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Blended Learning in the Spotlight of Educational Management - A Scientometric Analysis

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ABSTRACT

The mass adoption of ICT for online delivery of education due to the COVID-19 pandemic has brought many opportunities but also challenges for the education sector. In this paper, we conducted a scientometric analysis to provide insights into research trends and present bibliometric indicators of 5810 publications on blended learning to contribute to the knowledge base on the use of ICT in education management, during and after the COVID-19 pandemic, from 2020 to 2023. The number of citations and publications increased rapidly. Content analysis of the publications and keyword analysis revealed important and emerging topics such as the challenges and experiences of students, teachers and institutions with blended learning, especially in higher education, from implementation and use to digital literacy, attitudes, performance, self-regulation and learning outcomes. The main journals focused on the use of technology in education and health education. Blended learning has likely moved beyond the pandemic and has become an integral part of management in educational organizations.

Keywords: blended learning, education, bibliometric analysis, educational management, online learning, literature review

1. Introduction

During the COVID-19 pandemic, and especially during the lockdown aimed at reducing physical contact, there was a global urgency to provide solutions for fully online education in education systems around the world. The education sector was among the best prepared sectors, as the accelerated adoption of ICT technologies in classrooms began more than a decade earlier. Therefore, some educational institutions that were already well-equipped and had previously used some forms of online education began systematically using ICT technology, while others took the opportunity to better equip the institution with technologies they did not previously have, with the common goal of making online teaching and learning as available and high quality as possible [1]. While the technological solutions were largely in place, so was the basic knowledge of online and other forms of technology-enhanced teaching and learning. Due to the proliferation of educational enhancements through ICT in recent years, especially during the COVID-19 pandemic, many new expressions and terminologies have emerged, such as “blended learning”, “hybrid learning”, “distance learning”, “e-learning” and many others, causing confusion in choosing the correct expression and highlighting the need for clarification of terminology. The need to clarify some of these expressions and terms according to their meaning has been recognised by several authors [2], [3].

The impact of the COVID-19 pandemic was also reflected in the production of scientific publications in the field of education that focus on the introduction of new technologies in the classroom. While the period 2015 to 2020 has seen a decrease in the number of publications on e-learning as a new trend in teaching [1], the number of publications on the topic of newer forms of merging online and face-to-face teaching, such as hybrid teaching and blended learning, has increased, especially in the last three years after the COVID-19 pandemic. Whereas 20 years ago scholarly interest focused on the impact of online education on learners and the influence of asynchronous learning, scholarly interest has now shifted to learner satisfaction and informal learning [4].

In recent years, bibliometric analysis of publications has proven useful in summarising the knowledge base in emerging and rapidly growing research areas. For example, publications on bibliometric analysis have increased in the field of education focusing on teaching methodology as well as online teaching and learning, especially in the context of new technologies in education and Education 4.0 [5], [6]. The bibliometric analysis has shown that the active use of newer forms of teaching in an online environment such as blended learning and hybrid learning [7], [8] and the development of topics such as digital health education, blended learning environment, observed learning and others are increasing rapidly, but the collaboration between authors and universities is still very low [1]. However, research on the impact of COVID-19 period on online teaching and learning is not yet fully investigated.

In this paper, we make several contributions. First, we distinguish the differences between blended learning and hybrid learning as very similar but different concepts that are sometimes used as synonyms. Second, we analyse the rapidly developing research area of blended learning during and after the COVID-19 pandemic period and teaching to provide a knowledge base for the field. We identify the most productive journals, organisations, and countries, as well as the most important publications and the most relevant and emerging publication topics, using widely accepted qualitative and quantitative bibliometric indicators through a bibliometric analysis. Third, we enrich the bibliometric analysis with a content analysis of the most relevant publications during and after the period of the COVID-19 pandemic to highlight the main lessons learned from the rapid global adoption of ICT in education and its impact on education management.

The structure of the paper is as follows. In Section 1 we provide a literature review of previous research on blended learning and distinguish the terminology. In Section 2, we present the data and methodology. In Section 3, we present the results of several bibliometric analyses. We also present a content analysis of the most influential publications. In Section 4, we discuss the results, conclude, discuss limitations of our work and provide directions for further research.

2. Blending the Prior Research

During the COVID-19 pandemic, many educational institutions were faced with the rapid uptake of online teaching and learning tools and practises. To facilitate online teaching and learning, first, the technical infrastructure had to be supported. Second, each institution had to decide which approach to online teaching and learning was best for its institutional culture and student needs. Each institution decided on the most appropriate way to continue the teaching process unhindered; through different learning management system (LMS) platforms with different approaches such as hybrid learning, blended learning, synchronous type of online teaching versus asynchronous type of online teaching [9].

Both blended learning and hybrid learning were known and used in education before the pandemic, and the pandemic accelerated the adoption of these new learning models as a necessity to cope with the new situation [9], [10]. Very often the two pedagogical approaches of blended learning and hybrid learning are combined, and sometimes they are extended with other approaches such as flipped classroom, flexible learning, flipped learning and hyflex learning, which are known as variants of blended learning [7]. However, there is confusion regarding blended teaching and learning and hybrid teaching and learning stems from the fact that the terms are sometimes used interchangeably, referring to the same practices, while they are also used to refer to slightly different practices. In addition, the terms may be interpreted differently in different regions due to different educational traditions and are sometimes defined very similarly, so it can be very difficult to give a universal definition for each term [7]. The main difference, according to several authors, is that blended teaching and learning sometimes requires physical meetings between lecturers and learners, and the delivery method for certain topics is strictly prescribed by the curriculum, while hybrid teaching and learning leaves it up to the learners to decide whether to follow the lecture in person or online, with online teaching being as synchronized as teaching in real classrooms [11], [12].

Blended teaching and learning and hybrid teaching and learning can also be distinguished by the amount of time spent on in-person and online delivery of lectures. Although not a consensus, at least 50% of total course time in a blended learning model should be devoted to face-to-face teaching and learning [13], [8].

