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Blended Learning Research: A Systematic Review and Identification of Future Research Gaps

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Abstract

In the dynamic landscape of modern education, blended learning has emerged as a transformative paradigm, integrating face-to-face and e-learning experiences. In this systematic review paper, we explore into the multifaceted dimensions of blended learning, examining its trends, challenges, and future research gaps. As an innovative approach, blended learning strives to harmonize traditional teaching methods with online resources to optimize educational outcomes across diverse disciplines. The study followed the PRISMA guidelines, ensuring methodological rigor and reproducibility. The synthesis of diverse studies on blended learning indicates its positive impact on student performance, retention, and practical skills across various educational levels and subjects. Personalized approaches and technological interventions enhance its effectiveness. By shedding light on existing gaps and challenges, this study aimed to guide stakeholders in shaping the global design and adoption of blended learning practices, marking a novel contribution to the evolving literature on this transformative educational model.

Keywords: Blended Learning, Systematic Literature Review, Research Gap, Prisma.

Introduction

In this era of e-learning modernization, the term blended learning emerged as a novel paradigm to empower educators in e-learning and face-to-face learning practices at the same time (Sivakumar and Selvakumar, 2019). Practically, blended learning was characterized as the "integration of e-learning and classroom learning" (face-to-face) in delivering flexible, timely, and continuous learning experiences (Bazelais and Doleck, 2018). Blended learning, as defined by Vo et al (2017), involves the integration of face-to-face and technology-mediated instruction. It is characterized as "a thoughtful integration of classroom face-to-face learning experiences with online experiences" (Rasheed et al., 2020). Blended learning presents a promising alternative to e-learning due to perceived limitations in fostering "interaction, context, and remediation" (Berga et al., 2021). Subsequently, Nasution et al. (2021) expanded the blended learning model, defining it as integrating face-to-face and computer-mediated instruction.

However, several empirical studies investigated and concluded the positive and significant impact of the blended learning model on student's academic achievements in different fields of education, including higher education, medical, engineering, and art and science education contexts (Vo et al., 2017; Bordoloi et al., 2021; Singh et al., 2021; Li and Wang, 2022). Furthermore, Atwa et al (2022) discuss that blended learning seeks to leverage the strengths of traditional teaching methods and online resources to enhance educational outcomes. Empirically, past studies and practitioners have emphasized the complexity fundamentals in designing blended learning experiences, taking numerous factors into account, including the quality of learning experiences, instructional methods, the integration of learning technologies, teachers and student attitudes, engagement, and the e-learning platform of the institutions (Ayob et al., 2023). Consequently, studies have explored various perspectives on blended learning since the early 2000s. Despite over two decades of investigation, challenges persist, and inquiries remain unanswered, particularly concerning the quality of designed e-learning materials, instructional approaches, resistance to this method within educational cultures, and the potential overload experienced by educators when implementing the blended learning model.

The challenges associated with blended learning have been exacerbated by the COVID-19 pandemic, prompting educational institutions globally to adapt by combining online and offline learning modalities (Singh et al., 2021). In response to health regulations, such as reduced classroom sizes; some educational institutions have employed a blended learning approach with platforms like personalized learning software, interactive multimedia, learning management systems (LMS), and video conferencing software (Tubagus et al., 2020; Gunawan et al., 2021; Sumardi et al., 2021). Educators' concerns include infrastructure and competency issues in implementing a blended learning model, prompting calls for further examination.

Recognizing the evolving landscape where the blended learning approach is becoming unexceptional, this study aimed to extend a systematic review by analysing past studies on the blended learning approach. By rigorously examining articles, the study elucidates reported blended learning trends, challenges, research gaps, and future directions. These insights aim to assist diverse stakeholders, including policymakers, educators, and instructional designers, in facilitating the global design and adoption of blended learning. Despite systematic reviews in various fields such as engineering, healthcare, and tourism, no comprehensive review has been undertaken in the blended learning domain, making this study a novel contribution to the literature on the blended learning model.

The paper is organized as follows: first, it describes the importance and challenges of implementing blended learning practices; second, it outlines the method. Third, it provides the results and discussions; fourth, it concludes the overall systematic review findings; finally, it outlines the limitations, future research, and implications in section five.

Research Questions

This paper addresses the following research questions:

i. What are the blended learning research trends from 2014-2024?
ii. What are the challenges of blended learning?
iii. What are the future research gaps of blended learning?

Methods

In the present study, we systematically reviewed past studies on blended learning, adhering to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (Moher et al., 2009). PRISMA, a widely accepted methodology, ensures standardization through a checklist strictly adhered to in this study for quality assurance and replicability. The research implemented a review protocol outlining the search strategy, article selection criteria, quality assessment, and data extraction and analysis procedures. Therefore, the systematic review process is presented in Figure 1.

