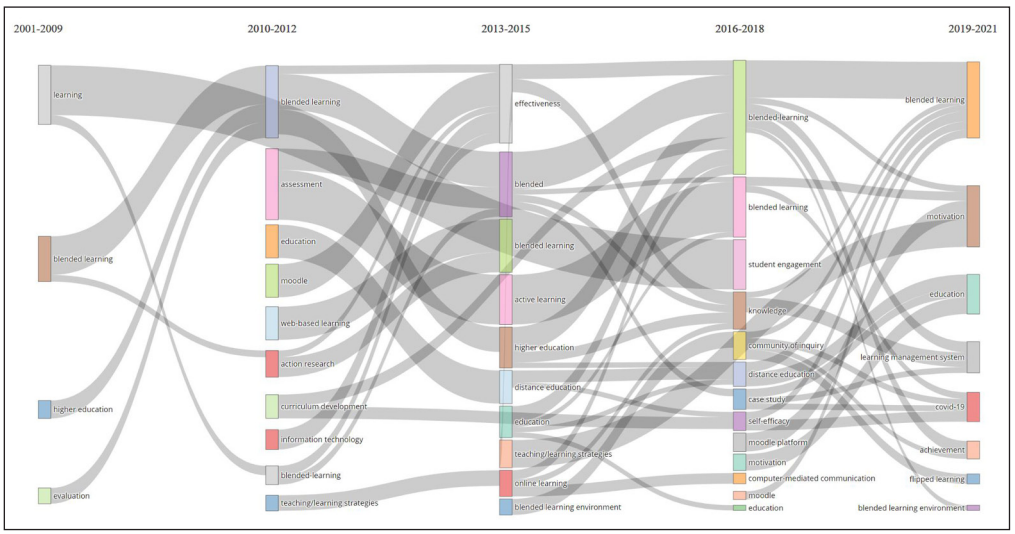


Figure 5 The conceptual evolution of blended learning research.

technology-mediated blended learning environments, the Covid-19 pandemic was the main focus of blended learning research.

THEMATIC PATTERN ANALYSIS

This section analyzes and discusses the four emerging thematic patterns identified through social network analysis (Figure 6) and text-mining (Figure 7): (I) the comparison of online and onsite learning to benchmark the effectiveness and efficiency of the two modalities, (II) technology-mediated blended learning experiences, (III) teacher training and curriculum development to overcome the challenges of blended learning, and (IV) dominance of the positivist paradigm in blended learning research.

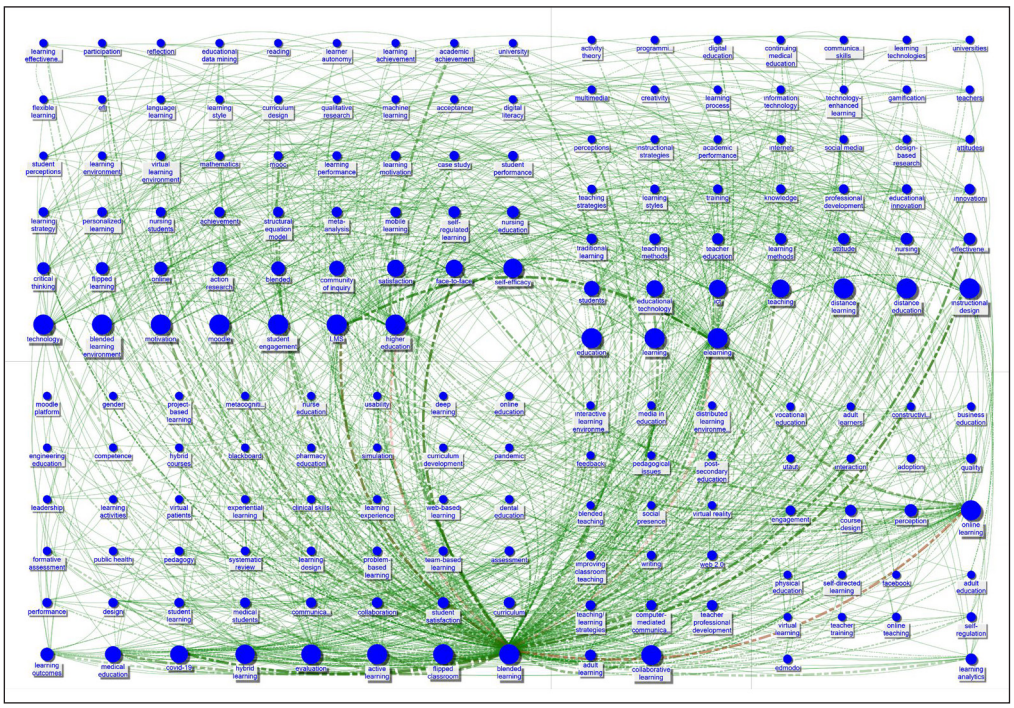


Figure 6 SNA of the keywords.

