DETERMINANTS OF E-LEARNING AND BLENDED LEARNING EFFECTIVENESS: A SYSTEMATIC REVIEW OF STUDENT OUTCOMES AND ENGAGEMENT

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ABSTRACT

Objective: This study aims to identify and synthesize key factors that influence the effectiveness of e-learning and blended learning, as well as their impact on learning outcomes, student satisfaction, and engagement through a systematic and comprehensive analysis of global literature from 2015 to 2025.

Research Design & Methods: A Systematic Literature Review (SLR) guided by PRISMA procedures was conducted using Scopus, ScienceDirect, ERIC, and Web of Science. Boolean search strategies and eligibility screening yielded 150 relevant peer-reviewed articles. Bibliometric mapping using VOSviewer and thematic analysis were used to classify the findings into five determining clusters: technological, pedagogical, individual, social, and institutional.

Findings: This review shows that the effectiveness of learning in a digital environment arises from the interaction between robust technological infrastructure, high-quality instructional design, learner readiness, social presence, and institutional support. Engagement and satisfaction serve as mediating variables that connect these determinants with learning outcomes. Trends indicate a shift in global research from emergency online learning to sustainable, quality-oriented digital education.

Implications & Recommendations: Institutions need to strengthen infrastructure and training, educators need to increase interaction and collaboration, while future research should focus on AI personalization and learning analytics to strengthen evidence of the effectiveness of digital learning.

Contribution & Value Added: This study presents an integrated conceptual model that synthesizes previous findings and provides a holistic understanding of the factors that shape the effectiveness of e-learning and blended learning, while strengthening the global literature and supporting evidence-based decision-making in digital education transformation.

Keywords: E-Learning, Blended Learning, Learning Outcomes, Student Satisfaction.

JEL codes: I21, O33
Article type: research paper

INTRODUCTION

A massive shift in the global education paradigm has placed e-learning (EL) and blended learning (BL) as increasingly dominant learning modalities at various levels, especially in higher education (Ashra et al., 2021). However, the success of digital learning implementation cannot be guaranteed because it is influenced by complex interactions between technological and pedagogical factors, the characteristics of individual learners, and the institutional context (Khan, 2005). At the

practical level, the implementation of EL/BL often faces structural challenges, including limitations in information and communication technology infrastructure, human resource readiness, and geographical disparities, which have led to complaints about a decline in learning quality and low student participation in online processes (Lasekan et al., 2024; Nortvig et al., 2018). This complexity is further exacerbated by the lack of a uniform and universally agreed definition of BL, making it difficult for researchers and educators to compare study results and interpret findings consistently (Park and Doo, 2024).

The literature shows that many studies have attempted to determine whether computer-based education, in the form of e-learning, blended learning, or hybrid learning, is superior to traditional face-to-face teaching, particularly in terms of student learning outcomes, satisfaction, and retention (Valverde-Berrocoso et al., 2020). Researchers, educators, and stakeholders want to know which learning format produces the best outcomes for learners and institutions. However, comparisons show mixed and often conflicting results, indicating that learning effectiveness is not solely determined by the EL/BL format itself (Fadamoro et al., 2023). Conversely, other factors such as learning spaces, learning communities, student identity, course design, and the role of educators have been shown to play a more prominent role in determining the quality of the student learning experience (Rusnilawati et al., 2023; Yokoyama, 2024).

Given the diversity of these findings, a comprehensive Systematic Literature Review (SLR) is needed to collect, evaluate, and synthesize the empirical results that have emerged over the past decade. This SLR aims to analyze the determinants of the effectiveness of e-learning and blended learning (EL/BL) on learning outcomes, satisfaction, and engagement of students by examining five main clusters of technology, pedagogy, individual, social, and institutional factors, as well as the causal mechanisms that explain their influence on cognitive, affective, and psychomotor dimensions. This study also examines how these factors shape students' emotional and cognitive satisfaction and engagement levels in the context of higher education and professional education, while evaluating the role of mediating or moderating variables in the relationship between these variables to produce a comprehensive understanding of the effectiveness of digital learning.

This study makes a significant contribution. Theoretically, this research will provide an integrated conceptual framework regarding the determinants of EL/BL success, overcoming the fragmentation of existing research findings. Practically, the synthesis of these findings will produce an evidence-based roadmap for designing appropriate intervention strategies for teachers and institutions. Furthermore, this research contributes to identifying urgent research gaps for the future, including exploring generative AI technology to bridge online and offline activities in BL, as well as the need for cross-country collaboration to address digital equity issues in a global context. In addition, these findings also emphasize the importance of institutional support through continuous professional development for lecturers to maximize the potential of digital learning.

The entire discussion is presented systematically in six sections: The structure of this article begins with Section 2, which presents a Literature Review of the concept of BL and models of success. Section 3 details the Research Methods, which explain the Systematic Literature Review procedures and article selection criteria. The Research Results, which are a synthesis of empirical findings, are presented in Section 4. Section 5 contains a Critical Discussion, interpretation of findings, comparisons with previous studies, and urgent recommendations. Finally, the article concludes with Section 6, which presents the Conclusions and summarizes the main implications of the literature synthesis.

LITERATURE REVIEW

The Concepts of E-Learning and Blended Learning

The concept of e-learning is academically defined as learning that utilizes information and communication technology to deliver learning materials digitally and flexibly. E-learning is the use of electronic technology (computers, the internet) to create learning experiences, both synchronously and asynchronously, so that it is not limited by time and place of use (Chaeruman et

al., 2018). Furthermore, in blended learning studies, the effectiveness of e-learning in improving interaction, learning engagement, and access to digital learning resources is emphasized in the relevant literature (Siregar et al., 2025).

Blended learning is a combination of face-to-face and online learning strategies. Graham (2006) states that blended learning systems combine "face-to-face instruction" with computer-based instruction (Hrastinski, 2019; Kintu et al., 2017). Garrison and Kanuka (2004) emphasize that the essence of blended learning is the careful integration of face-to-face experiences and online learning, not simply adding online elements to conventional classes (Hrastinski, 2019). A systematic review also shows that blended learning involves varying modalities of time, space, and learning paths to create meaningful learning experiences (Bozkurt, 2022).

From a design and implementation perspective, blended learning design features such as student-teacher interaction, technology quality, and face-to-face support greatly influence learning effectiveness and student satisfaction. Meanwhile, empirical studies at biology universities show that the transition from purely face-to-face teaching to a blended model can lower academic results in some modules, although flexibility and potential engagement remain key advantages (Harper et al., 2024). Finally, in contemporary pedagogical literature, BL is also often associated with 21st-century teaching practices, where flexible and personalized learning is supported by technology and face-to-face interaction (Mohammadi et al., 2025).