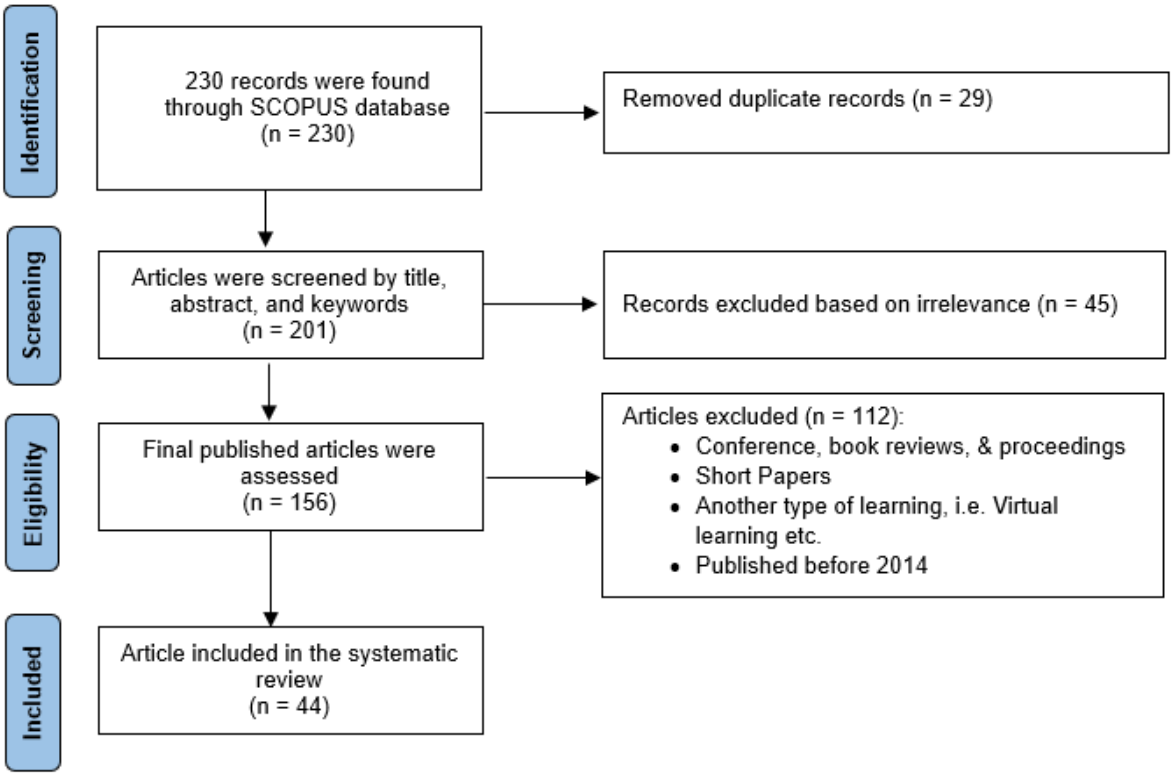

Figure 1. Systematic review process.

Search Strategy and Selection Criteria

An extensive search for past studies was conducted in widely recognized electronic databases called SCOPUS to address the Blended Learning topic. The search utilized 2 strings, which were “blended learning model” and “academic performance”. Eligibility assessment of the selected papers was conducted based on predefined criteria, resulting in 44 eligible research studies for inclusion in the systematic review, as illustrated in Figure 1, following PRISMA guidelines. Furthermore, Table 1 illustrates the inclusion and exclusion criteria of selected articles from the SCOPUS database.

Table 1
Inclusion and exclusion criteria described.

Inclusion	Exclusion
Journal articles (published) in English only	Conferences, book reviews, and proceedings
Empirical studies (qualitative, quantitative, or mixed method)	Conducting short papers (perspective or commentary)
Keywords were "blended learning" and "academic performance"	Another type of learning, i.e., virtual
Published from 2014-2024	Published before 2014

Data Analysis

First, the articles were analysed descriptively by identifying the number of articles published each year. Next, the articles were analysed using deductive thematic analysis, where the content was reviewed based on the following aspects:

i. Research methods applied in the research
ii. Objectives of the research
iii. Challenges faced in implementing blended learning
iv. Future research gaps of blended learning

In addition to these aspects, the deductive thematic analysis provided a detailed understanding of recurring themes and patterns within the articles. Through systematic categorization and data interpretation, we revealed deeper insights into the collective knowledge presented in the systematic literature review.

Discussion and Results

Over the past decade, blended learning research has burgeoned, revealing significant trends. Studies from 2014 to 2024 have underscored the effectiveness of blended learning in enhancing student outcomes across diverse educational contexts. Researchers have explored its impact on academic achievement, retention, and practical skill development. Notably, personalized approaches tailored to individual learning styles have gained traction, with studies emphasizing the importance of adaptive instructional design. The COVID-19 pandemic further accelerated the adoption of blended learning, highlighting its resilience and flexibility in facilitating continued education amidst disruptions. Additionally, research has explored into the pedagogical implications of blended learning for educators, emphasizing the need for ongoing professional development and support. Hence, as blended learning continues to evolve, future research is poised to explore deeper into refining methodologies, addressing equity concerns, and maximizing its potential for fostering inclusive and engaging learning environments. The overall trends from 2014 to 2024 signify a robust and dynamic field, driving innovation and transformation in education. Figure 2 illustrates the publication trend over the years.

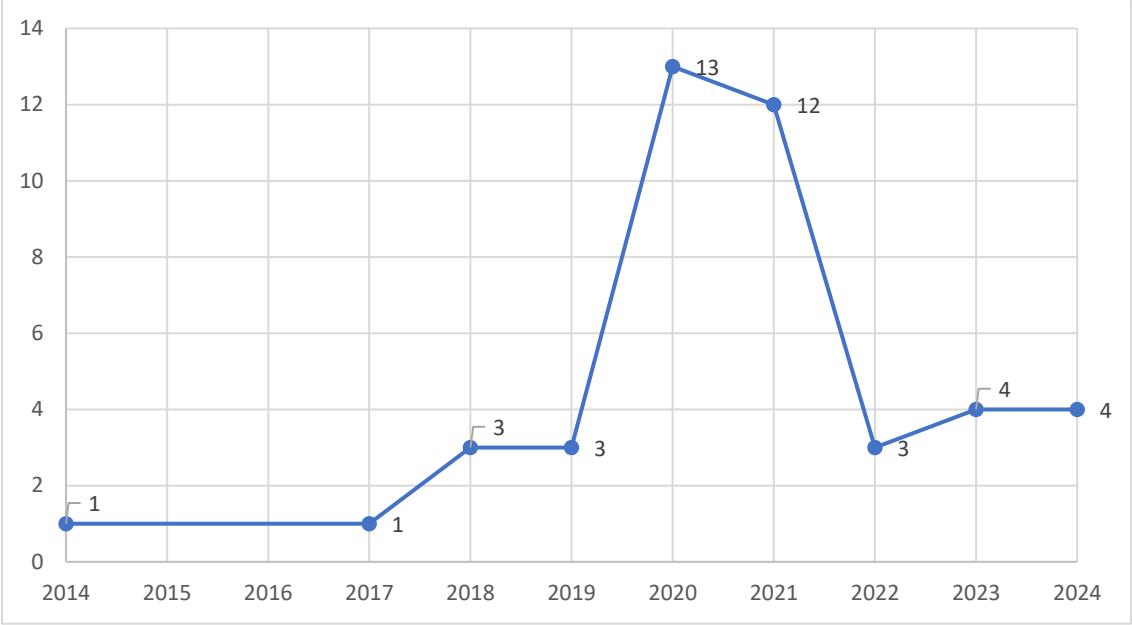

Figure 2. Publications between 2014 to 2024.