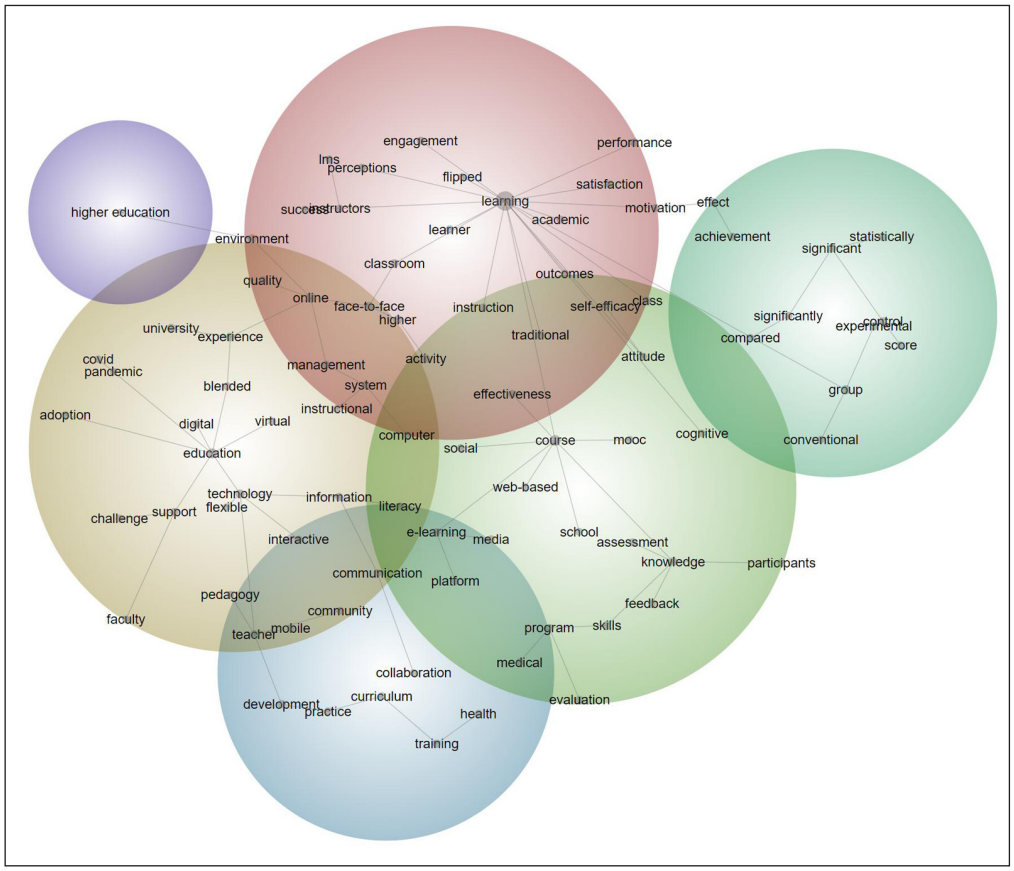


Figure 7 Concept map of blended learning publications.

The comparison of online and onsite learning to benchmark the effectiveness and efficiency of the modalities (See nodes in Figure 6: *higher education, learning environment, blended learning, face to face, traditional learning, learning experience, meta-analysis*; See connected paths in Figure 7: *blended, university, experience, higher education, environment, online, face to face, learning, traditional, course, school*).

Examination of the meta-studies on blended learning (Park & Shea 2020) showed that they tended to compare and contrast onsite and online learning (e.g., Parkinson et al. 2003; Rovai & Jordan 2004) to examine whether they were equivalent, or to determine the benchmark effectiveness and efficiency of blended learning vis-a-vis onsite face-to-face learning. Bliuc, Goodyear and Ellis (2007) reported in their study that "A potentially more comprehensive way of conducting research into blended learning is by comparing or contrasting learning across two or more contexts, such as some combinations of exclusively on-line, exclusively face-to-face, and/or distance education" (p. 238). The problem with comparative studies is, as noted by Bliuc, Goodyear and Ellis (2007), that "By their very nature, these comparative studies tell us more about separate components than they do about the integrated whole" (p. 239). From the implications of this theme, it can be argued that researchers should turn their focus to the approach itself in order to improve it rather than compare and contrast other educational delivery modes. Research that focuses strictly on blended learning would help to identify its weaknesses and provide empirical solutions to better deliver educational content.