Success Models in Digital Learning

The effectiveness of digital learning is generally analyzed through two main theoretical frameworks that emphasize technological and pedagogical aspects. The DeLone & McLean model is a widely used approach to evaluate the success of E-Learning systems, with a focus on the quality of information systems (Sary et al., 2021). This model covers several important dimensions such as system quality, which describes platform stability; information quality, which reflects content quality; and service quality, which indicates institutional support. These three aspects contribute to the level of usage, user satisfaction, and net impact of digital learning systems. Various studies that apply the D&M model show that user satisfaction is the most dominant factor that drives the continued use of E-Learning systems (Seta et al., 2018).

Meanwhile, the Community of Inquiry (CoI) framework is widely used as a pedagogical model to understand how meaningful learning is formed through interaction in a digital environment. This framework emphasizes that successful learning is determined by three forms of presence, namely teaching presence, cognitive presence, and social presence (Lasekan et al., 2024). Teaching presence encompasses instructional design, learning facilitation, and feedback provision by instructors. Cognitive presence focuses on the process of learners constructing knowledge and meaning through learning activities. Social presence relates to learners' ability to present themselves authentically in a virtual community, thereby creating open communication and comfortable interactions. These three components work synergistically to produce an effective and meaningful digital learning experience.

Key Factors Affecting Effectiveness (Five Clusters of Determinants)

The effectiveness of E-Learning and Blended Learning is determined by five main clusters that interact with each other, namely technological, pedagogical, individual, social, and institutional factors. These factors form a comprehensive framework that influences the quality of the learning process and outcomes in a digital environment (Setiawan et al., 2019).

Technological factors refer to system quality, including ease of access, platform stability, interactive features, and user interface design. In the DeLone & McLean model, this aspect is directly related to System Quality, which has been proven to influence user satisfaction and the smoothness of learning activities. Common challenges such as infrastructure limitations and low ICT skills, especially in developing countries, are major obstacles to the adoption of EL and BL (Nortvig et al., 2018). However, the quality of the system only serves as a basic prerequisite that supports engagement, and does not automatically improve learning outcomes (Ashra et al., 2021).

Pedagogical factors relate to how learning is designed and facilitated instructionally. Teaching Presence has been shown to be a dominant determinant in creating effective learning experiences through structured learning design, interactive activities, and rapid feedback. Content quality contributes significantly to student engagement, with data showing that 61.7% of students achieve high engagement thanks to good material quality (Abdulkadir, 2016). The presence of educators, activity structure, and interactive strategies directly influence learning outcomes (Khan, 2005).

Individual factors include student characteristics such as motivation, self-efficacy, digital literacy, and attitudes toward online learning. Academic self-efficacy has a positive influence on academic performance, especially in blended environments with synchronous and asynchronous interactions. Motivation helps strengthen self-efficacy and encourages greater engagement in learning. Research also shows that differences in individual characteristics and readiness affect the level of adoption and effectiveness of BL (Mohd et al., 2016; Nortvig et al., 2018).

Social factors and interactions emphasize the importance of social presence in building a sense of connection, comfort, and engagement in online learning. Quality social interactions have been proven to significantly increase student engagement (Khan, 2005). Environmental factors, such as private study rooms, contributed to a 69.2% increase in engagement, while the webcam policy helped strengthen nonverbal communication and relationships between students (Abdulkadir, 2016). Comfort and interpersonal connection are key to successful digital interactions (Rusnilawati et al., 2023).

Institutional factors relate to institutional support, including faculty training, academic policies, and management support. This support plays an important role in ensuring that the implementation of EL and BL is effective and sustainable. In developing countries, the lack of institutional support is often a major obstacle, requiring cross-country collaboration to strengthen the adoption and quality of BL implementation (Seta et al., 2018). Without strong institutional support, pedagogical innovation and technology integration cannot function optimally.

METHODS

This study uses a qualitative approach with a Systematic Literature Review (SLR) design that refers to PRISMA guidelines to ensure that the process of identifying, selecting, and synthesizing literature is systematic, transparent, and replicable. Literature was searched through reputable scientific databases such as Scopus, ScienceDirect, ERIC, and Web of Science using a strict Boolean strategy, with a combination of keywords related to e-learning, blended learning, online learning, learning outcomes, student satisfaction, engagement, and innovation. The search process was limited to peer-reviewed journal articles in English, with final publication status, open access, published between 2015 and 2025, and available in full text. During the identification stage, 3,226 articles were found, which were then filtered through a process of duplication removal and title and abstract screening, leaving 714 articles for full-text examination. Feasibility evaluation was conducted based on topic relevance, educational context, learning variables measured, and methodological clarity, resulting in 150 studies that met the SLR criteria.

The articles were then analyzed using VOSviewer for bibliometric mapping and analyzed thematically to identify patterns and group the findings into five main clusters of determinants of digital learning effectiveness, namely: technology, pedagogy, individual characteristics, social interaction, and institutional support. This process is then supplemented with narrative synthesis to explain the relationships between variables, the mechanisms underlying the effectiveness of EL/BL, and the consistency and differences in previous research findings, resulting in a comprehensive understanding of the effectiveness of e-learning and blended learning in improving learning outcomes, satisfaction, and engagement of learners.

