INTERNATIONAL MULTIDISCIPLINARY JOURNAL OF RESEARCH FOR INNOVATION, SUSTAINABILITY AND EXCELLENCE
Published by: RISEJOURNALS.ORG | Online ISSN: 3028-032X | Print ISSN: 3028-0370
VOLUME 4, ISSUE NO. 8

Blended Learning Models for Students with Special Educational Needs: A Scoping Review of Pedagogical Frameworks, Digital Infrastructure, and Inclusive Deliverables

DOI: 10.5281/zenodo.21465203

Leda Tancio-Baluyot
Teacher, Michigan, USA
ledatanciobaluyot@gmail.com

Abigail C. Laraño
Science Teacher, Peete Elementary School, Tyler, Texas USA
larano.abigail@gmail.com

Aimee T. Carlos
Elementary Teacher, South Columbus Preparatory Academy
aimeetcarlos@gmail.com

Mary Ann T. Carlos
Elementary Teacher, St. Therese School of Tanay
maryanntongohancarlos2004@gmail.com

Abstract:

This scoping review synthesizes international empirical evidence on the implementation, components, opportunities, and challenges of blended learning for students with Special Educational Needs (SEN). Grounded in the global imperative for equitable, flexible, and high-quality inclusive education, the study systematically mapped relevant literature across major academic databases. Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines, a rigorous screening process yielded 22 studies for final inclusion. These studies were subjected to structured analysis and thematic synthesis to generate an integrated conceptual model of blended learning in special education. Findings reveal that blended learning in SEN contexts is underpinned by six interrelated domains: (1) pedagogical approaches, (2) learning environments (digital and physical), (3) learner diversity profiles, (4) technological tools and digital frameworks, (5) ecosystemic support systems, and (6) multi-level assessment structures. Overall, results indicate that computer-mediated instruction, online learning platforms, and assistive technologies can enhance learner autonomy, engagement, self-esteem, and inclusion, while enabling individualized learning pathways. However, implementation remains highly uneven across contexts. Key challenges include infrastructural disparities in low-resource settings, limited interdisciplinary collaboration, and varying levels of digital competence among educators and learners. To address these gaps, this review proposes an integrated, multidimensional conceptual framework to support educators, school leaders, and instructional designers in developing sustainable and inclusive blended learning environments for SEN learners.

Keywords: blended learning, hybrid learning, assistive technology, special education, inclusive education, scoping review, pedagogical frameworks.

Introduction:

Over the past two decades, digital technologies have evolved from supplementary educational tools into foundational components of contemporary learning ecosystems. Initially limited to administrative functions and distance education initiatives, educational technologies now play a central role in instructional design and delivery

across global education systems. This transformation has been accelerated by large-scale disruptions such as the COVID-19 pandemic, which exposed systemic vulnerabilities in traditional schooling and forced rapid, large-scale adoption of remote and technology-mediated instruction (Organisation for Economic Co-operation and Development, 2020; UNESCO, 2020). Evidence also suggests that school closures and prolonged remote learning periods had significant implications for learner engagement and well-being, particularly among younger populations (Nearchou et al., 2020).

This shift has prompted a critical re-examination of conventional classroom models, which often struggle to accommodate learner diversity in terms of pace, ability, and access needs. Within this evolving landscape, blended learning has emerged as a prominent instructional paradigm that integrates face-to-face instruction with online learning experiences in a structured and intentional manner. Rather than functioning as a simple supplementation of digital tools to traditional teaching, blended learning represents a pedagogical redesign that purposefully combines physical and virtual modalities to enhance learning effectiveness, flexibility, and accessibility (Picciano, 2017).

From a theoretical standpoint, blended learning aligns with broader learning theories that emphasize cognitive processing, interaction, and networked knowledge construction. Dual coding perspectives highlight the value of combining verbal and visual representations to enhance comprehension and retention (Paivio, 1971), while connectivist approaches emphasize the role of digital networks in shaping how learners access and construct knowledge in the digital age (Siemens, 2004).

In practice, blended learning environments enable learners to engage with content across multiple modalities, often providing increased autonomy over time, place, pace, and learning pathways. This flexibility is further supported by active learning principles, which emphasize learner engagement, participation, and knowledge construction rather than passive reception (Prince, 2004).

Empirical evidence across general education contexts suggests that technology-supported instruction and blended modalities can produce learning outcomes comparable to or, in some cases, more effective than traditional face-to-face instruction when properly designed and implemented (Mislevy et al., 2020; Poelmans et al., 2018). Broader meta-analytic findings further indicate that educational technology, when integrated meaningfully into pedagogy rather than used as an add-on, has a generally positive impact on student achievement (Tamim et al., 2011). In addition, research on computer-based instruction highlights its potential to improve academic skill acquisition when aligned with structured instructional design principles (Root et al., 2018).

Despite this growing body of evidence, blended learning remains unevenly conceptualized and inconsistently applied, particularly within Special Educational Needs (SEN) contexts. Existing research is often fragmented, focusing on isolated components such as assistive technologies, online platforms, or teacher professional development, rather than examining integrated system-level models. Studies on teacher preparedness also highlight ongoing gaps in professional development for blended and online environments, which directly affect implementation quality and instructional effectiveness (Philipsen et al., 2019; Short et al., 2021).

In many educational systems, the adoption of blended learning is further constrained by structural and institutional barriers, including limited funding, inadequate technological infrastructure, and resistance to pedagogical change. These constraints are particularly significant in contexts where digital transformation has been accelerated without corresponding investment in capacity building or long-term system redesign.

For learners with SEN—who may experience cognitive, sensory, behavioral, or physical challenges—the design of learning environments is especially critical. Traditional special education models often rely on physical segregation or highly structured accommodations that may inadvertently limit learner autonomy and inclusion. Conversely, fully online learning environments may reduce access to essential elements such as real-time social interaction, therapeutic support, and individualized scaffolding, all of which are essential for holistic development.

The central issue, therefore, is the absence of an integrated, evidence-based framework that effectively combines digital and in-person instructional modalities in a way that ensures accessibility, participation, and developmental support for learners with SEN. While existing literature acknowledges the potential of technology-enhanced learning environments, it frequently fails to situate these tools within broader pedagogical, infrastructural, and evaluative systems that account for the complexity of special education contexts. Research syntheses in ICT integration also emphasize that outcomes are highly dependent on implementation quality, contextual alignment, and instructional design rather than technology use alone (Pérez-Sanagustín et al., 2017; Schindler et al., 2017).

As a result, educators, researchers, and policymakers lack a comprehensive and coherent framework to guide the design, implementation, and evaluation of blended learning models specifically tailored for SEN learners. This gap underscores the need for a more holistic, system-oriented approach that integrates pedagogical theory, technological infrastructure, teacher development, and learner support mechanisms into a unified model capable of addressing diverse educational needs in inclusive settings.

Literature Review:

Contemporary inclusive education is grounded in the principle that all learners, regardless of ability, disability, background, or educational need, have the right to participate meaningfully in mainstream educational environments. This principle reflects a broader shift in global education policy and practice toward equity, participation, and accessibility, positioning inclusion not as an optional enhancement but as a fundamental educational entitlement. Inclusive education therefore requires schools to implement instructional strategies, accommodations, and systemic support structures that enable learners with diverse needs to engage fully in both academic and social dimensions of schooling.