The graph illustrates the number of studies included in the systematic literature review (SLR) on blended learning from 2014 to 2024, with a total of 44 articles reviewed. A significant spike occurred in 2020-2021, likely due to the COVID-19 pandemic, which heightened interest in blended learning, peaking at 13 publications in 2020. This distribution reflects the evolving research focus on blended learning over the past decade, capturing key developments and shifts in the field.

Out of the 44 reviewed articles, 30 explicitly mentioned the location of the studies, which are distributed across seven continents, as shown in Figure 3. Western Asia leads with 9 studies, including those conducted in countries such as Saudi Arabia, Kuwait, Bahrain, Qatar, the United Arab Emirates, and Jordan. South-Eastern Asia follows with 7 studies from Malaysia, the Philippines, and Indonesia. Southern Asia contributed 5 studies, primarily from India and Pakistan. Northern America accounts for 4 studies, covering the United States and Canada. Eastern Asia, focused on China, and Europe, with studies in Italy and Spain, each contributed 2 studies. Finally, Australia had 1 study. This diverse geographic representation highlights the widespread interest and implementation of blended learning across different educational and cultural contexts.

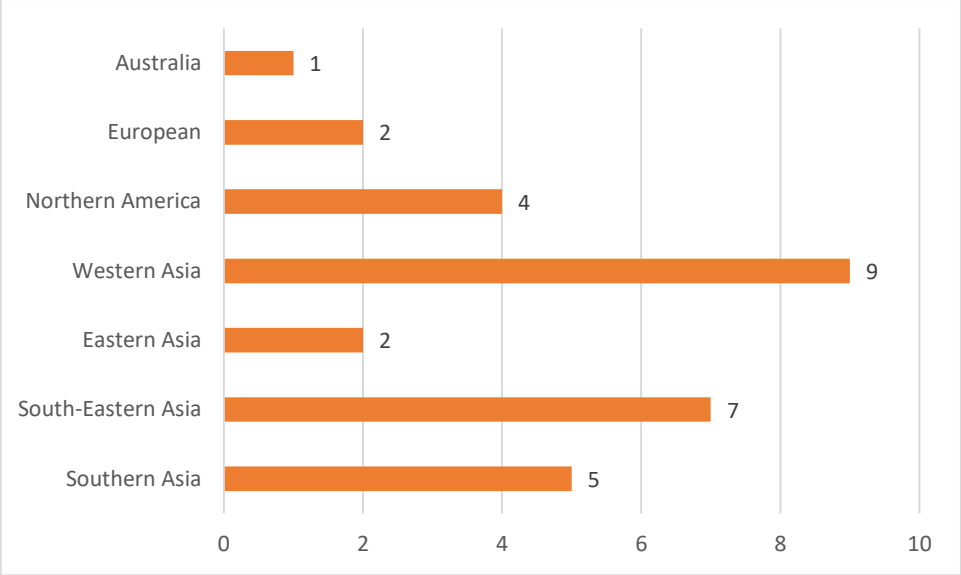

Figure 3. Publication by continent

The Challenges of Blended Learning

In examining the collective findings of past studies on blended learning, it becomes evident that the approach has substantial potential to positively impact student performance and learning outcomes across various educational contexts. Therefore, we listed the key articles in Table 2.

Table 2
Summary of all reviewed articles

No.	Title	Authors	Method	Objectives
1	The effect of blended learning on student performance at course level in higher education: A meta-analysis	Vo et al. (2017)	Quantitative	The study aimed to investigate and analyse the impact of blended learning on the academic achievement of higher education students.
2	Effect of blended learning on student performance in K-12 settings: A meta-analysis	Li and Wang, (2022)	Quantitative	The study aimed to comprehensively analyse the effects of blended learning programs on Kindergarten through Grade 12 (K-12) student performance.
3	Effects of a blended learning approach on graduate-level public health course student outcomes.	Kiviniemi, (2014)	Quantitative	As outlined in the abstract, this study aimed to investigate the impact of a blended learning approach on student learning in a graduate-level public health course. The researchers aimed to compare the effectiveness of the blended

No.	Title	Authors	Method	Objectives
				learning approach to a traditional course approach and evaluate its influence on student performance.
4	Blended learning package: It effectively affects students' performance and retention in higher secondary physics courses.	Sivakumar & Selvakumar, (2019)	Quantitative	This study aimed to investigate the effectiveness of blended learning in enhancing the performance and retention of higher-secondary learners in Physics.
5	Blended learning approach: Effect on students' academic achievement and practical skills in science laboratories.	Hinampas et al. (2018)	Quantitative	The study aimed to investigate the effect of a blended learning approach on students' academic achievement and practical skills in science laboratories.
6	Students' Learning Style and Its Effect on Blended Learning: Does it Matter?	Shamsuddin and Kaur, (2020)	Quantitative	The study aimed to investigate the relationship between students' learning styles and their perceptions of blended learning.
7	Improved pedagogical practices strengthen the performance of student teachers by a blended learning approach.	Marie (2021)	Quantitative	This study aimed to explore and evaluate the effectiveness of the innovative teaching and learning approach known as Blended Learning in improving the academic performance of student teachers.
8	The effectiveness of using blended learning teaching and learning strategy to develop students' performance in higher education.	Ayob et al. (2023)	Quantitative	This study examined the effectiveness of the blended learning strategy on students' academic achievement in higher colleges of technology in the United Arab Emirates (UAE).
9	We are investigating the impact of blended learning on academic performance in a first-semester college physics course.	Bazelais & Doleck, (2018)	Quantitative	This study aimed to investigate the impact of blended learning on pre-university science students, specifically in the context of the mechanics course in the physics pre-university program.