Both learning models enable flexible learning in collaboration between learners and teachers, except that hybrid learning can be much more tailored to the needs of learners and teachers, e.g., in terms of speed, time, and especially space [12]. Since there is confusion in the academic literature about the (di)similarities between blended and hybrid learning, we also consulted the most popular online dictionaries to capture a broader perspective on the terminology used: Oxford Learners Dictionaries, Cambridge Dictionary, Dictionary.com, and The Free Dictionary.

The definition of "blended learning" is found in all four dictionaries and emphasises, with some minor differences, the combination of traditional classroom learning with learning via the Internet or online. The Oxford Learners Dictionary and the Cambridge Dictionary do not include a definition of "hybrid learning". A definition of "hybrid learning" is found only on Dictionary.com, and that definition emphasises the combination of simultaneous classroom and online instruction, while The Free Dictionary automatically redirects the term "hybrid learning" to "blended learning". Although the terms "hybrid learning" and "blended learning" can be considered related in linguistics, the term "blended learning" is better known and more used. In addition, a review of the Web of Science Core Collection database (WoS CC) shows that most publications on hybrid teaching and learning come from the fields of engineering, computer science, and telecommunications, and only a small percentage of publications come from education and educational research fields. In contrast, most publications on blended learning come from the fields of education and educational research. Thus, it can be concluded that in the field of education the term "blended learning" is predominant, while in various technical fields the term "hybrid learning" is predominant.

Since we are interested in the field of education where the term "blended learning" is most commonly used, we will focus exclusively on "blended teaching and learning" in the remainder of this text. Furthermore, since the technology for online teaching and learning already exists due to the need to deliver education in the COVID-19 pandemic period, it is more plausible that some educational institutions will continue to use ICT to deliver some of the lectures online even in the post-pandemic time.

Even before the COVID-19 pandemic, emphasis was placed on blended learning because ICT has entered all aspects of life and its use can facilitate learning for rural or working populations, making learning more accessible. Research on blended learning addressed different methods of educational delivery, learners' experiences and preferences, and learners' learning outcomes and performance, which are particularly important when evaluating different methodological approaches in education. The main trends and themes of publications on blended teaching and learning have evolved since 2000, and the major themes have been instructional design (models, strategies, best practices, etc.), disposition (style, perceptions, preferences, etc.), exploration (benefits, trends, etc.), and learning outcomes (performance, satisfaction, engagement, etc.) [14]. Themes such as comparison to face-to-face classes, technology, and interaction were significantly less represented. Similar themes about blended learning with particular emphasis on instructional design were also highlighted in older publications, long before the integration of ICT into everyday life that we are experiencing today. The focus on instructional design research was highlighted as important, but there was a clear lack of theoretical underpinnings for online learning research, and the need for independent theory to further develop the field was emphasised [15].

In a systematic review, conducted before the mandatory uptake of online learning and teaching during COVID-19 pandemic, the biggest challenges of blended learning were incorporating flexibility, stimulating interaction and facilitating learning progression. Furthermore, the findings show that little attention is paid to instructional activities that promote an effective learning climate and that there is wide variation in how flexibility is incorporated into blended learning practices in terms of sequencing of activities and the relationship between online and face-to-face learning events [16]. The systematic review conducted by Rasheed and colleagues indicated that the online component of blended learning presents challenges for both educational institutions, teachers, and learners or students [17]. To deliver online teaching and learning, contemporary and technology of sufficient quality needs to be in place.

The main challenges for teachers were the reluctance to use and learn new technologies needed to facilitate online teaching and learning. The uptake of new technologies challenged teachers' technological literacy, ability to create high-quality video materials, as well as teachers' attitudes and beliefs about using technology in teaching. The main challenges for learners were the self-regulation and overall focus on technology rather than on learning. Understanding self-regulatory behaviours and relating them to a blended learning environment was the goal of Van Laer and Elen. Their findings showed that an educational institution's success in implementing self-regulatory features impacts not only learners who are good at self-regulation, but also those who regulate poorly [18]. Furthermore, when examining the preferences of a large group of students for combining online and face-to-face content, blended learning as a combination of online courses and face-to-face tutorials was rated highest, and students were found to enjoy the social aspect of learning [19]. In addition, student characteristics and attitudes toward computers, classmate characteristics,

and course quality and flexibility have been shown to be related to creating and maintaining a positive user experience and attitude toward learning [20]. Factors that influence students' academic performance in blended and traditional learning environments have also been researched [21].

In considering the effects of blended learning on learner performance, the COVID-19 pandemic has provided a natural experiment from which more thorough and detailed studies are emerging. For example, the results of a study were recently presented in which students demonstrated that blended learning provided students with better grammatical knowledge and skills than online-only learning [22]. However, as a recent systematic review of systematic reviews on blended teaching and learning shows, currently blended teaching and learning is mainly studied in the context of higher education institutions, research mostly targets the perspective of students and learners, most research is conducted in developed countries, and the main barriers are the lack of equipment in educational institutions and the lack of ICT skills among teachers and students [23].

Although the need to adopt online learning approaches during the COVID-19 pandemic has given researchers the opportunity to evaluate the overall impact of using ICT for online teaching and learning, this area of research is still evolving, and blended teaching and learning is one of the focuses of educational management research.

In general, educational management is the process of planning, organizing, directing and controlling activities within an educational institution in order to effectively achieve its objectives. The primary goal of educational management is to ensure the smooth running of schools, colleges and universities, with a focus on improving the quality of education. The importance of educational management lies in its role as the backbone of an institution's success. Effective management ensures that —human, financial and material resources are optimally utilized to create a conducive learning environment. Since educational management plays a crucial role in promoting innovation and ensuring continuous improvement of teaching methods, modern practices such as blended learning and other similar ITC-supported innovations are actually part of educational management. Educational management should therefore also provide structured support in distance and blended learning environments, helping teachers to focus on their core tasks — teaching and mentoring — while responding to the diverse needs of students.