Technology-mediated blended learning experiences (See nodes in Figure 6: *e-learning, distance education, distance learning, ICT, educational technology, social media, internet, technology-enhanced learning, information technology, digital education, online, teaching, online learning, online education, virtual learning, web-based learning, learning technologies, LMS, Blackboard, Moodle platform, Moodle, Edmodo, technology, virtual learning environment, computer-mediated communication, web 2.0, media in education, interactive learning environment*; See connected paths in Figure 7: *digital, virtual, education, technology, interactive, flexible, information, communication, literacy* and *online, management, system, instructional, computer* and *e-learning, platform, media*).

While online and onsite learning are two essential modalities of blended learning, onsite learning has a long history, whereas online learning is relatively new in comparison. However, while blended learning represents a whole, the research on blended learning has had a tendency to separate the modalities and has been inclined to examine only technology-mediated blended learning experiences. This theme is not surprising considering the dynamic nature of technological developments and what these developments offer in terms of meaningful learning experiences. As such, information and communication technologies (Stacey & Gerbic 2009), learning management systems (Holmes & Prieto-Rodriguez 2018), social media (Akgündüz & Akınoğlu 2017) and web 2.0 technologies (Köse 2010) are frequently investigated and have become a hot topic in blended learning research. This theme also signals that new technological affordances may lead to different technology-based educational delivery, which in turn could lead to capacity increase in blended learning.

Teacher training and curriculum development to overcome the challenges of blended learning (See nodes in Figure 6: *curriculum development, curriculum design, teacher professional development, improving classroom teaching, teacher training, teacher education, teaching methods, teaching strategies, training, professional development, instructional strategies*; See connected paths in Figure 7: *faculty, support, challenge* and *adoption, education, technology, pedagogy, teacher, development, practice, curriculum, training*).

One of the challenges of blended learning that educational institutions face is effective training support for instructors (Rasheed et al. 2020). In order to effectively implement blended learning, in addition to institutional support for instructors, developing the technological competencies of preservice teachers is equally important (Archambault & Kennedy 2014; Mirriahi, Alonzo & Fox 2015). However, blended learning involves more than simply combining onsite and online learning. It requires developing a proper curriculum (Gedik, Kiraz & Ozden 2013) that takes into consideration many critical issues, such as the use of technology, technology provision, and assessment and evaluation strategies.

Dominance of the positivist paradigm in blended learning research (See nodes in Figure 6: *student performance, learning performance, student perceptions, perceptions, attitudes,*

performance, academic performance, achievement; See connected paths in Figure 7: *outcomes, learning, compared, conventional, group, experimental, score, statistically, significant* and *performance, learning, outcomes, academic, satisfaction, motivation, effect, achievement*).

Bliuc, Goodyear and Ellis (2007) highlight in their study that in addition to case studies, there is a wide range of quantitative survey-type studies that examine associations between different variables and of comparative studies that are useful for making "deductions about the components of a system, but they tend to obscure interactions between those components" (p. 242). On this issue, the present researcher proposes that rather than compete with different modalities, blended learning should accept its own reality and focus on understanding its own components, and moreover, that there should be greater methodological diversity in blended learning research to advance the subject.