No.	Title	Authors	Method	Objectives
10	Effects of using a blended learning method on students' achievement and motivation to learn English in Jordan.	Oweis, (2018)	Quantitative	This research aimed to investigate the effect of blended learning on the achievement and motivation to learn English among students at German Jordanian University.
11	An individualized intervention approach to improving university students' learning performance and interactive behaviours in a blended learning environment.	Zhang et al. (2020)	Quantitative	This study aimed to investigate the impact of individualized learning interventions on students' academic performance and learning behaviors in a blended learning environment.
12	Using Artificial Intelligence to Predict Students' Academic Performance in Blended Learning.	Hamadneh et al. (2022)	Quantitative	This study aimed to employ statistical analysis and artificial neural networks (ANNs) to identify and predict factors affecting students' performance in a blended learning environment at Saudi Electronic University (SEU).
13	Promoting Self-Regulation Progress and Knowledge Construction in Blended Learning via ChatGPT-Based Learning Aid.	Wu et al. (2023)	Qualitative	This study aimed to integrate LINE, Apple's Shortcuts, and ChatGPT to create Learning Aid, aiming to maximize the knowledge and self-regulation process.
14	Towards an Efficient Integrated Distance and Blended Learning Model: How to Minimise the Impact of COVID19 on Education.	Al-Hunaiyyan et al. (2021)	Quantitative	This study sought to explore how educators and students perceive the acceptance of e-learning, aiming to identify the crucial factors and challenges affecting its adoption during the Covid-19 crisis.
15	Learning Technology Models that Support Personalization within Blended Learning	Alamri et al. (2021)	Qualitative	The objective of this study was to offer a comprehensive examination of personalized learning theory, technology

No.	Title	Authors	Method	Objectives
	Environments in Higher Education.			facilitating personalization in higher education, existing methodologies, and case studies illustrating the implementation of technology frameworks supporting personalized learning.
16	Learning from the problems and challenges in blended learning: Basis for faculty development and program enhancement.	Alvarez, (2020)	Qualitative	The aim of this study was to investigate the issues and obstacles faced by NSTP facilitators to establish a foundation for ongoing enhancement of teaching and learning practices.
17	A Systematic Review of Systematic Reviews on Blended Learning: Trends, Gaps and Future. Directions	Ashraf et al. (2021)	Qualitative	This study aimed to investigate and conclude the students' attitude and behaviour towards blended learning model through a systematic literature review approach.
18	Online, Face-to-Face, or Blended Learning? Faculty and Medical Students' Perceptions During the COVID-19 Pandemic: A Mixed-Method Study.	Atwa et al. (2020)	Mixed-Method	The objective of this study was to investigate the experiences of faculty and students with both online and face-to-face learning, as well as their preferences for learning modalities post-pandemic.
19	Blended learning versus face-to-face learning in an undergraduate nursing health assessment course: A quasi-experimental study.	Berga et al. (2021)	Quantitative	To explore the results concerning self-efficacy, knowledge, and perceptions associated with the introduction of a newly blended course.
20	Perception towards online/blended learning at the time of Covid-19 pandemic: An academic analytics in the Indian context.	Bordoloi et al. (2021)	Quantitative	The aim of this paper was to grasp the viewpoints of both teachers and learners concerning the utilization of online/blended learning methods in educational transactions during COVID-19 pandemic.

No.	Title	Authors	Method	Objectives
21	Blended learning in higher education: Trends and capabilities.	Castro (2019)	Qualitative	The objective of this paper was to pinpoint notable trends in blended learning implementations within higher education, examining the capabilities afforded by technology, such as datafication, and the various contexts in which these capabilities are utilized.
22	'I Couldn't Join the Session': Benefits and Challenges of Blended Learning amid COVID-19 from EFL Students.	Dahmash (2020)	Qualitative	This study aimed to examine the challenges and benefits of English language learning practices using blended learning model during COVID-19 pandemic.
23	Supporting engagement and retention of online and blended-learning students: A qualitative study from an Australian University.	Fan et al. (2024)	Qualitative	This study aimed to explore the students' perceptions towards blended subjects learning regarding the academic support.
24	Student engagement in online and blended learning in a higher education institution in the Middle East: Challenges and solutions	Fazza and Mahgoub (2021)	Qualitative	The study aimed to explore the students' engagement of Arabic as a Foreign Language (AFL) and Arabic Heritage Learners (AHLs) in online learning in higher education systems.
25	Effectiveness of Blended Learning Model Based on Problem-Based Learning in Islamic Studies Courses.	Hamzah et al. (2022)	Quantitative	The objectives of the study were to create LMS-based learning programs using the Web-Centric Course model for Islamic Studies.
26	An examination of teachers' strategies to foster student engagement in blended learning in higher education.	Heilporn et al. (2021)	Qualitative	This qualitative paper explored how teachers fostered student engagement in blended learning that combine synchronous and asynchronous activities.
27	Challenges of Distance, Blended,	Koi-Akrofi et al. (2020)	Qualitative	The study aimed to illustrate the fundamental distinctions