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│         IDENTIFICATION          │
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│       Records identified:       │
│ n = 3,226 (Scopus + WoS + ERIC  │
│            + SD)                │
│   Records after duplicates      │
│            removed              │
│          n = 2,814              │
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│          SCREENING              │
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│  Records screened (title/       │
│         abstract)               │
│          n = 2,814              │
│   Records excluded. n = 2,100   │
│ Full-text articles assessed.    │
│          n = 714                │
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│          ELIGIBILITY            │
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│ Full-text articles excluded:    │
│          n = 564                │
│           Reasons:              │
│        - Not relevant           │
│        - Non-empirical          │
│ - Not assessing outcome/        │
│   satisfaction/engagement       │
│     - Full text not available   │
│ Studies meeting eligibility:    │
│          n = 150                │
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│  Studies included in SLR n=150  │
│  (analyzed using VOSviewer and  │
│   thematic synthesis of 5 factor│
│           clusters)             │
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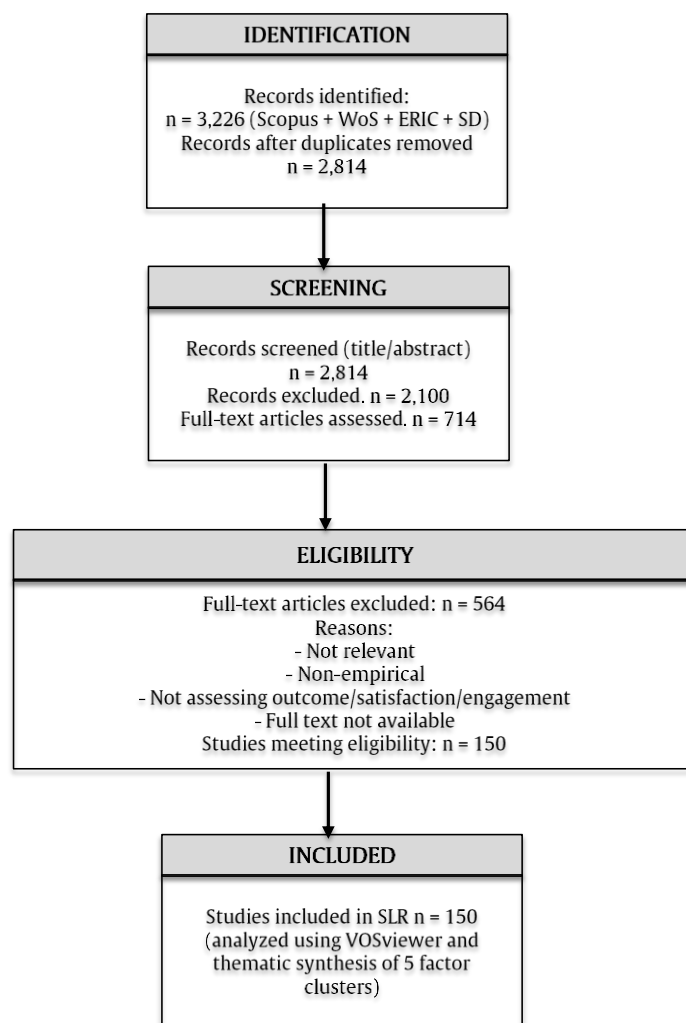
Figure 1. Systematic Literature Review Stages

RESULT

The bibliometric publication trend from 2015 to 2025 shows very dynamic developments in research related to e-learning, online learning, blended learning, hybrid learning, and variables such as learning outcomes, student satisfaction, and engagement. In the early period of 2015–2018, the number of publications increased gradually (43 → 87), reflecting the initial adoption phase of educational technology and LMS integration in higher education. A dramatic surge occurred in 2019–2021 (135 → 429), triggered by the COVID-19 pandemic, which prompted a global shift to fully online learning, thereby triggering an increase in research related to the quality of online learning, satisfaction, instructional design, and digital infrastructure readiness.

Entering 2022–2024, the publication trend remains high and stable (567–593), signaling a consolidation phase when research focuses on improving the quality and sustainability of the EL/BL model, including the integration of synchronous and asynchronous activities and strengthening the role of educators. In 2025, publications decreased to 464 but remained high, indicating a shift in research focus towards new topics such as AI in education and adaptive learning. Nevertheless, this data confirms that e-learning and blended learning remain the center of attention in global educational innovation and are relevant for further study, particularly in relation to learning effectiveness, student satisfaction, and engagement in higher education.
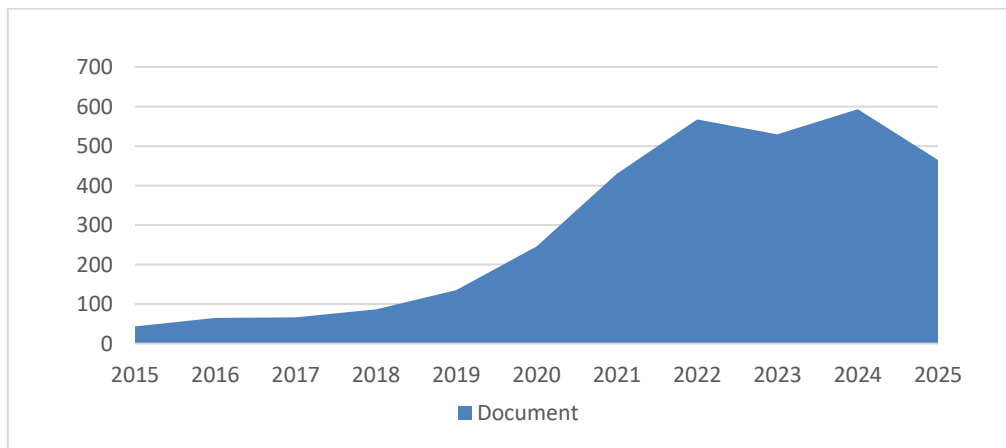
Figure 2. Trends in E-Learning and Blended Learning Research Publications for the Period 2015–2025

Based on the analysis of vos viewers, it shows that terms such as e-learning, education, distance learning, and curriculum are keywords with the highest frequency and connectivity. This confirms that global research does focus on the effectiveness of digital learning in the context of higher education. In addition, the strong emergence of keywords such as student engagement, active learning, and controlled study illustrates that the variables of learning outcome, engagement, and student satisfaction are very dominant research themes in EL/BL literature. This supports the relevance of the three main dependent variables in the study. Meanwhile, keywords such as curriculum, clinical competence, and collaborative learning indicate that instructional design and learning activities are pedagogical factors that are often tested for their impact on the effectiveness of EL/BL in line with the pedagogical factor cluster in the research model. The high connectivity of pandemic-related keywords, such as COVID-19, confirms that the surge in EL/BL research in the last five years has been greatly influenced by the global shift towards online learning. This condition enriches the empirical basis for your research theme, especially in analyzing changes in the technological context, institutional readiness, and student experiences during the period of massive online learning.
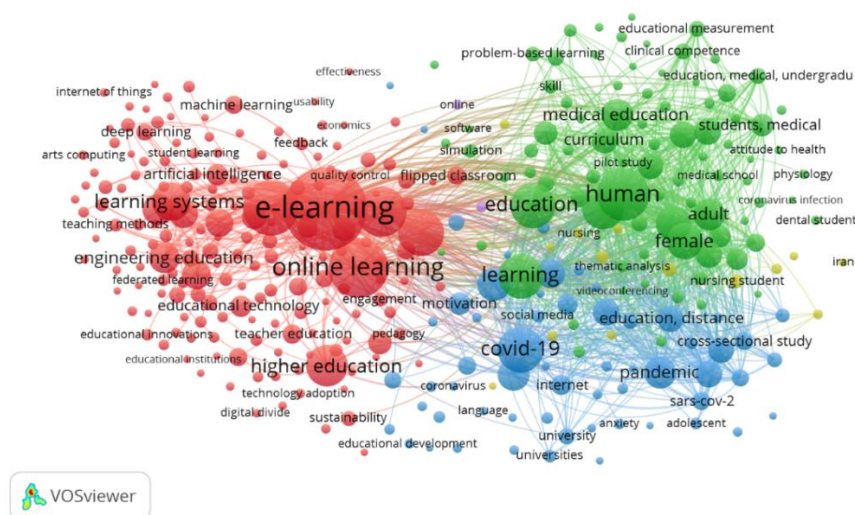