Educational leaders in blended learning environments need to manage change by building capacity in several key areas [24]. They should develop and implement plans to transform teaching into a personalized, competency-based system that meets the diverse needs of all learners. Establishing a culture of collaboration that promotes academic excellence, creativity and problem solving is critical. In addition, leaders must empower teachers to effectively utilize technology and digital resources, foster community support for innovative approaches, and employ best practices to bring about the changes necessary to support the institution's growth and success.

3. Data and Methodology

Bibliographic data for bibliometric analysis was extracted from the WoS CC. WoS CC is commonly used for bibliometric analysis, as it is a comprehensive database covering over 22000 journals and 8 citation indexes, including Social Science Citation Index or SSCI [25]. The bibliographic data is based on topic search using the query “blended learning” OR “blended teaching”. The topic search restricts the search of the keywords to titles, abstracts and keywords. The bibliographic data set was restricted to the period of the COVID-19 pandemic and post the COVID-19 pandemic, ranging from 2020 to 2023. The bibliographic data was further restricted to peer-reviewed publications, namely articles and review articles, written in English. There were 5810 studies left for bibliometric analysis.

Two software tools are used for bibliometric analysis. VOSviewer is a software commonly used for bibliometric analysis and visualisation of bibliometric networks, and R with the package “bibliometrix” allows performing a variety of bibliometric analyses that complement the results of VOSviewer [26], [27]. The nodes in the bibliometric networks visualised by VOSviewer represent the elements to be analysed, namely countries, organisations, journals, publications, or keywords, while the thickness between elements represents their relatedness based on co-authorship and co-occurrence analysis or bibliometric coupling analysis. The nodes are also divided into clusters by colours. We plot the annual publication and citation counts and provide summary statistics of the extracted publications, on which we then perform various bibliometric analyses.

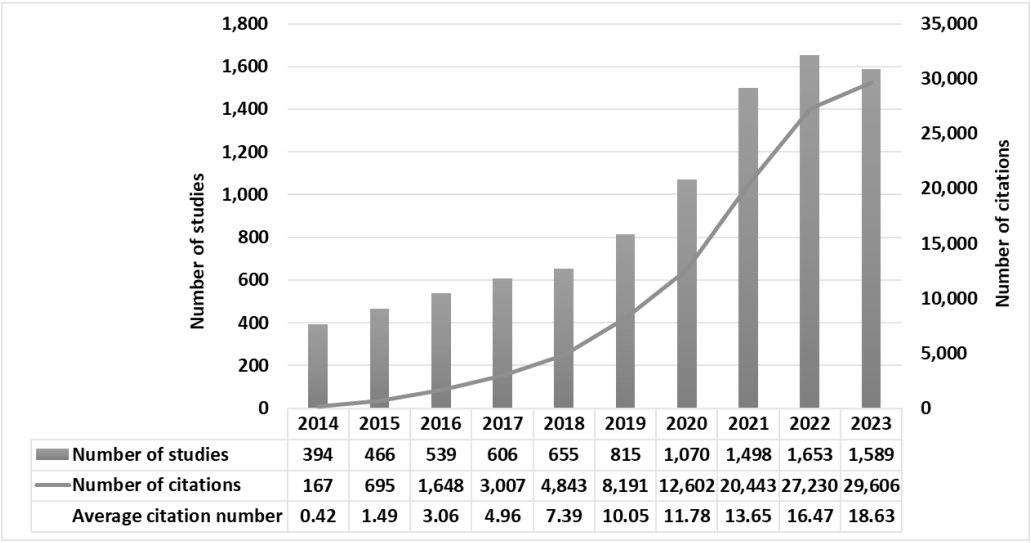
First, we are interested in cooperation between countries and organisations. We present the most productive countries in terms of number of publications and visualise co-authorship both in a bibliometric network and on a world map. Next, we present the most productive organisation and a bibliometric network that visualises the co-authorship between organisations. Second, we perform a bibliometric coupling analysis for journals and publications. The links in the bibliometric coupling analysis are based on mutual references

in publications. Therefore, bibliometric coupling analysis is more appropriate than co-citation analysis when examining relatively recent publications because their citations have not yet accumulated sufficiently compared to older publications [28]. We present the most productive journals in the area. Third, we focus on keywords and perform a keyword co-occurrence analysis. We present the most frequently occurring author keywords and keywords plus, specifically for the WoS CC database. Keywords plus represent keywords extracted from the titles of referenced studies and are a valuable resource when investigating the most frequently occurring topics underlying the references. Lastly, we present the most cited publications together with the bibliometric network of publications organised in clusters by topics. We also provide a content analysis of the most influential publications.

4. Results

4.1. Overview of the Research Area

The field of blended teaching and learning grew rapidly during the years of the COVID-19 pandemic and post the COVID-19 pandemic. Before limiting the publications to the stated period, we present the total number of publications and the total number of citations of all research articles and reviews written in English on the topic of blended teaching and learning in the last ten years. There are a total of 9285 publications on the topic of blended teaching and learning with a total of 120504 citations. We present the last ten years graphically in Figure 1. The number of publications has increased over the last ten years, with an even greater increase in citations. If we restrict the studies to the period of the COVID-19 pandemic and post the COVID-19 pandemic (2020-2023, we obtain 5,810 publications, which is more than 60% of the total publications on blended teaching and learning in the last ten years.