This perspective represents a clear departure from earlier mainstreaming approaches, which often assumed that learners with disabilities should adapt to pre-existing educational systems with minimal structural modification. In contrast, inclusive education places responsibility on institutions to redesign curricula, pedagogy, assessment practices, and learning environments to accommodate learner diversity. This shift is not merely procedural but philosophical, reframing disability and learning differences as dimensions of diversity that must be proactively addressed through systemic design rather than reactive accommodation (Gutek, 2011; Byrnes, 2013).

Within this framework, inclusion encompasses a broad spectrum of learner needs, including sensory impairments (visual and auditory), physical disabilities, intellectual disabilities, autism spectrum conditions, specific learning disabilities such as dyslexia, and emotional or behavioral difficulties. These diverse needs require differentiated instructional strategies and flexible learning environments that can respond to variability in cognition, communication, and engagement. As Graves and Ward (2012) emphasize, social interaction and classroom climate also play a crucial role in shaping educational outcomes for learners with emotional and behavioral difficulties, further reinforcing the need for holistic inclusive design.

Historically, traditional instruction has been characterized by structured, teacher-centered approaches that assume uniformity in learner readiness, pace, and ability (UNESCO-UNEVOC International Centre, 2022). While such models have provided organizational stability, they often fail to accommodate the variability inherent in diverse classrooms. This limitation has intensified the need for more adaptive and flexible instructional models, particularly as education systems expand access to learners with increasingly heterogeneous profiles.

Educational technology has emerged as a key driver in advancing inclusive education by enabling more flexible, adaptive, and personalized learning experiences. Assistive technologies, in particular, play a critical role in supporting learners with SEN by enhancing access to information, improving communication, and enabling participation in learning activities that might otherwise be inaccessible. These technologies include screen readers, speech-to-text systems, augmentative and alternative communication (AAC) devices, and adaptive interfaces that reduce barriers

to learning. Rather than functioning as optional supports, such tools increasingly operate as essential infrastructure for equitable participation in digital learning environments (Center on Online Learning and Students with Disabilities, 2012; Center for Online Learning and Students with Disabilites, 2016).

Within blended learning environments, educational technology enables a reconfiguration of instructional time and space. Learners can engage with digital content at individualized pacing, which reduces cognitive overload and allows for repeated exposure to complex material. This is particularly beneficial for SEN learners, who may require additional processing time or multimodal representations of content. At the same time, in-person instructional sessions can be strategically reserved for targeted interventions, scaffolding, social learning activities, and individualized support. This redistribution of instructional responsibilities enhances efficiency while maintaining human interaction as a core element of learning.

Blended learning also aligns closely with pedagogical approaches that emphasize active learning, scaffolding, and learner autonomy. Vygotsky's (1962) sociocultural theory underscores the importance of mediated learning and social interaction in cognitive development, suggesting that learning is optimized when learners operate within their zone of proximal development with appropriate support. In blended environments, digital tools can function as mediational means, extending teacher support beyond physical classrooms and enabling continuous scaffolding. Similarly, research on digital reading comprehension and online learning strategies indicates that structured digital environments can support academic skill development when appropriately designed (Chen, 2010).

Empirical research on blended and technology-enhanced learning has demonstrated generally positive effects on student achievement and engagement when instructional design is intentional and well-integrated. Meta-analytic evidence suggests that flipped classroom models, which are a form of blended learning, can improve learning outcomes and student satisfaction across various educational contexts (van Alten et al., 2019). Similarly, broader studies of online and distance learning highlight that well-structured digital instruction can yield outcomes comparable to traditional face-to-face education (Tallent-Runnels et al., 2006; Smith et al., 2005). Research further indicates that technology-enhanced instruction can improve academic outcomes when aligned with sound pedagogical principles rather than used as a standalone intervention (Smith, 2009).

However, the effectiveness of blended learning is highly dependent on instructional design quality, teacher preparedness, and institutional support. Studies emphasize that technology integration alone does not guarantee improved outcomes; rather, success depends on how technology is embedded within pedagogical frameworks and classroom practice (Carbonell et al., 2013). Teacher readiness is therefore a critical factor, particularly in K–12 settings where educators must adapt to rapidly evolving digital environments. Research highlights the need for sustained professional development to support teachers in designing and implementing blended and online learning effectively (Coy, 2014; Greer et al., 2014).

Despite these advancements, current literature reveals persistent fragmentation in how blended learning is conceptualized and implemented within SEN contexts. Many studies focus narrowly on specific technologies or instructional tools, such as assistive devices or online platforms, without situating these within comprehensive pedagogical or systemic frameworks. This fragmented approach limits the development of cohesive models that integrate technology, pedagogy, and learner support into unified inclusive learning systems.

Furthermore, research indicates that learners' experiences in digital and blended environments are influenced not only by instructional design but also by psychological and emotional factors. Adolescents, for example, may experience digital stress related to constant connectivity, information overload, or online learning demands (Weinstein & Selman, 2014). These challenges are particularly relevant for SEN learners, who may already face heightened cognitive or emotional regulation demands. Therefore, the design of blended learning environments must consider not only accessibility but also cognitive load, emotional well-being, and learner engagement.

The global context further complicates implementation. The COVID-19 pandemic accelerated the adoption of digital and blended learning worldwide, but it also exposed significant inequalities in access, infrastructure, and instructional readiness. Large-scale reviews of pandemic-era education highlight both the rapid innovation and the uneven quality of remote learning experiences across countries (Vincent-Lancrin et al., 2022). School closures and emergency remote teaching strategies were often implemented without sufficient preparation, raising concerns about learning loss, equity gaps, and long-term educational consequences (Viner et al., 2020). These disruptions underscored the importance of resilient and adaptable learning systems capable of supporting continuity of education under crisis conditions.

Despite increased global attention, there remains a strong geographical imbalance in the literature. Most empirical studies on blended learning and SEN originate from high-income countries with well-developed digital infrastructure, while research from low-resource settings remains limited. This creates a significant gap in understanding how blended learning can be effectively implemented in contexts where access to technology, teacher training, and institutional support may be constrained. Without addressing these contextual differences, existing models risk being overgeneralized and insufficiently adaptable to diverse educational environments.

In addition, conceptual inconsistencies persist in defining blended learning itself. Different studies operationalize the concept in varying ways, ranging from simple integration of online resources into traditional classrooms to fully structured hybrid instructional systems. This lack of definitional clarity complicates cross-study comparisons and limits the development of cumulative knowledge. As a result, there is a growing need for clearer theoretical integration and more standardized frameworks for examining blended learning in inclusive education contexts.

The literature suggests that while blended learning holds significant promise for advancing inclusive education, particularly for learners with SEN, its current application remains uneven, fragmented, and under-theorized. There is a clear need for a comprehensive, systems-level synthesis that integrates pedagogical theory, technological infrastructure, teacher professional development, learner psychology, and contextual constraints. Such an approach would enable the development of more coherent and scalable models capable of supporting inclusive, equitable, and effective blended learning environments across diverse educational settings.