INTELLECTUAL STRUCTURE OF BLENDED LEARNING AND PIVOTAL SCHOLARLY CONTRIBUTIONS

To identify the intellectual structure of blended learning and the pivotal scholarly contributions, a total of 73,070 references from 1,986 articles were analyzed through social network analysis, the visualization of which is presented in Figure 8. When examining the entire network, Garrison and Kanuka's (2004) study exploring the potential of blended learning in higher education from the lens of Community of Inquiry (Garrison, Anderson & Archer 2000) emerged as the most cited paper and therefore the most pivotal contribution. This was followed by Graham's (2006) book chapter, which conceptually explores blended learning, revisits its definition, and identifies trends in blended learning research. Another pivotal contribution was the article by Ginns and Ellis (2007) that highlights quality issues and examines the relationship between onsite and online learning and teaching. Osguthorpe and Graham's (2003) article similarly focuses on the conceptual approach and explores how blended learning is defined. Moskal, Dziuban and Hartman's (2013) longitudinal article argues that blended learning requires the alignment of institutional, faculty, and student goals, and that there is a need for a reliable and robust infrastructure to support students and faculty. Garrison and Vaughan's book (2008), similar to earlier pivotal contributions, provides a theoretical and conceptual perspective to better understand the blended learning model. An article by Means et al. (2013) takes a meta-analysis approach to examining blended learning to explore its effectiveness. Their study reports, "Students in online learning conditions performed modestly better than those receiving [onsite] face-to-face instruction" (Means et al. 2013: 1). López-Pérez, Pérez-López and Rodríguez-Ariza's article (2011) approaches blended learning from the perspective of higher education and found that it had a "positive effect on reducing dropout rates and in improving exam marks" (p. 818). Singh (2011), in a chapter from his book, proposes a conceptual approach that is based on the

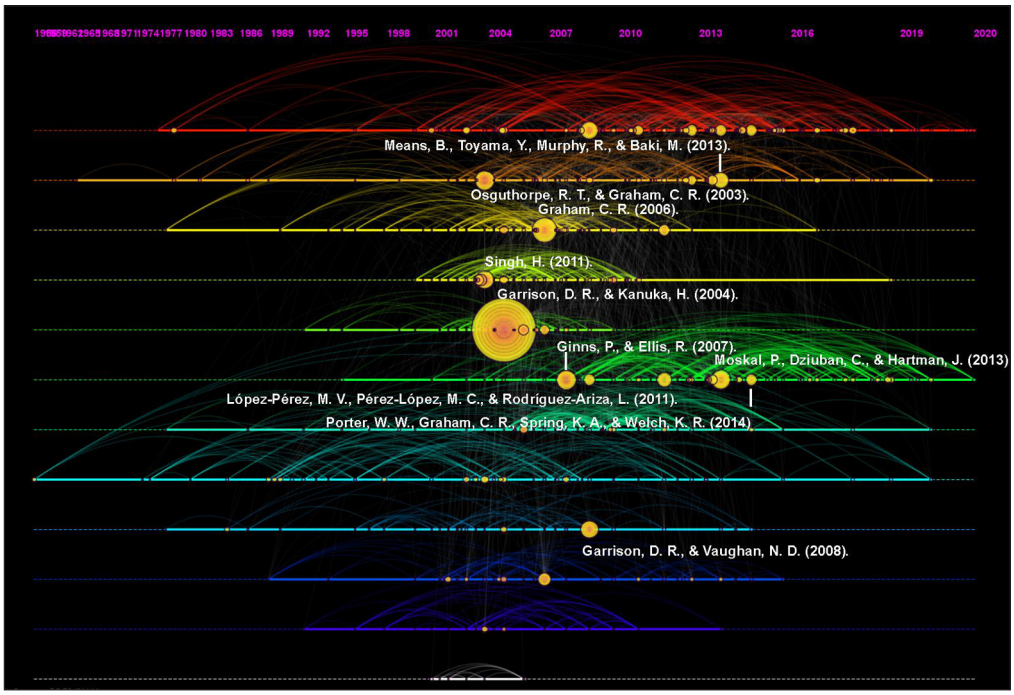


Figure 8 Timeline visualization of intellectual bibliometric network and pivotal contributions.

changing realities of technological affordances. Finally, Porter et al.'s (2014) article proposes strategies to adopt blended learning in higher education.