	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Number of studies	394	466	539	606	655	815	1,070	1,498	1,653	1,589
Number of citations	167	695	1,648	3,007	4,843	8,191	12,602	20,443	27,230	29,606
Average citation number	0.42	1.49	3.06	4.96	7.39	10.05	11.78	13.65	16.47	18.63

Figure 1. Number of publications and citations on the topic of blended teaching and learning, 2014-2023, Source: authors

The importance of blended learning is underscored by the extreme increase in citations of publications published during the years of the COVID-19 pandemic. In 2020, there were 1070 publications with 12608 citations; in 2021, there were 1498 publications with 20443 citations. The peak publication count was reached in 2022 with 1653 publications and 27230 citations, while the peak citation count was reached in 2023 with 1589 publications and 29606 citations (Figure 1). From 2020 to 2021, after the first year of the pandemic, the number of publications increased by a solid 40% and the number of citations increased by about 62%. The average number of citations per publication increased from 11.78 citations per publication in the first year of the pandemic, 2020, to 18.63 in 2023.

While the number of publications increased during the pandemic years, the increase in citations is more pronounced, and the increase in the post-pandemic research is even more evident. Comparing the year before

the pandemic, 2019, to 2022, the number of publications increased by about 69% (from 815 to 1653). Comparing the number of citations in 2019 to 2023, the number of citations increased by about 232.44% (from 8191 to 27230). The increase in publications and citations underscores the research interest and importance of the field, and the true significance of these studies is becoming more apparent in the years following the COVID-19 pandemic.

Next, we present the summary statistics of the publications included in the bibliometric analysis (Table 1). The publications came from more than 130 countries. There were more than 5800 affiliations from almost 20000 authors. The publications were published in more than 2100 journal titles by more than 540 publishers.

Countries	135
Affiliations	5849
Authors	19999
Journal Titles	2179
Publishers	548
Research Areas	147
Author Keyword	14648
Keyword Plus	5927

Table 2. Summary statistics, source: authors, using WoS CC database

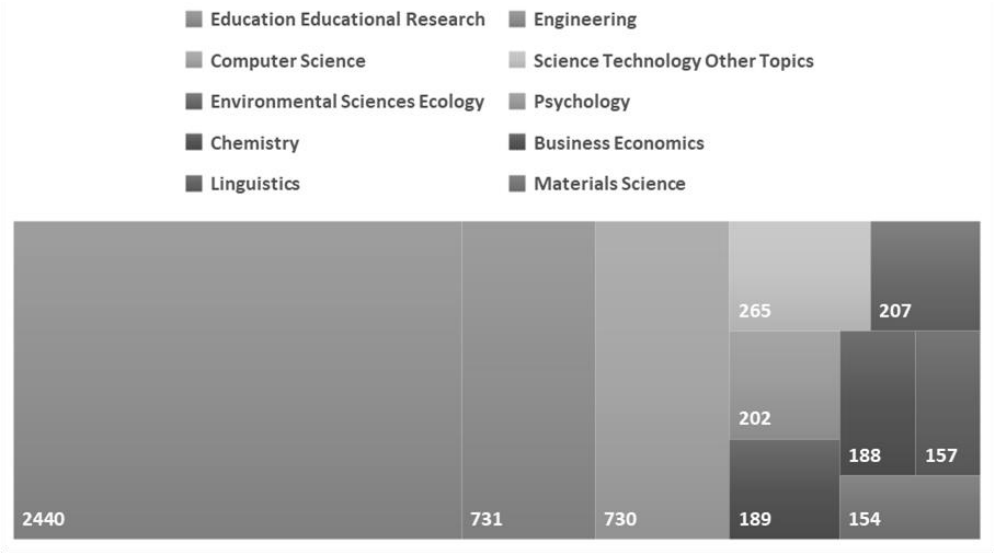


Figure 2. Ten research areas with the most publications, source: authors, using WoS CC database

The five most productive publishers included Elsevier, followed by Springer Nature, Taylor & Francis, MDPI, and finally, Wiley. Most publications on blended learning were indexed in the Science Citation Index Expanded (SCI-E) (2476), the Emerging Sources Citation Index (ESCI) (2217), and finally the Social Sciences Citation Index (SSCI) (1722). The topics of the publications were assigned to one of the 147 research areas. The ten research areas with the highest number of publications are shown in Figure 2. As expected, the first research area with the most publications is Education Educational Research (2440), followed by Engineering (731) and Computer Science (730).

4.2. Countries and Organisations

First, we present the countries that published the most publications on blended teaching and learning during and post the period of the COVID-19 pandemic. The United States of America (USA) was the most productive country with 1001 publications and 9150 citations. China was second with 970 publications and 8767 citations. The third-ranked country was England with 449 publications and 3791 citations. The ten countries with the most publications are listed in Table 2 together with the corresponding citation numbers.

Countries / Regions	Number of Publications	Number of Citations
United States	1001	9150
China	970	8767
England	449	3791
India	395	2574
Australia	385	3845
Canada	244	2337
Germany	242	2415
Spain	241	2176
Saudi Arabia	206	2610
South Africa	172	676

Table 2. Most productive countries, source: authors

The bibliometric network of countries based on the co-authorship analysis is shown in Figure 3. The size of the nodes corresponds to the number of publications of each country. The links indicate the collaborations between countries. Furthermore, the countries are divided into three groups based on the analysis of co-authorship. The red group at the left side of the network is mainly composed of European countries, and the green group is composed of the most productive countries such as the United States and Australia, as well as China and some other Asian countries. The blue group consists mainly of African countries and India. Figure 4 shows the world map of collaborations.