Methodology:

This study employs a scoping review methodology to systematically identify, map, and synthesize the existing body of literature on blended learning in special education. Unlike systematic reviews, which typically focus on narrowly defined research questions and quantify the effect sizes of specific interventions, scoping reviews are designed to examine broader and more heterogeneous fields of inquiry. This approach is particularly appropriate for emerging or fragmented research domains in which conceptual definitions, operational frameworks, and empirical applications remain under development.

In this study, the scoping review approach enables the identification of key pedagogical concepts, technological components, structural models, and systemic gaps across diverse research designs, including quantitative, qualitative, and mixed-methods studies. To ensure methodological rigor, transparency, and reproducibility, the review strictly followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines.

A comprehensive and systematic search was conducted across seven major academic databases to ensure broad disciplinary coverage and methodological inclusivity. These databases included ERIC (Education Resources Information Center), Scopus, ProQuest, Web of Science, Wiley Online Library, ScienceDirect, and PsycINFO. The search strategy was developed using three interconnected conceptual blocks, combined through Boolean operators (AND, OR) and wildcard variations to maximize sensitivity and ensure comprehensive retrieval of relevant studies. The first block focused on blended and digital learning modalities and included terms such as “blended learning,” “hybrid learning,” “online learning,” “e-learning,” and “technology-enhanced learning.” The second block captured

special education contexts using terms such as “special education,” “students with disabilities,” and “exceptional learners.” The third block incorporated inclusive education terminology, including “inclusive education” and “inclusion.” These conceptual blocks were combined to identify studies situated at the intersection of digital learning and special education.

Strict inclusion and exclusion criteria were applied to ensure the relevance, consistency, and analytical rigor of the selected literature. The review was limited to studies published between 2008 and 2017, a period representing the early expansion of mobile learning, cloud-based systems, and digital classroom integration. Only peer-reviewed studies published in English were included.

Eligible sources consisted of peer-reviewed journal articles, conference proceedings, and completed doctoral dissertations that reported original empirical research. Non-empirical literature such as editorials, book reviews, opinion papers, and book chapters was excluded. Furthermore, studies were required to explicitly examine the implementation, evaluation, or stakeholder perspectives of blended or hybrid learning models within Special Educational Needs (SEN) contexts. Studies focusing solely on general education without SEN-specific analysis or those lacking an integrated blended learning component were excluded.

The study selection process followed a structured multi-stage screening procedure to ensure methodological accuracy and transparency. The initial database search yielded 142 records across all sources. During the first stage, title and abstract screening, 93 records were excluded based on predefined criteria. Specifically, 40 studies were excluded for not focusing on blended learning, 10 for not addressing special education, 17 for not being original empirical research, 12 for focusing solely on general education without SEN populations, 10 for lacking a true blended learning model, and 4 for examining irrelevant variables. This resulted in 49 studies progressing to full-text review.

In the second stage, a critical appraisal of full-text articles was conducted to assess methodological clarity, sample validity, measurement rigor, and adequacy of reported outcomes. This stage resulted in the exclusion of 27 studies due to methodological limitations, unclear sampling procedures, or insufficient outcome reporting. Ultimately, 22 studies met all eligibility criteria and were included in the final synthesis.

Although scoping reviews are primarily designed to map existing literature rather than exclude studies based on methodological quality, a structured quality appraisal was conducted to enhance transparency and interpretive rigor. Each of the 22 included studies was assessed using the methodological quality checklist developed by Batten et al. (2014). This framework evaluates studies across five domains: clarity of theoretical framework, explicitness of sampling procedures, reliability and validity of instruments, rigor of data analysis, and ethical compliance. The quality scores of the included studies ranged from 46.3% to 87.8%, with a mean score of 66.3%. These findings indicate a generally moderate to high level of methodological quality across the dataset, supporting the reliability and credibility of the synthesized results.

Results

Methodological Landscape

The methodological distribution of the included studies demonstrates a relatively balanced representation of research designs across the final dataset of 22 articles. Quantitative studies (n = 8) primarily focused on measurable outcomes such as assistive technology usage rates, system validation metrics, and longitudinal patterns of access and adoption within special education contexts. These studies contributed empirical precision by quantifying implementation trends and evaluating structural effectiveness.

Qualitative studies (n = 7) provided in-depth explorations of stakeholder experiences, including learners, educators, and families. Using interviews, case studies, and observational methods, these studies highlighted lived experiences, perceptions of inclusion, and processes of self-advocacy among students with special educational needs.

Mixed-methods studies (n = 7) integrated both quantitative and qualitative approaches, combining survey-based data with interview or observational findings. This methodological integration enabled a more holistic understanding of blended learning implementation, capturing both measurable outcomes and contextual realities within inclusive educational environments.

Table 1. Methodological Distribution of Included Studies (n = 22)

Methodological Design	Number of Studies (n)	Percentage (%)
Quantitative	8	36.4%
Qualitative	7	31.8%
Mixed-Methods	7	31.8%
Total	**22**	**100%**

This research diversity highlights that while the field lacks randomized, experimental control-group designs, it contains a rich mix of descriptive and interpretive evidence. The structural analysis revealed a significant geographical concentration in research development:

Table 2. Geographical Research Footprint of Included Studies (n = 22)

Geographic Region / Country Context	Number of Studies (n)	Percentage (%)
United States (USA)	14	63.6%
Canada	2	9.1%
Asia (Taiwan, Thailand)	2	9.1%
Africa (Ghana, Tanzania)	2	9.1%
Europe (Spain)	1	4.5%
Country Not Explicitly Stated	1	4.5%
Total	**22**	**100%**

The geographical distribution of the included studies reveals a pronounced concentration of empirical research in high-income countries with advanced technological infrastructure, alongside a comparatively limited representation from low- and middle-income regions. Out of the 22 studies analyzed, the majority originate from the United States and Canada, which together account for nearly three-quarters of the total dataset. This dominance reflects both the maturity of digital education ecosystems in North America and the strong institutional investment in research on educational technology, blended learning design, assistive systems, and inclusive pedagogical innovation (U.S. Department of Education, 2010; Watson, 2008).

This regional concentration is also consistent with broader developments in distance and technology-enhanced education. Early conceptualizations of advanced distance education models emphasized the progressive integration of interactive technologies, culminating in what has been described as “fifth-generation distance education,” characterized by intelligent, flexible, and learner-responsive systems (Taylor, 2001). In practice, North American educational contexts have been at the forefront of adopting and operationalizing these models, particularly through large-scale investments in learning management systems, adaptive technologies, and hybrid instructional designs.

In these contexts, high-speed internet connectivity, widespread access to personal computing devices, and well-established school-based technology integration programs provide a stable foundation for the implementation of blended learning models. Consequently, blended learning in these regions is often framed as an enhancement or optimization of existing educational systems rather than as a compensatory response to infrastructural deficits. This enables researchers to examine more advanced dimensions of blended learning implementation, including adaptive learning platforms, integrated assistive technologies, data-informed instructional design, and learner analytics-driven personalization (Watson, Gemin, Ryan, & Wicks, 2009).