No.	Title	Authors	Method	Objectives
	and Online Learning: A Literature-based Approach.			among Distance, Blended, and Online learning, as well as to identify their shared challenges through existing literature.
28	Blended Learning as Instructional Model in Vocational Education: Literature Review.	Krismadinata et al. (2020	Qualitative	The objective of this paper was to examine and provide an explanation of the blended learning model in vocational education.
29	Blended Learning Tools and Practices: A Comprehensive Analysis.	Kumar et al. (2021)	Qualitative	This study aimed to examine the use and influence of various tools techniques and framework models useful for blended learning.
30	Face to Face Learning vs Blended Learning vs Online Learning (Student Perception of Learning).	Nasution et al. (2021)	Quantitative	The aim of this study was to ascertain students' perceptions of learning preferences among face-to-face, blended, and online modalities.
31	Challenges in the online component of blended learning: A systematic review.	Rasheed et al. (2020)	Qualitative	This qualitative study aimed to explore the challenges in blended learning practices from teachers and students' perspectives.
32	Influence of augmented reality app on intention towards e-learning amidst COVID-19 pandemic.	Saleem et al. (2023)	Quantitative	This study aimed to investigate the students' behavioural intention to use e-learning systems during COVID-19 pandemic.
33	Technology Enhanced Learning in Higher Education: How to Enhance Student Engagement through Blended Learning.	Serrano et al. (2019)	Qualitative	The aim of this study was to offer practical examples and raise awareness among Higher Education educators regarding the transformation of traditional face-to-face learning into blended courses.
34	Combining the Best of Online and Face-to-Face Learning: Hybrid and Blended Learning Approach for COVID-19, Post	Singh et al. (2021)	Qualitative	This study aimed to draw a fishbone model to identify and analyse the blended learning problems faced by the instructors.

No.	Title	Authors	Method	Objectives
	Vaccine, & Post-Pandemic World.			
35	A blended learning model with IoT-based technology: Effectively used when the COVID-19 pandemic?	Siripongdee et al. (2020)	Qualitative	The objective of this study was to examine the blended learning model using IoT technology during COVID-19 pandemic.
36	An effective way of designing blended learning: A three phase design-based research approach.	Ustun and Tracey (2020)	Qualitative	The objective of this research study was to identify the necessary elements to support a higher education instructor who lacks experience in designing and teaching a blended learning (BL) course.
37	The Effect of The Blended Learning Model on Student Critical Thinking Skill: Meta-analysis.	Suryono et al. (2023)	Quantitative	The aim of this study was to examine the students' critical thinking skills towards blended learning approaches.
38	Development of Learning Management System-Based Blended Learning Model using Claroline in Higher Education.	Tubagus et al. (2020)	Quantitative	The purpose of this study is to develop blended learning Using Claroline as a learning tool that facilitates students in learning.
39	Website-Based Learning Management System (LMS) as a Tool for Learning in the Covid-19 Pandemic Period for Junior High Schools.	Sumardi et al. (2021)	Quantitative	This study aimed to develop a blended learning website and explore how that website learning process influences students' learning habit.
40	Blended Learning Model Implementation in the Normal, Pandemic, and New Normal Era.	Mahmud, (2020)	Qualitative	The aim of this qualitative study was to examine the influence of blended learning model implementation during and before COVID-19 pandemic.
41	Challenges of Blended Learning in Refugee Camps: When Internet	Dridi et al. (2020)	Qualitative	The aim of this study was to identify the blended learning model challenges in refugee camps.

No.	Title	Authors	Method	Objectives
	Connectivity Fails, Human Connection Succeeds.			
42	Assessing the impact of hybrid teaching on students' academic performance via multilevel propensity score-based techniques.	Ragni et al. (2024)	Quantitative	This study examined the impact of hybrid teaching – a blend of face-to-face and online learning on student performance using multilevel propensity score techniques.
43	Blended learning in nursing pharmacology: elevating cognitive skills, engagement and academic outcomes.	Arien-Zakay (2024)	Quantitative	This qualitative study aimed to explore the nursing students' intention towards elevating cognitive skills, engagement, and academic outcomes using blended learning approach.
44	Does institution support matter? Blended learning approach in the higher education sector.	Wut et al. (2024)	Quantitative	The aim of this study was to investigate indicators influencing students' intention to join blended learning courses in higher education sector using "Community of Inquiry framework" and "Unified Theory of Acceptance and Use of Technology model."