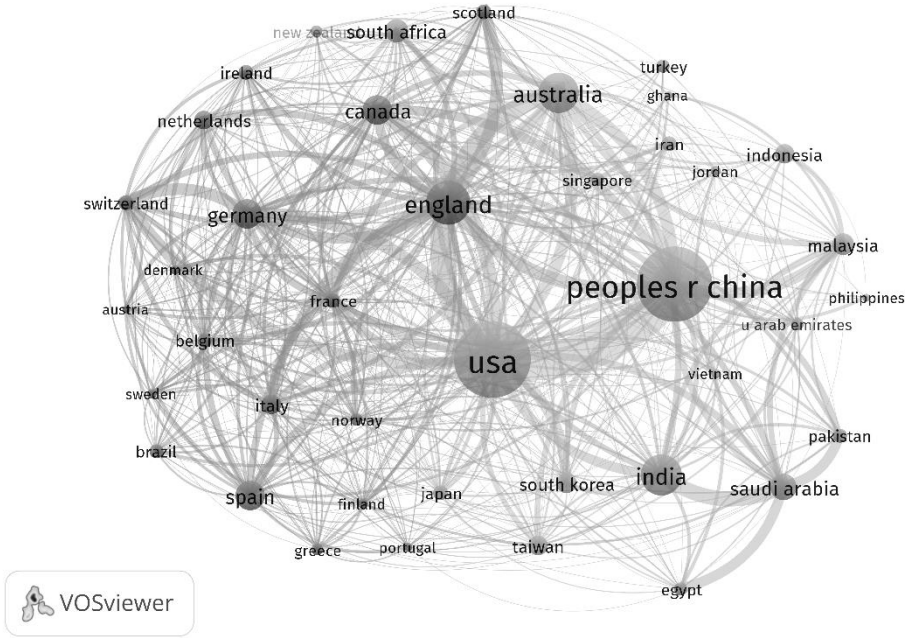


Figure 3. Network of countries based on co-authorship analysis, source: authors

The organisations that were most productive on the topic of blended teaching and learning were universities: Monash University, University College London, Griffith University and University of Edinburgh (Table 3). With the exceptions of University of Edinburgh, all universities were from the most productive countries.

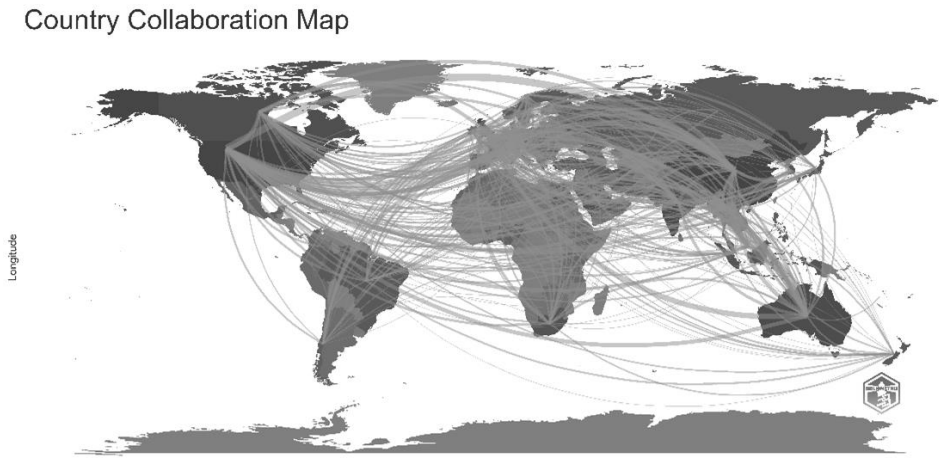


Figure 4. Collaboration network shown on the world map, source: authors

Organization	Country	Number Of Publications	Number Of Citations
Monash University	Australia	35	296
University College London	England	34	432
University of Edinburgh	Scotland	32	570
Griffith University	Australia	32	221
Zhejiang University	China	32	444
University of British Columbia	Canada	31	496
University of Melbourne	Australia	31	214
University of Toronto	Canada	31	452
Chinese Academy of Sciences	China	29	452
King Saud University	Saudi Arabia	29	377

Table 3. Most productive organizations, source: authors

4.3. Journals

The ten most productive journals are listed in Table 4. The publishers of the most productive journals include MDPI (3), Frontiers (2), and Springer (2). The most productive journals are Education Sciences, followed by Education and Information Technologies and Sustainability. The most productive journals are mainly focused on education, learning and technologies, and health-related fields.

Journal	Publisher	Number of Publications	Number of Citations
Education Sciences	MDPI	123	1248
Education And Information Technologies	Springer	110	1482
Sustainability	MDPI	82	580
BMC Medical Education	Springer Nature	75	756
International Journal of Emerging Technologies in Learning	IAOE	66	530
Frontiers in Psychology	Frontiers	65	511
IEEE Access	IEEE	59	423
Frontiers in Education	Frontiers	53	428
Interactive Learning Environments	Taylor & Francis	45	370
Applied Sciences	MDPI	38	265

Table 4. Most productive journals, source: authors

The network of journals based on bibliometric coupling analysis groups the journals into three groups (Figure 5). The largest, red cluster at the top and middle of Figure 5 includes journals on education in general and technology in education. The blue cluster further to the right comprises journals from the field of engineering sciences, while the green cluster on the bottom includes journals in the field of health and medical education. The number of medical education journals, which are also among the most productive journals, underscores the importance of blended learning in health-related education, especially during the period of the COVID-19 pandemic.