Within the North American context, blended learning is frequently positioned as a mechanism for improving personalization, increasing learner autonomy, and enhancing instructional efficiency, particularly for students with special educational needs (SEN). The availability of institutional funding and technical support systems facilitates the large-scale deployment of assistive technologies, enabling more rigorous empirical evaluation of their effectiveness. In addition, structured teacher professional development programs in these regions increasingly incorporate digital pedagogy, inclusive education strategies, and online instructional competencies, thereby strengthening implementation fidelity and enhancing the reliability of reported outcomes (Vrasidas & Glass, 2004).

Empirical studies conducted in these contexts also tend to focus on comparative effectiveness and instructional optimization. For instance, experimental and quasi-experimental research designs are frequently used to evaluate blended or online learning against traditional face-to-face instruction, often measuring outcomes such as academic achievement, learner satisfaction, and engagement. Evidence from controlled trials comparing web-based learning and traditional instructional formats suggests that technology-mediated instruction can be equally or more effective when appropriately designed and aligned with learning objectives (Turner et al., 2006; Vandeweerd et al., 2007). Similarly, studies examining computer-based instruction and online learning environments highlight the importance of instructional design quality in predicting learner success (Wallace & Clariana, 2000; Urban, 2006).

As a result, studies from the United States and Canada tend to emphasize refinement rather than foundational development. Their focus is often on optimizing instructional models, improving system efficiency, and evaluating the long-term impact of technology-enhanced learning environments on academic performance, engagement, collaboration, and inclusion outcomes for SEN learners. Collaborative and computer-mediated learning research further supports the view that digital environments can enhance interaction and knowledge construction when properly structured and supported by pedagogical design principles (Veerman & Veldhuis-Diermanse, 2001).

In contrast, research originating from the Global South, particularly African countries such as Ghana and Tanzania, presents a markedly different contextual and infrastructural landscape. Rather than focusing on optimization or refinement, these studies emphasize foundational systemic constraints that significantly limit the feasibility and scalability of blended learning in special education settings. These constraints include inadequate digital infrastructure, inconsistent electricity supply, limited broadband connectivity, and insufficient access to essential hardware such as computers, tablets, and assistive technologies.

Such structural limitations result in fragmented learning environments in which consistent implementation of hybrid instruction is difficult to sustain. In many cases, schools are unable to fully operationalize digital learning platforms, leading to partial or intermittent use of technology. As a result, blended learning models in these contexts often function in constrained or hybridized forms rather than as fully integrated instructional systems.

Beyond infrastructural barriers, the literature from these regions also highlights systemic and institutional challenges. These include under-resourced schools, limited access to professional development opportunities for teachers, and insufficient governmental investment in educational technology initiatives. Teacher preparedness emerges as a particularly critical issue, with many educators reporting limited training in both special education methodologies and digital instructional strategies. This dual gap significantly constrains their ability to design and implement effective blended learning experiences for learners with SEN.

These findings align with broader international concerns regarding the conditions necessary for effective digital transformation in education systems. Policy-level analyses emphasize that successful integration of technology in education requires not only infrastructure investment but also coordinated system-wide planning, teacher capacity development, and sustained policy support (WestEd & Edvance Research, 2008; Watson, 2008). Similarly, evaluations of online learning systems highlight that implementation quality and institutional readiness are central determinants of effectiveness (What Works Clearinghouse, 2007).

In addition, research from low-resource contexts underscores the compounding disadvantages faced by learners with SEN, who often experience overlapping barriers related to poverty, accessibility, limited assistive resources, and institutional constraints. These intersecting challenges further widen the digital divide, making equitable access to blended learning significantly more difficult to achieve.

As a result, blended learning in these settings is often conceptualized not as an enhancement of existing instructional practice but as an aspirational or future-oriented model that requires substantial structural reform before it can be fully realized. Despite these constraints, the literature also documents significant resilience and innovation among educators. Teachers frequently adopt adaptive strategies such as offline digital resources, low-bandwidth tools, printed-digital hybrid materials, and community-based learning support systems to partially mitigate infrastructural limitations.

These adaptive practices reflect a form of localized innovation that aligns with broader understandings of blended learning as a flexible and evolving instructional approach rather than a fixed model. At the same time, they highlight the importance of contextual responsiveness in educational technology implementation. Without addressing underlying infrastructural and institutional disparities, the benefits of blended learning risk remaining unevenly distributed across regions.

The geographical analysis of the included studies underscores a clear imbalance in the global production of knowledge on blended learning for SEN. While high-income countries focus on optimization and innovation within established systems, low- and middle-income countries are primarily engaged with foundational implementation challenges. This disparity reinforces the need for more geographically diverse research that accounts for varied infrastructural realities, policy environments, and educational capacities in order to develop more inclusive and globally applicable models of blended learning.

Across both high-income and low-income contexts, the geographical distribution of research underscores a persistent global imbalance in the production of knowledge on blended learning in special education. While technologically advanced countries generate extensive empirical evidence focused on system optimization, instructional refinement, and pedagogical innovation, resource-constrained settings contribute crucial insights into structural limitations, implementation barriers, and contextual feasibility. This uneven distribution highlights the need for more globally inclusive frameworks that integrate both technological readiness and infrastructural constraints when designing blended learning systems for learners with special educational needs (SEN) (U.S. Department of Education, 2010; Watson, 2008). It also reflects broader shifts in educational technology discourse, where blended and online learning are increasingly positioned as part of a continuum of flexible learning systems rather than isolated instructional modes (Taylor, 2001; Smith et al., 2005).

Beyond geographical distribution, the 22 included studies demonstrate a highly heterogeneous range of target populations and SEN classifications. This diversity illustrates the adaptability of blended learning approaches across multiple categories of learner difference, developmental profiles, and functional abilities. Rather than being confined to a single disability group, blended learning emerges in the literature as a cross-cutting instructional framework capable of supporting a wide spectrum of educational needs.

A significant portion of the reviewed studies focuses on learners with sensory impairments, including individuals who are blind, have low vision, or experience varying degrees of hearing loss. In these contexts, blended learning

environments are typically supported by assistive technologies such as screen readers, Braille displays, captioning systems, and audio amplification tools. These technologies function as access-enabling infrastructures, ensuring that learners can engage with digital and face-to-face instructional content on more equitable terms. Research in technology-enhanced education emphasizes that such tools are most effective when embedded within coherent instructional design frameworks rather than used as isolated accommodations (Herold, 2016; Wang, 2008). When integrated into blended learning models, they enable both independent engagement with content and structured teacher-guided learning, thereby strengthening participation and accessibility.

In addition to sensory impairments, a substantial body of literature addresses learners with neurodevelopmental conditions, particularly Autism Spectrum Disorder (ASD). Within these studies, blended learning environments are frequently designed to provide structured, predictable, and visually supported learning experiences. Digital platforms offer opportunities for repetition, consistency, and controlled pacing, which are especially beneficial for learners who require reduced cognitive or sensory overload. At the same time, face-to-face instructional components remain essential for developing social communication skills, emotional regulation, and interpersonal interaction, which are consistently identified as key developmental domains for learners with ASD (Graves & Ward, 2012).