Figure 3. Keyword Cluster Map

The results of bibliometric analysis (Figure 3) show that research on e-learning, online learning, blended learning, and hybrid learning has grown rapidly globally between 2015 and 2025. The focus of research is not only on technology adoption, but also on pedagogical issues such as learning outcomes, student satisfaction, engagement, collaboration, and educational innovation.

Restricting the search to English-language scientific articles indexed in international journals ensures that the literature collected is of high academic quality and relevant to the study of the effectiveness of EL/BL.
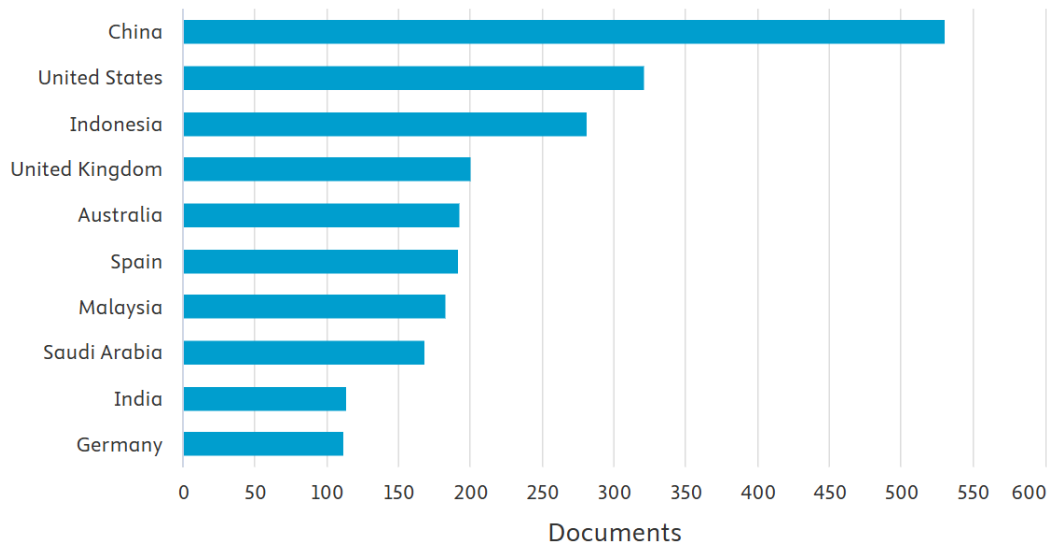

Figure 4. Global Publication Distribution

The distribution of publications in Figure 4 shows the widespread involvement of countries in Asia, Europe, America, and the Middle East, indicating that the topic of digital learning effectiveness has become a global issue across educational contexts. Bibliometric analysis shows that China leads in the number of e-learning publications due to its highly advanced digital education ecosystem. National-scale academic network infrastructure such as CERNET enables high connectivity on campuses, while significant investment in EdTech and the integration of AI technology in learning further strengthens research in the field of e-learning (C. Ma et al., 2025). The United States also ranks high due to its enormous research capacity, funding support for educational innovation, and strong academic tradition in educational technology. Meanwhile, Indonesia's high contribution reflects the push for digital transformation in local higher education post-pandemic, where the integration of e-learning systems has become a policy and research priority, as shown in the map of Indonesia's digital education transformation (Aripradono et al., 2024; Fuadiy et al., 2025).

The dominance of contributions from developed and developing countries reflects that the challenges and successes of EL/BL are greatly influenced by technological readiness, institutional capacity, and local learning culture. Overall, this trend underscores the importance of conducting a systematic literature review to map the factors that determine the effectiveness of EL/BL and understand its impact on student learning outcomes, satisfaction, and engagement.

Key Factors Affecting Effectiveness

Based on the literature review, it was found that the effectiveness of digital learning is influenced by a number of factors that work together to shape the quality of the learning experience of students. These factors can be mapped into several main clusters that cover technological aspects, pedagogical aspects, student characteristics, social dynamics, and institutional support. Each cluster has key variables and empirical findings that show how each factor contributes to improving student learning outcomes, satisfaction, and engagement. To provide a more structured overview of these relationships, the following is a summary of empirical findings along with citations from the literature that formed the basis for the analysis.

Table 1. Factor Clusters and Empirical Findings in the Literature

Factor Cluster	Key Variables	Empirical Findings from the Literature
Technology and Infrastructure	LMS quality, network stability, UI/UX, interactive features (video, simulation), mobile access	• Interactive features improve learning efficiency, reduce learning time, and improve results (Huang et al., 2023) • Mobile learning significantly improves engagement and learning outcomes (Anuyahong and Pucharoen, 2023). • Immersive VR improves concentration, emotional engagement, and learning outcomes (Huang et al., 2023). • Technological issues such as unstable WiFi hinder the effectiveness of online assessments (Huang et al., 2023).
Pedagogics and Course Design	Learning models (flipped, project-based, gamification), synchronous–asynchronous integration, scaffolding, authentic assignments	• ARCS-based flipped classrooms significantly improve motivation and learning outcomes (Wang and Wang, 2023). • Project-based BIM teaching improves conceptual understanding and learning outcomes (J. Ma and Tao, 2023). • Gamified mobile learning increases behavioral–emotional–cognitive engagement (Pan and Gooi, 2023). • Anchored instruction improves deep learning and fragmented learning outcomes (W. Li et al., 2023).
Learner Characteristics (Individual)	Motivation, self-efficacy, digital literacy, technological experience, self-regulation	• Learning needs can be predicted through digital behavior patterns, influencing personalization and learning satisfaction (J. Li, 2023). • Immersive VR enhances emotional engagement, with the affective dimension mediating learning outcomes (Liao, 2023). • Students with high tolerance for mobile technology show better engagement (Pan and Gooi, 2023).
Social / Community and Interaction	Social presence, peer interaction, sense of belonging, peer feedback, strength of learning community	• Social presence, particularly the dimensions of affective collectiveness, open communication, and sense of community, significantly influences students' cognitive presence in online learning, which in turn contributes to their academic performance (Pham et al., 2023). • Difficulties in open communication reduce learning experiences; sense of community is influenced by interaction and emotional support. • Gamification strengthens collaboration and support among students.
Institutional and Educator Support	Educator presence, feedback, clarity of instructions, faculty training, institutional policies, administrative support	• Educator presence greatly determines student engagement, especially in EL (Pham et al., 2022). • Teacher training using the Kirkpatrick model improves VL usage competencies and has an impact on learning outcomes (Achuthan et al., 2023). • Digital exam policies are influenced by institutional factors such as workflow, proctoring, and technology reliability (MacKevett and Gutmann, 2023).