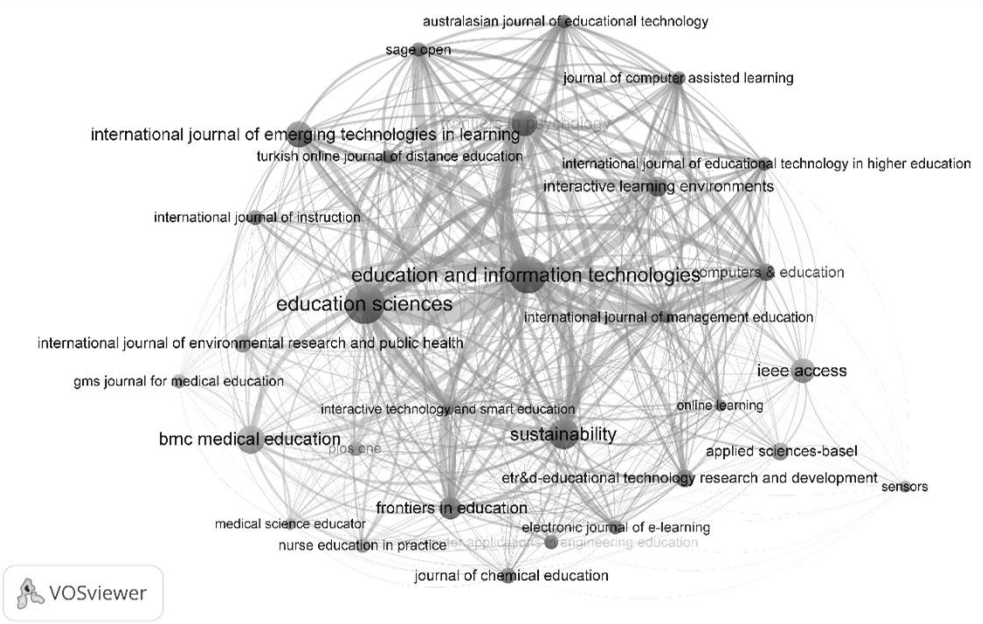


Figure 5. Bibliometric network of Journals based on the bibliometric coupling analysis, source: authors

4.4. Keywords Analysis

In the next step of our analysis, we examine the keywords used in publications on blended teaching and learning. Table 5 lists the most frequently occurring author keywords and keywords plus. The most common author keyword is blended learning, followed by COVID-19, higher education, and several keywords that refer to different forms of online education, such as online learning and e-learning, making different forms of online learning the focus of publications. There are also several other keywords related to broader terms of teaching and learning using ICT, such as online teaching and online education and distance learning and distance education. Flipped classroom, a special form of blended learning, is also among the 20 most frequently occurring keywords. Medical education is also highlighted among the most frequently occurring keywords. Among the keywords plus, which are the keywords extracted from the references of the publications, the most frequently occurring keywords were education, students, and online. In addition, there are several keywords related to online education experiences, such as performance, impact, perception, satisfaction, engagement, motivation, and skills, which emphasise the importance of online education experiences and attitudes toward online education. Higher education was among the most frequently occurring keywords in both keyword types, underscoring the recognised importance of research in this area in higher education.

The topics found through keyword analysis are consistent with the literature review, which highlighted the variety of terms used in the field, the importance of learner experiences, and the prevalence of research in higher education institutions.

Author keywords		**Keywords Plus**	
Keyword	**Occurrences**	**Keyword**	**Occurrences**
blended learning	1442	education	565
covid-19	453	students	483

higher education	337	online	396
online learning	336	performance	384
machine learning	323	model	312
e-learning	270	impact	295
deep learning	222	perceptions	243
education	199	technology	235
flipped classroom	133	higher education	222
distance learning	114	design	207
medical education	111	satisfaction	185
artificial intelligence	91	knowledge	169
covid-19 pandemic	87	engagement	168
online education	80	skills	141
learning	78	science	138
active learning	76	motivation	137
training	73	framework	133
student engagement	71	achievement	128
distance education	66	classroom	125
learning analytics	66	teachers	111

Table 5. 20 most occurring author keywords and keywords plus, source: authors

Keywords were connected in a bibliometric network based on keyword co-occurrence (Figure 6).

We describe the clusters based on their colour. On the one hand, the green cluster, at the top of Figure 6, contains keywords related to participant (student) perceptions related to blended teaching and learning: engagement and motivation, participant experiences and satisfaction, as well as participant performance, self-efficacy, and achievements and outcomes. On the other hand, the red cluster covers different aspects of blended teaching and learning from the teaching point of view – curriculum, challenges, knowledge, skills, technology, pedagogy. The red cluster also contains keywords related to different types and synonyms of online learning, teaching and education, such as distance learning, e-learning, and flipped classroom. There is also a strong link between blended learning with higher education and university teaching in both the green and the red cluster. The blue cluster at the right side of Figure 6 refers to keywords related to emerging digital technologies such as machine learning, deep learning, and artificial intelligence, as well as related keywords such as model, prediction, classification, system and design.

The clusters show how research on teaching and learning with ICT is intertwined with education-related keywords in general and participants' and learners' perceived experiences of teaching and learning.

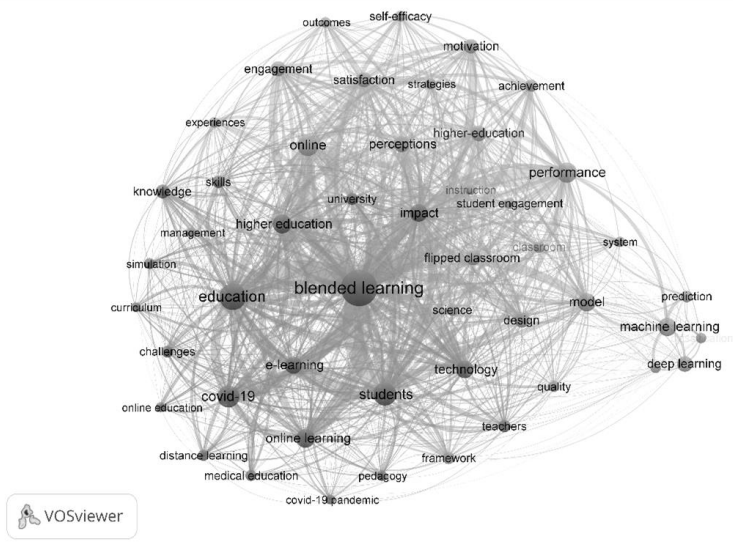


Figure 6. Network of keywords based on co-occurrence analysis, source: authors

4.5. Publications

As a final point of our analysis, we present the most frequently cited publications and provide a content analysis of these publications. The most frequently cited publications focused primarily on student perspectives and challenges, recommendations, and frameworks related to blended learning. The publications that focused on student perspectives examined attitudes toward online learning and student performance and engagement in online courses. In addition, publications that addressed frameworks, challenges, and recommendations also addressed strategies for delivering online education, success factors, digital literacy, and digital competence of teachers. In addition, several publications compared traditional learning methods and experiences with online education. Almost all of the most frequently cited articles dealt with publications related specifically to the COVID-19 pandemic. The ten most frequently cited publications also included three literature reviews and one framework study (Table 6).