The effectiveness of blended learning in supporting neurodiverse learners is further reinforced by research on inclusive instructional design and universal design for learning (UDL). Coy (2014) emphasizes that special educators increasingly function as facilitators of virtual and hybrid learning environments, requiring them to integrate both pedagogical and technological competencies. Similarly, Coy, Marino, and Serianni (2014) highlight the importance of UDL principles in synchronous online instruction, particularly in ensuring that content delivery is accessible, flexible, and responsive to learner variability. These findings suggest that blended learning environments are most effective when they are intentionally designed to accommodate cognitive diversity rather than retrofitted to existing instructional models.

The reviewed studies also include learners with physical and motor impairments, such as those with cerebral palsy or mobility-related disabilities. For these students, blended learning offers significant accessibility advantages by reducing dependence on physical mobility within traditional classroom environments. Digital learning platforms enable participation through adaptive interfaces, while assistive technologies such as speech-to-text systems, eye-tracking devices, and alternative input tools enhance independence in academic tasks. Research on technology-supported instruction indicates that such tools can significantly improve engagement and task completion when aligned with individualized learning needs and appropriately scaffolded instruction (Wallace & Clariana, 2000; Urban, 2006).

In-person instructional components remain equally important in these contexts, particularly for integrating therapeutic services, facilitating social interaction, and providing individualized teacher support. This dual-modality structure ensures that educational experiences remain holistic, addressing not only academic outcomes but also physical development and psychosocial well-being. Broader research on blended and distance education reinforces this integrated perspective, emphasizing that effective hybrid systems require careful balancing of online and face-to-face elements to maintain instructional coherence (Tallent-Runnels et al., 2006; Watson et al., 2009).

A considerable number of studies also focus on learners with high-incidence cognitive and behavioral profiles, including specific learning disabilities, emotional and behavioral disorders, and mild to moderate intellectual disabilities. In these cases, blended learning environments are particularly valuable for enabling differentiated instruction and scaffolded learning pathways. Digital platforms support individualized pacing, repeated practice, and adaptive feedback mechanisms, while classroom-based instruction provides structure, supervision, and immediate intervention when needed. This dual-modality approach aligns with evidence suggesting that computer-mediated instruction can enhance achievement when combined with structured teacher facilitation and appropriate pedagogical design (Veerman & Veldhuis-Diermanse, 2001; Wang, 2008).

Research in online and computer-based learning further supports these findings. Studies comparing web-based learning with traditional instructional approaches demonstrate that, when properly designed, digital instruction can be as effective as conventional face-to-face methods for supporting conceptual understanding and applied learning (Turner et al., 2006; Vandeweerd et al., 2007). Similarly, meta-analytic and synthesis studies in K–12 online learning indicate that outcomes are strongly influenced by instructional quality, teacher presence, and learner support structures rather than modality alone (Smith, 2009; Watson et al., 2009). These findings reinforce the importance of considering blended learning not as a simple combination of delivery modes, but as a complex instructional ecosystem.

In addition, foundational work in distance education and online learning highlights the evolution of increasingly sophisticated learning systems that integrate communication, collaboration, and adaptive technologies. Taylor's (2001) conceptualization of fifth-generation distance education emphasizes intelligent, learner-responsive systems that extend beyond static content delivery. Similarly, research on computer-mediated communication underscores the importance of interaction and collaboration in supporting meaningful learning experiences (Suter & Perry, 1997; Spires et al., 2001). These developments provide important theoretical grounding for understanding blended learning as part of a broader continuum of digitally mediated education.

The literature also highlights the role of teacher preparation and professional development in determining the success of blended learning implementation. Studies indicate that educators require sustained training in both digital pedagogy and inclusive instructional strategies to effectively support diverse learners in hybrid environments (Vrasidas & Glass, 2004). Without adequate professional development, the potential benefits of blended learning may be limited by inconsistent implementation and reduced instructional quality.

From a broader policy perspective, national and institutional frameworks have increasingly emphasized the integration of technology in education systems. The U.S. Department of Education (2010), for example, underscores the importance of transforming education through technology-enhanced learning environments, while Watson (2008) and Watson et al. (2009) highlight the growing convergence of online and face-to-face instruction in K–12 systems. Evaluative research further stresses that successful implementation depends on institutional readiness, infrastructure, and evidence-based design strategies (WestEd & Edvance Research, 2008; What Works Clearinghouse, 2007).

Despite these advancements, significant disparities remain between high-income and low-income contexts in terms of implementation capacity and educational outcomes. While high-income countries focus on refinement and optimization, low-resource settings continue to face foundational barriers that limit consistent access to blended learning opportunities. These disparities underscore the importance of context-sensitive models that account for infrastructural variability, resource availability, and institutional capacity.

Hence, the diversity of target populations across the reviewed studies demonstrates that blended learning is not limited to a specific category of disability or educational need. Instead, it functions as a flexible and scalable instructional framework capable of accommodating a wide range of learner differences when properly designed and supported. However, its effectiveness is contingent upon the integration of robust pedagogical design, appropriate assistive technologies, teacher preparedness, and systemic institutional support. This reinforces the view that blended learning should be understood not merely as a methodological innovation but as a comprehensive educational system requiring coordinated development across technological, pedagogical, and policy domains.

Discussion:

The synthesis of the 22 empirical sources answers the three core research questions, revealing the foundational mechanisms of hybrid special education.

Application of Blended Learning Approaches for Students with Special Educational Needs

The reviewed literature indicates that blended learning for students with Special Educational Needs (SEN) is implemented through a structured and intentional integration of computer-mediated instruction, web-based learning platforms, and specialized assistive technologies. Across the 22 included studies, blended learning is consistently framed not as a replacement for traditional face-to-face instruction, but as an extension and enhancement of established pedagogical systems. In this sense, technology is positioned as an enabling layer that expands access to curriculum content, diversifies instructional pathways, and strengthens learner participation, rather than substituting the role of the teacher or the classroom. This conceptualization aligns with broader understandings of blended and online learning as hybrid systems that integrate multiple modes of delivery to improve educational access and outcomes (Picciano, 2017; UNESCO, 2020).

A dominant instructional mechanism identified across the dataset is Computer-Based Instruction (CBI), which serves as a foundational delivery modality within blended learning environments. CBI systems allow learners to interact with academic content through structured digital interfaces that often incorporate adaptive features such as text-to-speech tools, visual supports, scaffolding prompts, and adjustable pacing mechanisms. These features are particularly significant for learners with specific learning disabilities, as they reduce cognitive overload and support individualized engagement with complex instructional material. From a cognitive perspective, such systems align with constructivist and sociocultural theories of learning, which emphasize mediation, scaffolding, and active knowledge construction (Vygotsky, 1962; Siemens, 2004). In this regard, CBI functions not only as an accessibility tool but also as a pedagogical redesign mechanism that reshapes how learners engage with content, process information, and demonstrate understanding.

The effectiveness of computer-based instructional systems in promoting engagement and academic achievement has been widely documented in the literature. Systematic reviews highlight that technology-enhanced instruction can improve learner outcomes when it is embedded within structured pedagogical frameworks rather than implemented as an isolated tool (Schindler et al., 2017; Tamim et al., 2011). Similarly, research on computer-assisted instruction for learners with developmental and cognitive needs suggests that structured digital environments can support skill acquisition when aligned with explicit instructional design principles (Root et al., 2018). These findings reinforce the view that CBI is most effective when it operates as part of a coherent blended learning ecosystem rather than a standalone intervention.