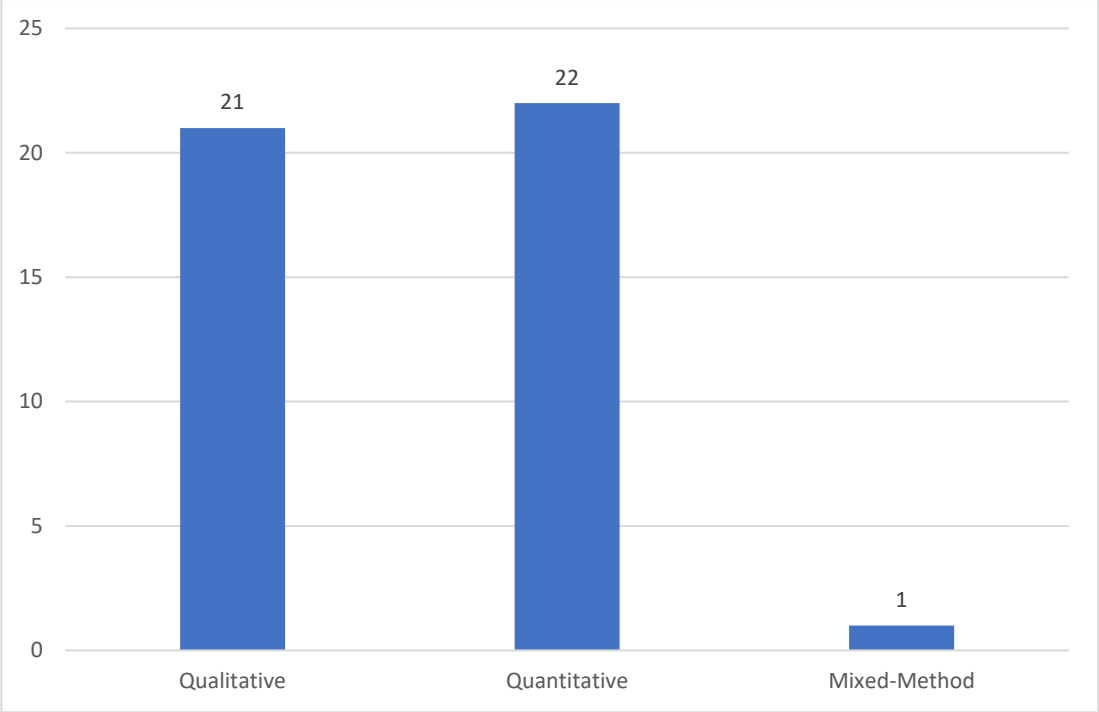

Figure 4. Presenting the Methods Applied by the Past Studies

Based on the review of 44 articles (see Figure 4), majority of the research were conducted using either qualitative or quantitative methodologies, as opposed to mixed-method studies. This highlights an opportunity for researchers to prioritize mixed-method approaches, which can provide comprehensive answers to both the 'what' and the 'why,' integrating quantitative data with qualitative insights. This integration enables researchers to capture a fuller understanding of phenomena, enhancing the richness and depth of their findings.

The synthesis of findings from the diverse studies on blended learning across various educational contexts reveals critical insights into its impact on student performance and learning outcomes. Empirically, Vo et al (2017), and Li and Wang (2022), examined and concluded the positive effects of blended learning models on academic achievements of the students. Furthermore, another study by Kiviniemi (2014), in a graduate-level public health course and Sivakumar and Selvakumar's (2019), exploration of higher secondary physics learners bring depth to our understanding. These studies emphasize the blended learning model's effectiveness in improving academic performance and fostering retention and practical skills. The research by Hinampas et al (2018), demonstrates the positive impact of blended learning on both academic achievement and practical skills. Similarly, Shamsuddin and Kaur (2020), add a layer of complexity by examining the relationship between students' learning styles and their perceptions of the blended learning model, highlighting the need for personalized approaches in instructional design.

However, the potential of blended learning plays an important role in enhancing the pedagogical practices of student teachers (Marie, 2021). Thereby, Zhang et al (2020) study introduces an individualized intervention approach, demonstrating its positive influence on academic performance and learning behaviours in a blended learning environment. Finally,

Hamadneh et al (2022), qualitative study incorporates artificial intelligence to predict students' academic performance in a blended learning setting.

Collectively, these studies provide a rich tapestry of evidence supporting the effectiveness of blended learning across diverse educational levels, subject areas, and geographical locations. The findings from past studies underscore the need for adaptive and context-specific approaches in implementing blended learning, considering factors such as learning styles, subject specificity, and technology integration. While the research indicates overwhelmingly positive outcomes, it also highlights the importance of ongoing exploration, refinement of methodologies, and consideration of potential challenges to ensure the continued success of BL in fostering enhanced learning experiences. As educational institutions worldwide continue to navigate challenges, particularly in the face of events like the COVID-19 pandemic, the insights derived from these studies offer valuable guidance for educators, policymakers, and instructional designers seeking to optimize learning outcomes through the thoughtful integration of blended learning approaches.

Implementing blended learning comes with challenges that educational institutions must navigate. First, educational institutions in developing countries still lack reliable internet access, hardware, and software to integrate technology (Siripongdee et al., 2020). Second, arranging training and skills development programs for educators in technical aspects and pedagogical strategies for online instruction is still challenging for educational institutions (Castro, 2019). Third, overcoming resistance from teachers, students, and parents who may prefer traditional methods or are unfamiliar with technology is a significant challenge (Fadde and Vu, 2014); elaborating clear communication and showcasing the benefits of blended learning are essential. Fourth, balancing face-to-face and online instruction requires effective time management, where teachers are limited in allocating time for planning, content delivery, online discussions, and timely feedback (Ustun and Tracey, 2020). Fifth, maintaining students' engagement in online and offline activities is crucial for teachers, as they must employ strategies to keep students motivated and actively participate in the learning process (Fazza and Mahgoub, 2021). Sixth, the absence of clear policies and guidelines for blended learning led to inconsistencies. Finally, budget constraints can limit educational institutions' ability to adopt and sustain blended learning practices due to a lack of significant financial investment.

Addressing these challenges demands a collaborative approach involving educators, administrators, policymakers, and technology experts. Therefore, successful implementation of blended learning requires strategic planning, ongoing support, and a commitment to overcoming obstacles to enhance the overall learning experience for students. Therefore, we discussed the key challenges in blended learning in Table 3, which were explicitly mentioned in 11 out of the 44 articles reviewed.

Table 3
Blended Learning Challenges

No.	Authors	Challenges	Themes
1	Al-Hunaiyyan et al. (2021)	Readiness of instructors and students Low motivation, knowledge and skills in using the systems Infrastructure and Resources	Readiness, Knowledge and Skills, Infrastructure, Infostructure
2	Alvarez, (2020)	Technological, instructional, class size, technical support, and collaboration	Infrastructure, Infostructure, Supports
3	Ashraf et al. (2021)	Lack of ICT skills and infrastructure	Skills, Infrastructure,
4	Atwa et al. (2020)	Online examinations, technical issues	Infostructure, Infrastructure
5	Koi-Akrofi et al. (2020)	Lack of infrastructure, low or no IT skills, self-disciplinary problems, content issues, policy issues, and social issues.	Infrastructure, Skills, Attitude, Infostructure, Supports, Social Issues
6	Bordoloi et al. (2021)	Poor Internet connectivity and electricity Lack of ICT skills, digital services	Infrastructure, Skills, Supports
	Rasheed et al. (2020)	Self-regulation, using learning technology, suitable instructional technology, effective training support	Attitude, Skills, Infrastructure Supports
7	Fazza and Mahgoub (2021)	Students' unprecedented health, social and mental constraints	Mental Health Social Issues
8	Singh et al. (2021)	Attitude toward technology, limited (or no) training, software challenges, and lack of online infrastructure, lack of a humanized learning environment, lack of sense of community	Attitude, Infostructure Infrastructure, Social Issues
9	Dridi et al. (2020)	Poor Internet connection	Infrastructure
10	Kumar et al. (2021)	Lack of automation, lack of resources and managerial decision power, lack of internet access, lack of security and privacy concerns	Infostructure, Infrastructure, Social Issues, Supports
11	Dahmash (2020)	Technological problems, flaws in the instructor's performance, difficulties with online tests, attitudes to online learning and limited resources, and the university council's decisions	Infrastructure, Skills and Knowledge, Attitude, Infostructure, Supports