The results of the literature synthesis show that the effectiveness of E-Learning (EL) and Blended Learning (BL) is shaped by the interaction of five main clusters of determinants: technology, pedagogy, individual characteristics, social interaction, and institutional support. In the technology and infrastructure cluster, the quality of the LMS, network stability, mobile access, and interactive features such as videos, simulations, or immersive VR have been shown to increase learning efficiency, concentration, emotional engagement, and student learning outcomes, while technical disruptions such as unstable WiFi actually reduce the effectiveness of online assessments (Huang et al., 2023).

From a pedagogical perspective, learning designs that combine flipped classrooms, project-based learning, gamification, synchronous-asynchronous integration, and scaffolding can increase motivation, behavioral-emotional-cognitive engagement, conceptual understanding, and deep learning (W. Li et al., 2023; J. Ma and Tao, 2023; Pan and Gooi, 2023; Wang and Wang, 2023). In the individual characteristics cluster, motivation, self-efficacy, digital literacy, and self-regulation play an important role because learning needs and emotional responses to technology have been shown to mediate learning outcomes; for example, digital behavior patterns can predict the personalization of learning needs, while immersive VR increases emotional engagement, which has an impact on learning outcomes (J. Li, 2023; Liao, 2023).

Furthermore, social clusters and interactions confirm the crucial role of social presence, especially the dimensions of affective collectiveness, open communication, and sense of community, which directly improve cognitive presence and student academic performance (Pham et al., 2023). Weaknesses in open communication reduce the learning experience, while gamification can strengthen collaboration and support among students. Finally, institutional clusters and educator support show that educator presence, clarity of instructions, consistency of feedback, lecturer training, and institutional policies such as workflow and digital exam technology are crucial to the effectiveness of online learning. Studies show that Kirkpatrick model-based training can improve competency in the use of virtual labs and have a direct impact on learning outcomes, while technology reliability and proctoring policies affect the success of digital assessments (Achuthan et al., 2023; MacKevett and Gutmann, 2023). Overall, these five clusters work synergistically: the quality of technology and pedagogical design strengthens individual engagement, which is then enriched by social interaction and reinforced by institutional support, forming an effective and sustainable digital learning ecosystem.

Causality Mechanisms and the Role of Mediation and Moderation in the Effectiveness of e-learning and Blended Learning

A synthesis of the literature shows that the effectiveness of e-learning (EL) and blended learning (BL) is not determined by a single factor, but rather by a series of interrelated causal processes involving technology, pedagogical design, individual characteristics, social dynamics, and institutional support. The most consistent causal mechanism found in the literature is that technology quality, including platform stability, accessibility, immersive tools, and interactivity, drives increased engagement, particularly in the emotional and cognitive dimensions. Studies such as Liao (2023) show how immersive VR can improve students' concentration, emotional engagement, and focus, which in turn contributes directly to higher learning outcomes. This mechanism also appears in the context of mobile learning, where flexible access increases the frequency of interaction and persistence in learning, which then triggers improved academic performance (Anuyahong and Pucharoen, 2023).

In addition, pedagogical design plays a key role in triggering the process of knowledge internalization. Models such as the ARCS (Attention, Relevance, Confidence, Satisfaction) based flipped classroom have been proven to increase intrinsic motivation, which in turn strengthens students' tendency to engage in deep cognitive activities (Wang and Wang, 2023). Structured activities such as project-based learning, tiered scaffolding, and integration between theory and practice extend the causal pathway from course design to improved learning outcomes through increased self-regulation and cognitive engagement. The findings of J. Ma and Tao (2023) also show

that project-based learning, such as BIM learning, results in deeper conceptual understanding because learning activities are designed to replicate real professional contexts.

The social dimension also functions as a critical link in causal mechanisms. Study by Pham et al. (2023) shows that social presence increases cognitive presence, which is the level of student engagement in constructing meaning. Cognitive presence then acts as a mediator that explains how social relationships and emotional support improve academic performance. In other words, in a digital environment, feeling connected to others not only impacts comfort, but also triggers reflective and dialogical thinking processes that are important for deep learning. When there is a strong sense of belonging, students are more involved in collaborative activities, participate more actively, and show a higher level of persistence. Conversely, the absence of social interaction causes isolation that is detrimental to engagement and has the potential to reduce learning satisfaction.

Meanwhile, institutional support and educator presence are factors that strengthen or weaken other causal pathways. Educator presence, which includes the quality of feedback, facilitation of discussion, and clarity of instructions, is an important moderator of course design effectiveness. When instructors actively provide feedback and are present in discussions, effective course design has a stronger influence on engagement and satisfaction. Achuthan et al. (2023) showed that structured institutional training for educators improves the quality of virtual learning implementation, which ultimately improves student learning outcomes. Meanwhile, research by MacKevett and Gutmann (2023) shows that institutional factors such as digital assessment policies and infrastructure reliability can either strengthen or hinder the effectiveness of learning.

Throughout the model, various variables function as mediators and moderators. Engagement (behavioral–emotional–cognitive) repeatedly emerges as the most consistent mediator explaining how technology or course design influences learning outcomes. Motivation based on the ARCS model mediates the relationship between course design and learning outcomes. Cognitive presence mediates the relationship between social presence and academic performance. Conversely, variables such as self-efficacy, digital literacy, previous technology experience, and network stability act as moderators that determine how strongly these causal pathways work under certain conditions. For example, mobile learning has a stronger impact on students with high technology tolerance (Pan and Gooi, 2023), whereas VR has different effects depending on the nature of the course and the level of student readiness (Liao, 2023).