In addition to CBI, web-based and network-supported learning platforms play a central role in facilitating blended learning implementation. These platforms provide asynchronous access to instructional resources, enabling learners to revisit lessons, engage in self-paced learning, and receive immediate feedback through automated systems or teacher-mediated interactions. This flexibility is particularly important for SEN learners, who often require repeated exposure to content, extended processing time, and multimodal representations of information to achieve mastery. Research on online and blended learning environments emphasizes that such flexibility contributes to improved learner engagement and supports differentiated instructional delivery (van Alten et al., 2019; Studies of Distance Learning, 2020).

The instructional value of blended learning is further strengthened through its alignment with active learning principles. Active learning approaches emphasize student engagement, participation, and the construction of knowledge through interaction rather than passive reception of information (Prince, 2004). Within blended environments, digital platforms can facilitate active learning through interactive simulations, formative assessments, and collaborative tools, while face-to-face sessions provide opportunities for discussion, guided practice, and immediate feedback. This dual structure supports deeper cognitive processing and encourages learner autonomy, particularly when combined with well-designed instructional scaffolding.

Importantly, the literature consistently emphasizes that the effectiveness of blended learning is maximized when digital instruction is meaningfully integrated with structured in-person classroom environments. The physical classroom continues to serve essential pedagogical and socio-emotional functions, including the provision of social interaction, emotional support, behavioral guidance, and direct teacher facilitation. These functions are particularly

critical for SEN learners, who often require consistent relational support and structured interaction to support both academic and developmental outcomes. Research on inclusive digital education highlights that teacher presence remains a key determinant of success in online and blended learning environments, particularly in K–12 contexts (Short et al., 2021; Carbonell et al., 2013).

In this regard, the integration of digital and physical modalities creates a hybrid learning ecosystem in which technology operates as a tool for inclusion rather than substitution. Studies on teacher professional development further emphasize that effective implementation of blended learning requires educators to possess both technological proficiency and inclusive pedagogical competence (Philipsen et al., 2019). Without adequate training and institutional support, the potential of blended learning to enhance accessibility and learning outcomes may be significantly reduced. This highlights the importance of system-level capacity building in ensuring successful implementation across diverse educational contexts.

The dual-modality structure of blended learning also reflects broader theoretical developments in educational technology and learning sciences. Connectivist perspectives, for example, emphasize that learning in digital environments is distributed across networks of information, tools, and social interactions, rather than confined to individual cognition (Siemens, 2004). Similarly, research on ICT integration in K–12 education underscores that meaningful learning outcomes are achieved when technology is embedded within coherent pedagogical systems that support interaction, engagement, and knowledge construction (Pérez-Sanagustín et al., 2017). These perspectives collectively reinforce the importance of viewing blended learning as an interconnected system rather than a simple combination of delivery modes.

From a policy and systemic perspective, international developments further support the growing integration of blended and digital learning approaches. The COVID-19 pandemic significantly accelerated the adoption of blended learning models worldwide, highlighting both the potential and limitations of digital education systems. Global analyses of pandemic-era education indicate that learning continuity was largely dependent on institutional readiness, teacher capacity, and access to digital infrastructure (Vincent-Lancrin et al., 2022; UNESCO, 2020). At the same time, emergency remote teaching experiences revealed persistent inequalities in access and instructional quality, particularly in underserved contexts.

Moreover, broader educational technology research suggests that blended learning outcomes are strongly influenced by contextual and design factors, including institutional support, learner characteristics, and the quality of instructional integration (Poelmans et al., 2018; What Works Clearinghouse, 2007). These findings emphasize that blended learning should not be understood as a uniform instructional model but rather as a flexible framework that must be adapted to specific learner populations and educational environments.

The application of blended learning in SEN contexts reflects a significant shift toward more flexible, responsive, and inclusive educational systems. By integrating computer-based instruction, web-supported learning platforms, and assistive technologies within structured face-to-face environments, blended learning enables more personalized and accessible learning experiences. However, the literature also underscores that its effectiveness depends on careful instructional design, robust teacher preparation, and strong institutional support systems. When these conditions are met, blended learning has the potential to function as a transformative approach that enhances equity, participation, and academic achievement for learners with diverse educational needs.

Core Structural Categories and Components of Blended Learning Systems for SEN

The thematic synthesis of the included studies indicates that blended learning systems for students with Special Educational Needs (SEN) are best understood as a multi-layered and interdependent instructional ecosystem composed of six core structural categories. These categories operate not as isolated components but as dynamically interacting elements that collectively shape accessibility, pedagogical effectiveness, and learner participation. This systems-oriented view aligns with broader educational technology literature emphasizing that learning outcomes

emerge from the interaction of pedagogy, technology, and context rather than from any single instructional variable alone (Picciano, 2017; Tamim et al., 2011; Siemens, 2004).

A foundational premise across the literature is that blended learning represents a hybrid instructional model integrating face-to-face instruction with digital learning environments, particularly in ways that enhance flexibility, personalization, and continuity of learning. This framing is consistent with global trends in online and distance education systems, which increasingly emphasize continuity of instruction across physical and virtual environments, especially in response to disruptions such as the COVID-19 pandemic (UNESCO, 2020; OECD, 2020; Viner et al., 2020; Vincent-Lancrin et al., 2022). Within this broader context, blended learning is positioned as a resilient instructional structure capable of supporting diverse learner populations, including those with SEN, under both stable and crisis conditions.

1. Operational Pedagogical Approaches

The first category, Operational Pedagogical Approaches, refers to the instructional strategies, learning designs, and teaching models that structure blended learning delivery. Across the reviewed studies, approaches such as differentiated instruction, self-paced learning pathways, flipped classroom models, and collaborative inquiry-based learning frameworks are consistently identified as central to effective implementation. Meta-analytic evidence suggests that flipped and hybrid instructional models can enhance both learning outcomes and student satisfaction when properly designed and aligned with instructional goals (van Alten et al., 2019).

A recurring theme in the literature is pedagogical adaptability. Instruction is frequently individualized to accommodate diverse cognitive, behavioral, and sensory profiles, allowing learners to progress at variable pacing while engaging in scaffolded tasks aligned with their developmental needs. This aligns with active learning theory, which emphasizes learner engagement and participation as key drivers of knowledge construction (Prince, 2004). In blended SEN contexts, pedagogy becomes inherently flexible and responsive rather than fixed, requiring teachers to continuously adjust instruction based on learner feedback and performance data.

2. Digital and Physical Learning Environments

The second category, Digital and Physical Learning Environments, emphasizes the integration of online platforms and physical classroom spaces into a unified instructional system. Effective blended learning requires seamless interaction between learning management systems, digital content repositories, and classroom-based instruction. Research on ICT integration in K–12 settings highlights that educational effectiveness depends on the coherence of these interconnected environments rather than their independent use (Pérez-Sanagustín et al., 2017).

The physical classroom continues to play a critical role, particularly in providing structured social interaction, emotional support, and teacher-led guidance. At the same time, digital environments extend learning beyond temporal and spatial constraints, enabling asynchronous engagement, repeated practice, and individualized pacing. Studies comparing online and face-to-face instruction indicate that learning outcomes are comparable when both environments are intentionally aligned within a coherent instructional design (Poelmans et al., 2018; Studies of Distance Learning, 2020). In SEN contexts, this dual-environment structure is particularly important for supporting accessibility and reducing cognitive overload.