Title	Author, year	Total Citations
Knowledge, Attitudes, Anxiety, and Coping Strategies of Students during COVID-19 Pandemic	Baloran, 2020	389
Challenges in the online component of blended learning: A systematic review	Rasheed, Kamsin and Abdullah, 2020	382
Building Effective Blended Learning Programs	Singh, 2021	346
Emergency remote teaching and students' academic performance in higher education during the COVID-19 pandemic: A case study	Iglesias-Pradas et al., 2021	277
Mapping research in student engagement and educational technology in higher education: a systematic evidence map	Bond et al., 2020	248
Challenges to Online Medical Education During the COVID-19 Pandemic	Rajab, Gazal and Alkattan, 2020	234
From digital literacy to digital competence: the teacher digital competency (TDC) framework	Falloon, 2020	211
Blended Learning Compared to Traditional Learning in Medical Education: Systematic Review and Meta-Analysis	Vallee et al., 2020	205
E-Learning Critical Success Factors during the COVID-19 Pandemic: A Comprehensive Analysis of E-Learning Managerial Perspectives	Alqahtani and Rajkhan, 2020	200
Student perspective of classroom and distance learning during COVID-19 pandemic in the undergraduate dental study program Universitas Indonesia	Amir et al., 2020	186

Table 6. The ten most cited publications, source: authors

The most frequently cited publications from the observed period deal with the problem of absorbing course contents from the students' point of view and the way the same content is taught from the professor's point of view, thus highlighting the most common problems during the demanding process of receiving and teaching from psychological, technical, and pedagogical points of view.

The challenges were primarily related to the acceptance of new technologies in education and the delivery of education in an online environment, such as the challenges related to self-regulation, the challenges of delivering medical education in an online environment, and the challenges faced by teachers as a result of new teaching methods. Rasheed and colleagues [17] also found that challenges with self-regulation and the use of learning technologies were the biggest challenges students faced. They also distinguished the challenges teachers face and concluded that they are mainly in the use of technology for teaching. The biggest challenges for educational institutions are providing appropriate instructional technologies and effective support for teacher training.

Some of the most influential publications showed that students had sufficient knowledge and perception of the high health risk during the COVID-19 pandemic and were therefore satisfied with the government's preventive measures of social distancing and restriction of social contact. However, it was also found that online approaches to teaching and learning in various forms, such as e-learning and blended learning, were not well received by the students [29]. Amir and colleagues emphasise that the COVID-19 pandemic is changing not only the use of technology in education but also the educational strategies of the future. Despite some challenges, students were able to adapt to the new learning methods of distance learning and the

majority agreed that blended learning, meaning combining face-to-face and online learning, can be implemented in the future [30]. Support for emergency distance learning was also found in a case study by Iglesias-Pradas and colleagues in which students' academic performance improved during emergency distance learning. No difference was found between courses with different teaching methods or class sizes. Students supported the idea that organisational factors can contribute to the successful implementation of emergency distance education, and the study discussed considered various organisational, individual, and instructional aspects of distance education [31].

A systematic review of the use of digital technologies in higher education provided an evidence map that forms the basis for further research into the discipline-specific use of technology to promote student engagement. Behavioural engagement was by far the most frequently identified dimension related to educational technology use, followed by affective and cognitive engagement [32]. The key enablers for the future use of technology in the classroom are the digital literacy of students and teachers needed to work productively in the new digitised environments while ensuring safety and ethics [33]. Alqahtani and Rajkhan found that technology management, management support, student awareness of the use of e-learning systems, and demand for high levels of information technology by lecturers, students, and universities were the most influential factors for e-learning during the period COVID-19 [34]. Readiness to adopt e-learning played an important role in promoting the educational process during the COVID-19 pandemic. Among the five learning systems studied, blended learning proved to be the most suitable learning system. Blended learning also showed better impact on knowledge outcomes compared to traditional learning in education.

Medical and health education was of particular interest during the COVID-19 pandemic. Rajab and colleagues concluded that the COVID-19 pandemic could have a positive impact on some factors of medical and health-related education, but also pointed to numerous challenges that arose in terms of social life, finance, and research [35]. In the area of medical and health-related education, the development of online simulators, virtual hospitals and virtual case studies, as well as various forms of telemedicine, may help to promote virtual education. A systematic review of blended learning compared to traditional learning in medical education consistently found better results in learning outcomes for blended learning [36].

The publications can further be grouped into four clusters of publications basis of a bibliometric coupling analysis, in which the references in the publications are taken into account when creating bibliometric links (Figure 7).

Based on a content analysis, the red cluster focuses mainly on publications related to the COVID-19 pandemic, such as the adoption of online education technologies as an emergency measure for providing education during the COVID-19 pandemic. The green cluster focuses on blended learning from the teacher perspective, tackling challenges, strategies, and skills needed to deliver high quality learning experience and also contains several literature reviews, including publications on bibliometric analysis. The blue mainly containts publications that deal with reviews on students' attitudes towards self-regulated learning, online courses, with some of the articles focusing on nursing students particularly. The yellow cluster contains publications that consider participant or student engagement and satisfaction, strategies for online education and support for online education delivery.