Overall, the EL/BL causality mechanism forms an integrative pattern: technology and course design trigger cognitive and affective processes; the social dimension strengthens engagement; individual characteristics moderate the experience; and institutional support ensures the sustainability and quality of implementation. It is the combination of these five clusters that ultimately determines the level of learning outcomes, satisfaction, and student engagement in digital learning.

Table 2. Mediating Variables of Digital Learning

Mediation Variables	Supported by	Mechanism
Engagement (behavioural, emotional, cognitive)	VR, gamified, mobile (Anuyahong and Pucharoen, 2023; Liao, 2023; Pan and Gooi, 2023)	Technology/Desain→ Engagement→Learning Outcome
Motivation	Flipped ARCS (Wang and Wang, 2023)	Course design→Motivation→ Learning Outcomes
Cognitive Presence	(Pham et al., 2023)	Social presence→Cognitive presence→Performance

Table 3. Moderating Factors of E-Learning Effectiveness

Moderating Variables	Findings
Digital literacy / technological experience	Students with high tolerance for mobile tech → higher engagement (Pan and Gooi, 2023).
Course type (practical vs. theoretical)	Fragmented learning and IVR have different effects on certain courses (Liao, 2023).
Institutional support and infrastructure	Network stability moderates the effectiveness of online exams (MacKevett and Gutmann, 2023).

Integrated Impact on Learning Outcomes, Satisfaction, and Engagement

Various literature in the file confirms that effectiveness factors in E-Learning and Blended Learning have a strong and multidimensional relationship with learning outcomes, satisfaction, and engagement, which ultimately determine the overall quality of the student learning experience. In terms of learning outcomes, research shows that skills such as self-regulated learning and internet self-efficacy not only have a direct impact on academic achievement, but also shape students' ability to navigate a more independent and flexible learning environment. When students are confident in using technology and able to manage their own learning process, they can make better use of the materials, discussion forums, and learning activities available digitally (Dinh and Nguyen, 2022). In addition, positive perceptions of the learning environment, including instructor support, peer interaction, and technology reliability, encourage increased cognitive engagement, which is an important predictor of improved learning outcomes (Liu and Duan, 2022). This is reinforced by evidence from blended and hybrid learning models that are capable of creating richer learning spaces, combining practical and theoretical aspects so that students can construct knowledge more deeply (Hariadi et al., 2019; Huda et al., 2022).

In terms of learning satisfaction, the integration of technology and good learning design has proven to be an important key. When e-learning systems provide a clear structure, personalized learning resources, and consistent feedback, students experience a more focused and meaningful learning experience. For example, the integration of algorithm-based teaching resources and user-friendly interface features improves the perception of ease of learning, which directly affects student satisfaction (Rojabi et al., 2022). In addition, the site map-based interface minimizes cognitive load, making it easier for students to understand the flow of activities and materials, thereby increasing comfort and learning performance (Simó et al., 2015). Interestingly, satisfaction is not only the end result, but also acts as a mediating variable that connects the perception of system benefits, perception of risk, self-efficacy, and the intention to continue using e-learning. This indicates that satisfaction is a key component in the sustainability of educational technology implementation (Awad et al., 2022).

Meanwhile, engagement aspects that include behavioral, cognitive, and emotional involvement appear to be greatly influenced by the quality of interaction and technology-based learning strategies. The use of platforms such as Microsoft Teams provides a space for direct interaction that strengthens a sense of togetherness, increases discussion participation, and facilitates collaboration, thereby encouraging motivation and active engagement among students (Rojabi et al., 2022). Gamification strategies in mobile learning also stimulate interest and positive emotions, so that students are more deeply involved in learning activities (Liao, 2023). This is in line with findings that the use of mobile technology increases the intensity of student interaction with learning content and activities, which leads to increased engagement and learning outcomes (Anuyahong and Pucharoen, 2023). These findings indicate that technology not only provides a learning medium, but also shapes interaction behaviors and emotional experiences that are crucial in digital learning. Overall, the relationship between learning outcomes, satisfaction, and engagement appears to be mutually reinforcing. High engagement creates meaningful interactions that increase satisfaction; satisfaction drives motivation to continue engaging; and these two factors together strengthen academic achievement. Therefore, the effectiveness of E-Learning and Blended Learning greatly depends on the alignment between pedagogical design, students' psychological

readiness, and the integration of technology that supports interaction, personalization, and a rich learning experience. These findings confirm that digital learning cannot be viewed solely from a technical perspective, but must be treated as an ecosystem that holistically integrates technology, pedagogy, and learning psychology.

Table 4. Factors that affect the effectiveness of E-Learning

Effectiveness Factor Cluster	→ Learning Outcome	→ Satisfaction	→ Engagement
Technology	• The reliability and ease of use of the platform improves access to materials and supports academic achievement. • Technologies such as Microsoft Teams, mobile learning, and gamification strengthen cognitive processing, thereby improving learning outcomes.	• A clear interface, easy navigation (e.g., site map principles), and integration of learning resources enhance the convenience and perceived quality of the system.	• Interactive features (chat, video meetings, gamification) increase participation, interaction, and motivation.
Pedagogical (Learning Design)	• Blended/hybrid designs that combine practice and theory reinforce knowledge construction. • Structured assignments, feedback, and adaptive curricula improve understanding.	• A clear learning structure, relevant material, and varied teaching methods increase satisfaction.	• Collaborative activities, active discussions, and engaging instructional design encourage higher engagement.
Individual (Psychological Readiness)	• Self-regulated learning and internet self-efficacy have a direct effect on academic achievement.	• Perceived benefits, confidence in using technology, and perceived risks influence satisfaction.	• Internal motivation, readiness to learn, and self-competence perception contribute to stable engagement.
Sosial (Interaction & Support)	• Support from instructors and peers strengthens cognitive engagement, which contributes to learning outcomes.	• Social interaction and a sense of community in digital classrooms increase satisfaction with the learning process	• Collaboration and active interaction (peer discussion, group work) increase emotional engagement and behavior.
Institutional (Policy & Infrastructure)	• Stable infrastructure (bandwidth, LMS support) helps ensure learning continuity and improves learning outcomes.	• Technical support and academic policy services that enhance user comfort and satisfaction.	• Institutional policies on adopting platforms, providing training, and facilitating learning activities strengthen engagement.