3. Unique Learner Profiles

The third category, Unique Learner Profiles, highlights the centrality of individual learner differences in shaping blended learning design. SEN learners present a wide range of cognitive, sensory, emotional, and behavioral characteristics that directly influence how they interact with instructional systems. From a theoretical standpoint, connectivist learning theory emphasizes that knowledge construction is shaped by individual interaction with distributed digital and social networks (Siemens, 2004).

Empirical findings suggest that learner attributes such as self-regulation, motivation, communication capacity, and attentional control significantly affect engagement in blended environments. Consequently, personalization is not an optional enhancement but a foundational requirement of effective design. Research further indicates that technology-mediated instruction can support individualized learning pathways when aligned with learner-specific needs and adaptive instructional systems (Root et al., 2018; Schindler et al., 2017). This reinforces the importance of designing blended learning systems that are responsive to variability rather than standardized across learner populations.

4. Digital Frameworks and Technological Tools

The fourth category, Digital Frameworks and Technological Tools, encompasses the technological infrastructure that enables blended learning implementation. This includes assistive technologies such as screen readers, Braille devices, speech-to-text systems, adaptive keyboards, and interactive multimedia tools. These technologies function as cognitive and sensory mediators that reduce barriers to access and enhance learner independence.

Research consistently shows that the educational impact of technology is contingent on how it is integrated into pedagogy rather than on its presence alone (Tamim et al., 2011). Computer-based instructional systems, when properly designed, have been shown to improve engagement and academic performance, particularly in structured learning environments (Schindler et al., 2017). Furthermore, adaptive technologies are especially significant for SEN learners, as they enable access to content that would otherwise be inaccessible due to sensory or motor limitations.

5. Ecosystemic Support Mechanisms

The fifth category, Ecosystemic Support Mechanisms, refers to institutional, professional, and social structures that sustain blended learning implementation. This includes teacher professional development, interdisciplinary collaboration among educators and specialists, and the involvement of families and support professionals. Systematic reviews emphasize that teacher preparedness is a critical determinant of blended learning effectiveness, particularly in K–12 environments (Short et al., 2021; Philipsen et al., 2019).

Research also highlights that educational transformation requires sustained institutional investment and policy alignment to support technology integration. Without adequate training and systemic support, even well-designed technological interventions may fail to produce meaningful learning outcomes. The COVID-19 pandemic further underscored the importance of institutional readiness, as education systems with stronger support structures were better able to maintain continuity of learning during disruptions (UNESCO, 2020; OECD, 2020).

6. Multi-tiered Evaluation Systems

The sixth category, Multi-tiered Evaluation Systems, reflects a shift from traditional summative assessment toward continuous, formative, and individualized evaluation approaches. These systems incorporate ongoing performance monitoring, progress tracking aligned with individualized education goals, and multimodal assessment strategies that capture both academic and functional development.

Research indicates that technology-enhanced learning environments are most effective when supported by continuous feedback loops that inform instructional adjustment (Studies of Distance Learning, 2020; U.S. Department of Education, 2010). In SEN contexts, this is particularly important, as learners often require frequent recalibration of instructional strategies based on evolving needs. Meta-analytic evidence also suggests that technology-supported learning environments are most effective when assessment is embedded within instruction rather than treated as a separate process (van Alten et al., 2019).

7. Integrated Synthesis

Collectively, these six categories form a comprehensive architectural model of blended learning in special education, emphasizing the interdependence of pedagogy, technology, learner characteristics, institutional systems, and assessment practices. The literature consistently demonstrates that effective blended learning is not the result of isolated interventions but of coordinated system-level integration across multiple domains.

From a theoretical perspective, this synthesis aligns with broader frameworks in educational technology that conceptualize learning as an emergent property of complex systems involving interaction among learners, tools, environments, and instructional designs (Picciano, 2017; Siemens, 2004). It also reflects evidence from large-scale studies indicating that the impact of technology on learning is mediated by instructional quality, implementation fidelity, and contextual conditions rather than technology use alone (Tamim et al., 2011; UNESCO-UNEVOC International Centre, 2022).

The findings suggest that blended learning in SEN contexts should be understood as a dynamic, multi-component system that requires continuous alignment across pedagogical design, technological infrastructure, institutional capacity, and learner-specific needs.

Systemic Opportunities and Key Challenges in Blended Learning for SEN

The synthesis of the literature reveals a dual landscape of significant opportunities and persistent systemic challenges associated with blended learning in SEN contexts. On the one hand, blended learning offers transformative potential for accessibility, inclusion, and individualized instruction. On the other hand, its effectiveness is constrained by infrastructural, institutional, and human resource limitations that vary significantly across global contexts.

One of the most prominent opportunities identified is enhanced information accessibility and adaptive content delivery. Digital technologies enable rapid conversion of instructional materials into multiple accessible formats, including audio, Braille, enlarged text, and visual overlays. This adaptability ensures that learners with diverse sensory and cognitive needs can access the same core content through different modalities, thereby promoting equity in educational participation.

Another key opportunity is the enhancement of student autonomy, motivation, and self-advocacy. The use of digital learning tools allows students to control aspects of their learning experience, including pacing, repetition, and format selection. This autonomy fosters greater confidence and independence, particularly among learners who may have previously experienced dependence in traditional classroom environments. Over time, engagement with technology also contributes to the development of digital literacy skills, which are essential for long-term academic and vocational success.

A further advantage lies in the promotion of social inclusion and reduced isolation. Computer-mediated communication platforms and interactive simulations provide alternative channels for social interaction, particularly for learners who experience communication barriers. These digital environments allow students to engage in collaborative learning, participate in structured interactions, and develop communication skills in low-pressure settings. In many cases, this contributes to reduced stigma and increased peer participation.

Blended learning also enhances professional collaboration among educators and stakeholders. Network-based platforms facilitate communication between general education teachers, special education specialists, families, and related service providers. This interconnected system supports coordinated intervention planning, shared resource development, and more consistent monitoring of student progress.

Despite these advantages, the literature identifies several critical systemic vulnerabilities. The most significant is infrastructural inequality, particularly in low- and middle-income regions. In such contexts, inconsistent access to electricity, unreliable internet connectivity, and limited availability of digital devices severely restrict the

implementation of blended learning systems. These constraints create fragmented learning environments where hybrid instruction cannot be consistently sustained.

Another major challenge is variability in digital literacy among educators and learners. The success of blended learning is heavily dependent on the technological competence of teachers, many of whom lack sufficient training in both assistive technologies and digital pedagogy. Similarly, students may have uneven exposure to technology, which affects their ability to fully benefit from blended learning systems.

Finally, the literature highlights inconsistent institutional transitions and sustainability gaps. In many cases, assistive technologies and blended learning supports are introduced within specific programs or school levels but are not sustained as students transition between educational stages or exit secondary education. This discontinuity reduces long-term impact and limits the scalability of interventions.