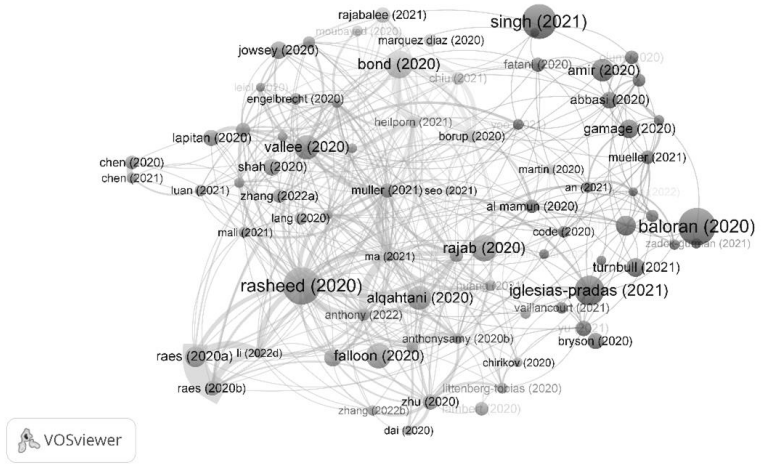


Figure 7. Bibliometric network of publications based on the bibliometric coupling analysis, source: authors

5. Discussion and Conclusion

As elaborated in previously, "blended learning" is not a term coined for teaching in the COVID-19 pandemic. Blended learning represents one of the forms for technologically supported teaching and learning and has been a topic of interest to researchers and teachers for more than a decade. However, the COVID-19 pandemic served as a catalyst to accelerate the adoption of ICT solutions in the classroom. Now that it is known that there are viable and affordable alternatives to traditional teaching methods, that educational institutions are already equipped with some technological solutions, and that teachers and educational institutions have experience using them, it might be argued that there will not be a complete return to the old methods. Perhaps technology is here to stay. If adopted by smaller universities as a part of their educational management efforts to better compete with larger or closer universities, ICT solutions such as blended learning may even be seen as disruptive innovations that will lead to further globalisation of education [37]. In addition to increasing competition among educational institutions, these disruptive innovations may also help provide needed and more affordable education to potential students who live far from universities (e.g., on islands, in rural or other remote areas). While the education sector during the COVID-19 pandemic period relied heavily on online learning approaches and methods, the interest in ICT-enhanced education also spilled over into the scientific community, providing an opportunity to examine influences, factors, and mechanisms in more detail.

Scientific interest in publishing research on blended learning is steadily increasing over the last decade. This trend accelerated from 2020 to 2023 due to the effects of the COVID-19 pandemic and the need for urgent uptake of teaching and learning in an online environment. The importance of research in this area is supported by the sharp increase in citations of publications. Although there are several geographic and institutional centres that produce much of the research on blended learning, the topic is globally significant, as evidenced by the large number of authors, journals, affiliations and countries contributing to the field. The most productive countries are USA, China, England, India and Australia, and the most productive universities, namely Monash University, University College London, Griffith University, University of Edinburgh, and Zhejiang University mostly pertain to the most productive countries. The most productive journals are Education Sciences, followed by Education and Information Technologies, Sustainability, BMC Medical Education and International Journal of Emerging Technologies in Learning.

The most productive journals are mainly focused on educational research, using technologies for learning, and health-related fields. The most used keywords were blended learning and COVID-19, followed by higher education, online learning and e-learning. Higher education as an important topic across the are is indicating that members of academia are well aware of the need and presence of blended learning in their environment. Furthermore, several keywords that refer to different forms of online learning, and broader terms related to teaching and learning using ICT. Medical education is also highlighted among the most frequently occurring keywords. There are several keywords emphasising the importance of online education experiences and attitudes toward online education, such as performance, impact, perception, satisfaction, engagement, motivation, and skills. The keywords use is in line with the literature reviewed and the topics of the most influential publications. The most influential publications addressed student perspectives, the challenges to teachers and challenges to institutional adoption of various forms of online learning, and recommendations and frameworks for online education and blended learning, and higher education.

Of particular interest were student and learner attitudes toward online learning, their experiences, performance, and engagement in online courses. Most publications were related to the higher education sector and focused on students, teachers, institutions, and their experiences with blended learning during the pandemic. In addition to exploring the challenges of online education from several perspectives, the publications also addressed strategies for providing online education, success factors, and teacher and student digital competence and literacy as the skills needed in a digital environment. Some of the major obstacles to implementing blended learning methods in classrooms were the lack of ICT and the lack of knowledge about how to use the new technology. However, these barriers were quickly overcome in the COVID-19 period as education systems in Europe and most other parts of the world moved to some form of e-learning. The challenges of delivering online education lie not only in the digital literacy of all involved, but also in uncertainty about the impact of the new teaching methods on the quality of the curriculum and the quality of learning in general. Concerns about blended learning and other types of online learning approaches include the likely loss of social interaction and soft skills, the additional administrative burden teachers face in an online environment, and the lack of effective control in knowledge assessment. Furthermore, if technology and blended learning lead to a shift in the role of teachers from that of lecturer to that of knowledge facilitators, this could be seen as a devaluation of the teaching profession. Several publications have therefore

compared traditional learning methods and experiences with blended learning and similar approaches, and some have concluded that blended learning provides better results in learning outcomes.

The main contribution of this paper is to highlight the importance of blended learning as one of the technological advances in education, especially during the COVID-19 pandemic. The purpose of this research is to provide a knowledge base on the findings and advances in the extensive research on blended learning during the COVID-19 pandemic, providing indicators of the most productive countries and organisations, the most important journals in the area, the main topics and findings, thus providing an overview and aid in promoting further research in the area. Therefore, blended learning is not only considered as a here-to-stay teaching practise, but also as a branch of educational management research that is vivid of scientific research. Transformation from traditional to blended learning seems inevitable and should not be left to itself, i.e. it should be carefully managed. In these efforts, educational management should be planned and administered in a way that promotes excellence, prepare teachers to not just adapt to new technological requirements but also to shift to transform teaching into a personalized, competency-based system that meets the diverse needs of all learners.

The main limitation of this work is that it focuses mainly on blended learning as one of the approaches to online learning. Moreover, the bibliometric analysis is limited by the choice of keywords and the choice of database, language and type of study. Future research should focus on the long-term trends and development of blended learning and other online learning approaches in general in the post-pandemic period. In addition, future research in this area could gather the experiences of learners, educators, and institutions during the COVID-19 pandemic and synthesise key findings, leading to the creation of a comprehensive theoretical framework for blended learning.

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