Information System Success Model

A comprehensive analysis of the implementation of E-Learning (EL) and Blended Learning (BL) shows that the success of information systems in both learning models is greatly influenced by the integration of technology quality, pedagogical design, social interaction, instructor support, and institutional service quality. From a System Quality perspective, research shows that platform stability, ease of access, and interactive features such as videos, simulations, podcasts, and synchronous discussions are important factors in increasing student participation and learning experiences (Fedynich et al., 2015). A well-designed system also allows for the integration of real-world experiences through practical activities, role-playing, and reflective narratives (Heinerichs et al., 2016). These findings are in line with the results of Purwati et al., 2018; Waluyowati and Riandi,

2024, who found that system quality, along with information quality and service quality, has a significant influence on student satisfaction in the use of LMS, confirming that system quality is the foundation of success in the DeLone & McLean model.

In terms of Information Quality, the success of EL/BL increases when learning content is designed to be relevant to professional needs, structured, and capable of fostering reflective dialogue. The diversity of online activities such as educational social media, independent learning resources, and podcasts produced by students has been proven to improve students' conceptual understanding, collaboration, and confidence in using technology (Cheng and Chau, 2016; Forbes and Khoo, 2015). The quality of this information is a key component in building perceived learning and satisfaction (Gray and Diloreto, 2016). The research by Zine et al. (2019) reinforces this aspect by emphasizing that the stability of the digital learning environment and the quality of adaptive information are prerequisites for the system to provide a personalized and effective learning experience.

The dimension of Service Quality, particularly the role of lecturers in providing quick feedback, scaffolding online activities, and actively participating in synchronous discussions, emerged as the strongest determinant of EL/BL success. Studies show that instructor presence significantly increases student motivation, engagement, and satisfaction (Beth et al., 2015; Chiero et al., 2015; Tomas et al., 2015). This corresponds directly with the findings of Huang et al. (2023) who identified service quality as the most dominant factor influencing user satisfaction. In addition, institutional support in the form of policies, facilities, training, and learning management has also been proven to determine students' intention to continue using the system. Wan (2022) study on the MOOC environment shows the significant contribution of facility quality and management support to continuance intention.

In the Use and User Satisfaction dimensions of the D&M model, appropriate pedagogical integration, effective online collaboration, and meaningful digital activities have been shown to increase system usage and student satisfaction. Students tend to be satisfied and continue to use the system when EL/BL is designed to be closely connected to practical experience, supported by meaningful social interaction, and provides space for reflection and collaboration (Cheng and Chau, 2016; Martín-Rodríguez et al., 2015; Montrieux et al., 2015). Strong interactions between students and lecturers, as shown in many studies, are direct predictors of learning outcomes and satisfaction (Chiero et al., 2015; Fedynich et al., 2015).

DISCUSSION

Construction of an Integrated E-Learning Success Model

The findings in the file consistently support the idea that the success of E-Learning and Blended Learning must be understood as the result of a holistic interaction between Technology–Pedagogy–People, reinforced by Social and Institutional factors. The literature in the file shows that Technology and Institutional factors serve as structural foundations that ensure accessibility, system stability, and sustainability. For example, studies on teaching resource integration emphasize that user-friendly and well-organized systems increase satisfaction and facilitate a more stable learning experience (Rojabi et al., 2022). The site-map based learning interface approach also proves that technological designs that minimize cognitive load contribute to satisfaction and academic success (Simó et al., 2015). Institutional factors such as administrative support and the provision of digital resources reinforce the characteristics of this technology, especially in the implementation of LMS and training in the use of the platform.

However, the literature in the file also shows that pedagogical and individual factors are the main drivers that determine the quality of learning outcomes, both cognitive and affective. Research on community science and technology-based blended learning and hybrid learning shows that learning designs rich in interaction improve the quality of students' knowledge, understanding, and even applied skills (Hariadi et al., 2019; Huda et al., 2022). In the realm of Individual Factors, the concept of academic self-efficacy (ASE) appears very strongly in several articles, especially research

on internet self-efficacy and self-regulated learning, which has been proven to directly contribute to student learning outcomes and persistence (Dinh and Nguyen, 2022). This reinforces your argument that ASE is a key driver of success in the integrated model.

The findings in the file also support that the relationship between factors is interactive, layered, and mutually reinforcing, rather than linear. For example, several studies highlight how digital learning experiences are influenced by the quality of teaching presence, namely the clarity of instructions, the quality of feedback, and the closeness of communication in a digital environment. This quality of teaching presence does not arise spontaneously, but rather depends on institutional support in the form of lecturer training, the provision of pedagogical guidelines, and standardized LMS implementation policies. When teaching presence increases, interactions become more meaningful, which in turn increases students' cognitive engagement (Liu and Duan, 2022). It is cognitive engagement that has been proven to be a strong bridge to improved learning outcomes.

The file review also reinforces the important distinction between Satisfaction and Engagement as two different mediating variables. Satisfaction is primarily influenced by technological factors, interface appearance, and ease of use of the system. This is evident in studies that emphasize the role of system quality and ease of use as key predictors of student satisfaction (Awad et al., 2022). Thus, satisfaction can be viewed as a hygiene factor. It is necessary to prevent resistance and increase user retention, but it is not sufficient to directly guarantee pedagogical effectiveness.

In contrast, engagement, particularly cognitive and emotional engagement, appears in the file as a variable that directly contributes to learning outcomes. Engagement is strongly influenced by the quality of learning design, social interactions, and pedagogical strategies such as gamification and collaborative activities. Gamification based on mobile learning has been proven to increase motivation, participation, and depth of information processing (Liao, 2023). Interaction using platforms like Microsoft Teams also strengthens student engagement and enhances the learning experience (Rojabi et al., 2022). Overall, Engagement acts as a psychological and behavioral process that is the core link between pedagogical quality and learning outcomes.

Thus, the findings of the file support the construction of an integrated E-Learning success model that positions Technology + Institutional as enablers, Pedagogical + Social as drivers of the learning process, and Individuals (especially ASE) as internal determinants that shape learning outcomes. Meanwhile, Satisfaction functions as a structural mediator related to access and convenience, while Engagement serves as a motivational mediator that directly influences the effectiveness of digital learning. This model is not only consistent with the empirical findings in the file, but also supports your analysis regarding the need for a holistic approach in evaluating the success of E-Learning and Blended Learning.