Overall, it can be argued that the pivotal scholarly contributions to blended learning research are centered around three thematic discussions. First, blended learning research has focused on theoretical and conceptual approaches to explain blended learning, which is not surprising considering that blended learning and its basic modalities, that is, onsite and online learning, merged as a result of the capacity increase facilitated by technology, or more specifically, online internet technologies. Second, higher education practices have been the main area of interest in research on blended learning, likely due to the self-directed and self-regulated learning skills needed by higher education students to benefit from blended learning. Third, much of blended learning research has tended to adopt a quantitative research paradigm that compares, and contrasts blended learning with traditional face-to-face learning to empirically validate the former's effectiveness. These general themes align with those reported in earlier studies. For example, the large amount of research committed to examining theoretical and conceptual approaches to blended learning can be explained by the confusion over terminology (Bozkurt & Sharma 2021; Hrastinski 2019; Irvine 2020) that has been generated by emerging new models, innovative approaches, and the dynamic nature of blended learning due to the use of new technologies. The focus on higher education practices, on the other hand, may stem from not only the self-directed and self-regulated learning skills needed by higher education students to benefit from blended learning but also from the autonomy and responsibilities for learning that higher education students are supposed to have. That these factors defining blended learning have largely been addressed at the higher education level (Ashraf et al. 2021) points to the need for more research to be conducted at the K-12 level (Poirier, Law & Veispak 2019). The quantitative research trend can be attributed to the efforts to scientifically validate blended learning. For example, earlier meta-analyses conducted in different disciplines (e.g., Bernard et al. 2014; Li et al. 2019; Liu et al. 2016; Means et al. 2013; Vallée et al. 2020; Vo, Zhu & Diep 2017) aimed to demonstrate the effectiveness of blended learning by comparing and contrasting blended learning or by focusing on factors such as student achievements. However, it should be noted that a quantitatively dominated research landscape can create a bottleneck for blended learning models, as the opportunities and flexibility proposed by blended learning go beyond quantifiable measures. Bozkurt and Sharma (2021), in their study, highlighted this by drawing attention to the idea that flexibility extends further than the "efficiency and effectiveness in academic achievements and excellence of learning processes. As learned from experience during the Covid-19 pandemic, the flexibility of blended learning models can perfectly serve the resilience and sustainability goals of educational systems" (p. 4).

CONCLUSION AND IMPLICATIONS

This study systematically reviewed, mapped, and visualized the scholarly landscape in blended learning research by employing different data mining and analytic approaches to triangulate the data and provide a multi-layered, comprehensive perspective. The findings of this study revealed the increasing interest in blended learning, which doubled during the Covid-19 pandemic, and the interdisciplinary connections between education and technology-related fields. It is also noteworthy to mention that blended learning research draws attention to its use in the fields of health and medicine. This is important in terms of documenting that, as applied disciplines, the fields of health and medicine pursue the blending of theoretical and practical knowledge by combining the strengths of onsite and online modalities. The trend analysis performed in this study demonstrated the importance of teacher training to effectively implement blended learning and of the proper use of educational technology to enrich blended learning environments. The study identified four thematic patterns: (I) the comparison of online and onsite learning to benchmark the effectiveness and efficiency of modalities, (II) technology-mediated blended learning experiences, (III) teacher training and curriculum development to overcome the challenges of blended learning, and (IV) dominance of the positivist paradigm in blended learning research. The analysis of the intellectual structure of blended learning identified three emerging patterns: (I) widespread theoretical and conceptual discussions, (II) higher education-oriented research, and (III) the tendency to adopt a quantitative research paradigm. While this study served to provide a multidimensional analysis of blended learning research, answers to additional questions are still needed. For example, when we blend, do we

blend only modalities (onsite and online), pedagogies, technologies, or a combination of all of them? Should we explore the flexibility offered by blended learning, or deepen our research by looking closer at its effectiveness and efficiency?

Based on the findings of the study, the following implications can be drawn. First, blended learning research has been shown to have a strong focus on higher education, which means that to improve the field of blended learning research, future research should examine blended learning implementations at the K-12 level, as was done during the Covid-19 pandemic. Second, it was observed that research in blended learning largely applies horizontal (quantitative) approaches. Considering the imbalance in the distribution of methodologies, it is clear that there is a need for more vertical (qualitative) research, especially types that explore the flexibility blended learning offers and issues related to the flexibility provided by onsite and online modalities (e.g., self-paced learning), technology use (e.g., digital divide), and learning opportunities (e.g., equity and social justice). Third, more attention needs to be given to curriculum development strictly for blended learning purposes. Curriculum development is also important in terms of developing instructional design strategies, going beyond the course level, and laying the foundation for institutional level practices. Fourth, the related literature has largely neglected to examine assessment and evaluation strategies, as many studies have chosen instead to adopt the assumption that modalities of blended learning can benefit from existing approaches. However, blended learning must be seen as a whole with different modalities, meaning that it requires assessment and evaluation strategies developed specifically for blended learning. Lastly, while blended learning refers to the combination of onsite and online learning through the use of sequential or parallel designs, it was observed that the main concern has been for the efficiency and effectiveness of the online modality, which can hinder the blending of the two modalities by the neglect shown to the onsite modality.

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The author has no competing interests to declare.

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