The challenges identified in blended learning can be categorized into several critical themes, including readiness, infrastructure, infostructure, skills, attitude, mental health, and supports. A recurring challenge across studies, such as those by Al-Hunaiyyan et al (2021), and Bordoloi et al. (2021), is the readiness of both instructors and students. This encompasses low motivation, inadequate knowledge, and insufficient skills in using the systems required for blended learning. Additionally, the infrastructure, including internet connectivity and electricity, is frequently highlighted as a barrier, with poor access to these essential resources limiting the effectiveness of blended learning. Furthermore, infostructure, which involves the technical backbone supporting online learning environments, is often underdeveloped, leading to significant issues during the implementation of blended learning.

Another critical challenge revolves around the lack of ICT skills and technical support, as indicated by Alvarez (2020), Ashraf et al (2021), and others. These studies underscore the need for adequate instructional design, class size management, and collaboration tools. The absence of these elements often exacerbates the problems related to infrastructure and infostructure. Self-regulation and the ability to use learning technologies effectively are also significant challenges. Rasheed et al (2020), highlighted the importance of suitable instructional technology and effective training support, while Singh et al (2021), emphasized the attitude towards technology and the lack of a humanized learning environment. These factors contribute to a broader issue of student and instructor engagement, further complicating the blended learning experience.

Social issues, mental health, and the overall learning environment present additional challenges. Fazza and Mahgoub (2021), pointed out the unprecedented health, social, and mental constraints faced by students, which can hinder their ability to participate in blended learning effectively. Similarly, Kumar et al (2021); and Dahmash (2020), discussed the lack of automation, resources, and managerial decision power, as well as security and privacy concerns. The combination of these factors, along with the university council's decisions and policy issues, highlights the complex, multifaceted nature of the challenges in blended learning. Addressing these issues requires a holistic approach that considers not only technological and infrastructural improvements but also the social and psychological needs of students and educators.

Discussion

The findings of this study explain several key aspects of blended learning implementation and its impact on student outcomes. Firstly, our research indicates a positive correlation between blended learning models and enhanced student performance across various educational contexts. This aligns with existing literature highlighting the effectiveness of blended learning in improving academic achievement and fostering retention of knowledge and skills (Vo et al., 2017; Li & Wang, 2022). By integrating online and face-to-face components, blended learning offers students opportunities for active engagement, personalized learning experiences, and flexibility in accessing instructional materials.

Moreover, our study identified several critical challenges in the implementation of blended learning, including issues related to readiness, infrastructure, infostructure, skills, attitudes, mental health, and support systems. The readiness of instructors and students, coupled with insufficient skills and motivation to engage with blended learning technologies,

remains a significant barrier (Al-Hunaiyyan et al., 2021; Bordoloi et al., 2021). Infrastructure issues, such as poor internet connectivity and lack of resources, further impede the effective adoption of blended learning (Dridi et al., 2020; Kumar et al., 2021). Additionally, infostructure deficiencies, such as limited technical support and inadequate instructional design, contribute to the overall complexity of implementing blended learning environments (Alvarez, 2020; Rasheed et al., 2020). Addressing these challenges requires a coordinated effort to improve infrastructure, enhance technical support, and provide comprehensive training for educators and students alike. Furthermore, bridging the digital divide through equitable access to technology and resources is essential to fostering an inclusive and effective blended learning environment (Koi-Akrofi et al., 2020).

In conclusion, while blended learning holds promise for transforming educational practices and improving student outcomes, its effective implementation requires addressing various challenges and filling gaps in research. By collaboratively addressing these issues and advancing our understanding of blended learning, stakeholders can harness its full potential to create engaging, inclusive, and effective learning experiences for students in the 21st century.

Implementations

Heilporn et al (2021), highlighted that blended learning models were often disjointed from strategic or comprehensive plans. This resulted in informal and unstructured approaches, lacking alignment with institutional policies, strategies, mission, and vision to install modern educational practices using a blended learning model. The implementation of this model often occurred without input from relevant educational personnel and shared governance processes, as Serrano et al (2019), noted. These models typically include a technological revolution supporting the identification and development of a sustained blended learning model (Krismadinata et al., 2020).

In higher education settings, blended learning, as Hamadneh et al (2022), observed, is rarely emphasized, particularly within basic educational development. The three crucial components of blended learning—integrating different modes, adapting to diverse learning styles, and leveraging technology for effective instruction—need attention for educational enhancement (Oweis, 2018; Shamsuddin and Kaur, 2020). Although rooted in educational theories, blended learning has evolved, adapting to technological advancements in instructional methods and strategies based on educational needs (Marie, 2021).

Compared to the business sector, higher education institutions have been slow in adopting blended learning models within their strategic frameworks (Bazelais and Doleck, 2018). Bridging this gap is essential for fostering educational enhancement and ensuring blended learning becomes integral to higher education institutions' long-term strategies.

Limitation and Future Research Gaps

In summary, future research in blended learning should address key gaps and limitations to strengthen the evidence base further and inform effective implementation strategies. The following research directions and considerations emerge from the current literature:

(a) *Validation and Generalizability:* Conducting larger-scale studies with robust research designs and control groups is crucial to validate the effectiveness of the blended learning package

identified in specific studies, e.g., Sivakumar and Selvakumar (2019) assessed its generalizability to other physics courses or subject areas. Meta-analyses with stricter inclusion criteria and refined analysis techniques can contribute to a more comprehensive understanding of blended learning's effectiveness, especially in diverse K-12 contexts.