Comparison with Previous Research

The findings of this study indicate that the effectiveness of E-Learning and Blended Learning depends on a complex interaction between Technological, Pedagogical, Social, Individual, and Institutional factors, with Satisfaction and Engagement as important mediators that shape Learning Outcomes. Previous studies tend to be fragmented and focus on a single dimension. For example, some studies only highlight the role of technology in enhancing engagement and learning outcomes, such as the effectiveness of mobile learning (Anuyahong and Pucharoen, 2023), gamified mobile teaching (Pan and Gooi, 2023), and immersive VR (Liao, 2023). Other research focuses on pedagogical innovations such as ARCS-based flipped classrooms (Wang and Wang, 2023), project-based BIM learning (J. Ma and Tao, 2023), or anchored instruction (W. Li et al., 2023), however, it has not yet incorporated the roles of technology, institutions, or social factors. Studies on social presence also show a positive relationship with cognitive presence and LO (Pham et al., 2023), but it remains a separate finding from other dimensions.

Different from these studies, the model developed in this study offers a more holistic integration by positioning technology and institutional support as structural prerequisites, pedagogical design and social factors as triggers for meaningful learning processes, and individual

factors such as self-efficacy and motivation as internal drivers of success. Furthermore, this study highlights the distinct mediating roles of Satisfaction as a response to technology quality and access, and Engagement as a pedagogical mediator that directly influences learning outcomes, a distinction not explicitly identified in previous studies. This alignment is also evident with recent research trends, such as studies on mediation models that have begun to emphasize the multidimensional interrelationships of factors in online learning (Riofrío-Calderón and Ramirez-Montoya, 2023), and studies on blockchain that highlight the importance of institutional ecosystems (Hao et al., 2023). Thus, compared to previous research, this model not only confirms various empirical findings, but also contributes to a more comprehensive synthesis by integrating technology–pedagogy–human–social–institutional factors into a complete causal relationship framework.

The study's limitations

The studies in the file indicate that previous research on e-learning and blended learning still suffers from a number of methodological and conceptual limitations. First, most studies are fragmented, examining only one factor or a limited combination of variables such as technology, pedagogical innovation, or individual self-efficacy, without integrating them into a systemic framework. For example, research on mobile learning, gamification, and immersive VR only highlights increased engagement and learning outcomes from the technology side, but does not link them to institutional support or overall pedagogical design. Second, many pedagogical studies such as flipped classrooms, BIM-based project learning, or anchored instruction do not include technological variables or social interactions as important mediators in the digital learning process, so that the resulting models tend to be partial and do not capture the complexity of the EL/BL environment. Third, studies on social factors such as social presence are also conducted separately, without connecting them to institutional factors or the quality of the technology that supports these interactions. Furthermore, most studies use cross-sectional designs, thus failing to capture the dynamics of changes in engagement, satisfaction, or self-efficacy over time. Finally, there is limited research that considers institutional support as an analytical variable, even though findings in the files indicate that faculty training, LMS infrastructure, and digital policies are crucial foundations for successful EL/BL.

Advice on Future Research Directions

Based on these limitations, future research needs to move towards a more integrative and longitudinal approach. First, research should adopt a multi-factor systemic model that combines the roles of technology, pedagogy, social, individual, and institutional factors into a single causal framework, as is beginning to be suggested in studies of mediation models. Second, EL/BL studies need to test the dual mediating role between satisfaction and engagement more explicitly, given that previous research tends to separate these two variables without understanding their hierarchical relationship. Third, research is needed that assesses the influence of institutional support, such as the quality of teacher training, data access, digital policies, and technology infrastructure, on teaching presence and pedagogical performance areas that are still rarely addressed in the literature. Fourth, longitudinal and mixed-method research needs to be developed to capture the dynamics of changes in motivation, cognitive engagement, and the development of self-regulated learning over the course of one semester or more. Fifth, future research could explore the adaptive interactions of technologies such as AI, learning analytics, or blockchain that have been mentioned in several studies in the file to examine how intelligent systems can modulate engagement and personalization of learning. Finally, exploration of cultural context, institutional characteristics, and variations in educational levels is also important to make the EL/BL effectiveness model more generalizable.

CONCLUSION

The results of a systematic literature review of 150 international studies for the period 2015–2025 show that the effectiveness of e-learning (EL) and blended learning (BL) is the result of a multidimensional interaction between technological factors, pedagogical factors, individual

characteristics, social dynamics, and institutional support. This research confirms that the success of digital learning is not determined by a single element, but by the entire, mutually reinforcing learning ecosystem. Quality technology and infrastructure stability serve as the foundation that ensures access and convenience of learning, while a structured pedagogical design that includes the integration of synchronous and asynchronous activities, authentic assignments, scaffolding, and collaborative interactions is the main driver of meaningful learning. On the other hand, individual psychological factors such as self-regulated learning, motivation, digital literacy, and self-efficacy emerge as internal determinants that directly influence academic engagement and achievement. Social interaction and the presence of a learning community mediate this relationship by strengthening cognitive presence, while the role of educators and institutional support strengthen the entire process by providing clear instructions, consistent feedback, and policies and training that support EL/BL implementation.

Bibliometric findings show global consistency in research focus, with keywords such as e-learning, education, curriculum, student engagement, and learning outcomes dominating, as well as strong contributions from countries such as China, the United States, and Indonesia. The evolution of research shows that since the COVID-19 pandemic, EL/BL research has shifted from simply adopting technology to analyzing the quality of learning design, social interactions, and smart technology integration. Overall, this study presents an integrated model that positions technology and institutional support as enablers, pedagogical design and social interaction as core learning processes, and individual readiness as an internal determinant, with engagement and satisfaction as key mediators toward learning outcomes. This holistic model unifies previously fragmented research findings and confirms that EL/BL effectiveness is built through a combination of system quality, pedagogical quality, and learner psychological readiness.

Conceptually and practically, this research has several important implications. For educators, the findings emphasize that active instructional presence through feedback, discussion facilitation, and meaningful activity design has a direct impact on student engagement and satisfaction. For institutions, investment in digital infrastructure, lecturer training, adaptive curriculum design, and policies that support the sustainability of digital learning are inseparable factors for the success of EL/BL. Meanwhile, policy makers need to consider variations in student technology readiness and characteristics to design inclusive and effective digital programs. These findings also highlight the importance of developing systems based on analytics, AI, and adaptive personalization to address increasingly complex learning needs. Thus, this study not only synthesizes diverse empirical findings into a comprehensive model but also provides strategic direction for policy development, learning design, and future research to improve learning outcomes, satisfaction, and engagement in the digital learning era.

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