(b) *Long-Term Impact on Learning Outcomes:* Investigating the long-term impact of blended learning on knowledge retention, problem-solving skills, and critical thinking abilities in physics and other science, technology, engineering, and mathematics (STEM) subjects is essential for understanding the sustained benefits of this pedagogical approach. Exploring the long-term impacts on various learning outcomes beyond academic performance, such as skills development, is crucial for a holistic evaluation of blended learning's effectiveness.

(c) *Diverse Learning Activities and Strategies:* Exploring the effectiveness of different blended learning activities and teaching strategies within the package is important for tailoring approaches to cater to diverse learner needs and learning styles. Investigating the effectiveness of different blended learning models and pedagogical strategies for specific subjects, grade levels, and learner needs can provide valuable insights for instructional design.

(d) *Student Engagement and Collaboration:* Analysing student engagement patterns and developing strategies to promote active learning and collaboration within the blended learning environment is vital for creating an interactive and participatory learning experience. Conducting qualitative studies to understand student experiences and perceptions will shed light on challenges faced by students and areas for improvement, contributing to a more learner-centric approach.

(e) *Teacher Training and Support:* Researching the challenges and best practices for teacher training and support in effectively implementing blended learning packages in high schools or similar educational settings is crucial. Addressing the concerns related to teacher preparedness and workload is essential for successful implementation. Investigating the influence of contextual factors, such as socio-economic background and access to technology, on the effectiveness and equity of blended learning implementation in basic schooling education is necessary to ensure inclusivity.

(f) *Higher Education Context:* Conducting similar research in higher education contexts is essential. Examining the influence of institutional context, faculty training, and technology access on the success of blended learning implementation in higher education will provide insights into the unique challenges and opportunities at the tertiary level. Addressing challenges related to technology integration, accessibility, and equity will ensure that all students in higher education have equal opportunities to benefit from blended learning experiences.

(g) *STEM Education Focus:* Conducting larger-scale studies with robust designs to investigate the long-term impact of blended learning on teacher skill development and classroom practices in STEM education is crucial. Exploring the effectiveness of different blended learning models and pedagogical strategies for specific STEM disciplines and student needs will contribute to tailored approaches in science, technology, engineering, and mathematics education. Researching the challenges and best practices for faculty training and support in blended learning implementation for STEM education will be instrumental in enhancing the quality of STEM instruction.

(h) *Teacher Education Programs:* Investigating the effectiveness of different blended learning models and pedagogical strategies for teacher education programs will contribute to the preparation of future educators. Exploring the influence of individual learning styles and

needs on how student teachers engage with, and benefit from blended learning approaches will provide insights into adapting instructional methods to diverse learners.

In conclusion, addressing these research directions and challenges will contribute to a more detailed understanding of blended learning's impact across educational levels and disciplines. The education community can better leverage blended learning to enhance student outcomes and support effective teacher preparation by conducting comprehensive studies, refining research methodologies, and incorporating diverse perspectives. The evolving landscape of education demands continuous research efforts to optimize the implementation of blended learning for the benefit of learners and educators alike.

Conclusion

In critically assessing the findings presented in the synthesis of blended learning studies, it is evident that while there is a substantial body of evidence supporting the positive impact of blended learning on student performance and learning outcomes, detailed aspects, and challenges demand careful consideration. The empirical studies by Vo et al. (2017) and Li and Wang (2022), are evident on the positive effects of blended learning on academic achievements. However, the generalizability of these findings to various educational contexts remains a critical consideration. The depth provided by Kiviniemi (2014) and Sivakumar and Selvakumar's (2019), exploration of specific courses emphasizes the need for context-specific approaches, indicating that the effectiveness of blended learning may vary across subjects and educational levels.

However, studies highlight improvements in academic performance, retention, and practical skills, and there is a call for a more comprehensive understanding of the long-term impact of blended learning. The suggested research direction to investigate knowledge retention, problem-solving skills, and critical thinking abilities is crucial in addressing the broader educational objectives beyond immediate academic achievements. Therefore, incorporating artificial intelligence in predicting students' academic performance, as seen in Hamadneh et al (2022), study, introduces a technological dimension. However, it also raises questions about the transparency and interpretability of such models, pointing to the importance of addressing ethical considerations and ensuring fairness in AI-powered educational analytics.

Additionally, the trends in blended learning underscore its increasing adoption across diverse educational settings, driven by advancements in technology and a growing recognition of its potential to enhance learning outcomes. However, this widespread implementation is accompanied by a range of challenges, including issues related to readiness, infrastructure, infostructure, skills, attitudes, mental health, and support systems. Addressing these challenges requires collaborative efforts among stakeholders to provide adequate support, training, and resources for educators and students alike. Additionally, there exists a gap in research focusing on the long-term impact of blended learning on student outcomes, as well as the effectiveness of specific instructional strategies and technologies within blended learning environments. Closing this gap requires rigorous empirical studies, longitudinal research, and systematic evaluations to inform evidence-based practices and optimize the design and implementation of blended learning models. By addressing these challenges and filling the existing gaps in research, stakeholders can harness the full potential of blended

learning to create engaging, inclusive, and effective learning experiences for learners in the 21st century.

Contribution of the Research

This study makes significant contributions to both the theoretical and contextual understanding of blended learning. Theoretically, it expands existing knowledge by demonstrating the positive impact of blended learning on student performance and learning outcomes, thereby providing evidence to support its continued integration into educational practices. The study also identifies publication trends from 2014 to 2024, which enrich the academic discourse by revealing how blended learning research has evolved, particularly during the COVID-19 pandemic.

Contextually, this research addresses the practical challenges of implementing blended learning. By identifying and analysing these challenges, the study offers valuable insights that can guide educators and policymakers in refining their approaches to blended learning. Furthermore, the comprehensive review of 44 previous studies not only highlights the sustained use of blended learning but also underscores its growing importance in modern education. This dual contribution enhances both theoretical frameworks and practical applications, making this research a valuable resource for future studies and for practitioners seeking to improve blended learning environments.

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