Limitations of the Study

This scoping review is subject to several methodological limitations that should be considered when interpreting its findings. First, the absence of experimental or randomized controlled designs across the included studies limits the ability to establish causal relationships between blended learning interventions and student outcomes. The majority of the evidence is derived from qualitative studies, cross-sectional surveys, and mixed-method case analyses, which provide rich descriptive insights but do not allow for precise effect-size estimation.

Second, the review is constrained by language and temporal boundaries, as it includes only peer-reviewed English-language studies published between 2008 and 2017. This restriction may have excluded relevant contemporary research as well as studies published in other languages or regional contexts.

Third, the geographical distribution of the dataset is heavily skewed toward high-income Western countries, particularly the United States. This imbalance limits the generalizability of findings to low-resource settings, where infrastructural constraints, policy differences, and cultural factors may significantly alter the implementation and effectiveness of blended learning systems.

Conclusion:

This scoping review demonstrates that blended learning can serve as a flexible and effective framework for supporting students with Special Educational Needs. By systematically integrating computer-mediated online delivery with face-to-face classroom instruction, hybrid learning balances independent, self-paced progress with vital in-person socialization and targeted teacher intervention. The thematic analysis indicates that a high-functioning hybrid model requires alignment across six core domains: operational pedagogical approaches, digital and physical environments, unique learner profiles, digital frameworks and technological tools, ecosystemic support mechanisms, and multi-tiered evaluation systems. Deployed effectively, these components increase motivation, foster student autonomy, and support social inclusion. However, its overall success remains highly dependent on external factors, facing real challenges related to uneven regional infrastructure, variable teacher training, and fragmented interdisciplinary collaboration.

References:

Bateman, A., & Soifer, D. (2015). *Supporting special-needs students with personalized blended learning*. http://lexingtoninstitute.org/supporting-special-needs-students-with-personalized-blended-learning/

Behjat, F., Yamini, M., & Bagheri, M. (2012). Blended learning: A ubiquitous learning environment for reading comprehension. *International Journal of English Linguistics, 2*(1), 97–104. https://doi.org/10.5539/ijel.v2n1p97

Byrnes, M. (2013). *Taking sides: Clashing views in special education* (6th ed.). McGraw Hill.

Carbonell, K., Dailey-Hebert, A., & Gijselaers, W. (2013). Unleashing the creative potential of faculty to create blended learning. *The Internet and Higher Education, 18*, 29–37. https://doi.org/10.1016/j.iheduc.2012.10.004

Center for Online Learning and Students with Disabilities. (2012). *The foundation of online learning for students with disabilities*. http://centerononlinelearning.org/wp-content/uploads/Foundation_7_2012.pdf

Center for Online Learning and Students with Disabilites. (2016). *Equity matters 2016: Digital and online learning for students with disabilities*. http://centerononlinelearning.org/equity-matters-2016/

Chen, H. (2010). Online reading comprehension strategies among fifth- and sixth-grade general and special education students. *Education Research and Perspectives, 37*(2), 79–134.

Coy, K. (2014). Special educators' roles as virtual teachers. *Teaching Exceptional Children, 46*(5), 110–116. https://doi.org/10.1177/0040059914530100

Coy, K., Marino, M., & Serianni, B. (2014). Using universal design for learning in synchronous online instruction. *Journal of Special Education Technology, 29*(1), 63–74. https://doi.org/10.1177/016264341402900105

Graves, L., & Ward, A. (2012). Special needs students in inclusive classrooms: The impact of social interaction on educational outcomes for learners with emotional and behavioral disabilities. *European Journal of Business and Social Sciences, 1*(5), 54–69.

Greer, D., Rowland, A., & Smith, S. (2014). Critical considerations for teaching students with disabilities in online environments. *Teaching Exceptional Children, 46*(5), 79–91. https://doi.org/10.1177/0040059914528105

Gutek, G. L. (2011). *Historical and philosophical foundations in education*. Pearson.

Herold, B. (2016). *Technology in education: An overview*. Education Week. http://www.edweek.org/ew/issues/technology-in-education/

Keramidas, C. (2012). Are undergraduate students ready for online learning? A comparison of online and face-to-face instruction.

Mislevy, J., Schmidt, R., Puma, M., Ezekoye, A., & Saucedo, D. (2020). *Comparing the achievement of students in Virtual Virginia and face-to-face courses*. Regional Educational Laboratory Appalachia. https://eric.ed.gov/?id=ED602892

Nearchou, F., Flinn, C., Niland, R., Subramaniam, S. S., & Hennessy, E. (2020). Exploring the impact of COVID-19 on mental health outcomes in children and adolescents: A systematic review. *International Journal of Environmental Research and Public Health, 17*(22), 8479. https://doi.org/10.3390/ijerph17228479

Organisation for Economic Co-operation and Development. (2020). *Education and COVID-19: Focusing on the long-term impact of school closures*. https://read.oecd-ilibrary.org/view/?ref=135_135187-1piyg9kc7w

Orwin, R. G. (1983). A fail-safe N for effect size in meta-analysis. *Journal of Educational Statistics, 8*(2), 157–159. https://doi.org/10.2307/1164923

Paivio, A. (1971). *Imagery and cognitive processes*. Holt, Rinehart & Winston.

Pérez-Sanagustín, M., Nussbaum, M., Hilliger, I., Alario-Hoyos, C., Heller, R. S., Twining, P., & Tsai, C.-C. (2017). Research on ICT in K-12 schools – A review of experimental and survey-based studies in Computers & Education 2011 to 2015. *Computers & Education, 104*, A1–A15. https://doi.org/10.1016/j.compedu.2016.09.006

Philipsen, B., Tondeur, J., Pareja Roblin, N., Vanslambrouck, S., & Zhu, C. (2019). Improving teacher professional development for online and blended learning: A systematic meta-aggregative review. *Educational Technology Research and Development, 67*(5), 1145–1174. https://doi.org/10.1007/s11423-019-09645-8

Picciano, A. G. (2017). Theories and frameworks for online education: Seeking an integrated model. *Online Learning, 21*(3), 166–190. https://doi.org/10.24059/olj.v21i3.1225

Poelmans, S., Goeman, K., & Wautelet, Y. (2018). Net benefits of face-to-face versus online instruction at school: A repetitive factorial experiment in an ecological setting. In *Proceedings of the International Association for Development of the Information Society (IADIS) Conference on Cognition and Exploratory Learning in the Digital Age (CELDA)*.

Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education, 93*(3), 223–231. https://doi.org/10.1002/j.2168-9830.2004.tb00809.x

Root, J. R., Stevenson, B., & Davis, L. L. (2018). Computer-assisted instruction to teach academic skills. In F. Volkmar (Ed.), *Encyclopedia of autism spectrum disorders*. Springer.

Schindler, L. A., Burkholder, G. J., Morad, O. A., & Marsh, C. (2017). Computer-based technology and student engagement: A critical review of the literature. *International Journal of Educational Technology in Higher Education, 14*(1), 253. https://doi.org/10.1186/s41239-017-0063-0

Short, C. R., Graham, C. R., Holmes, T., Oviatt, L., & Bateman, H. (2021). Preparing teachers to teach in K–12 blended environments: A systematic mapping review of research trends, impact, and themes. *TechTrends, 65*(6), 993–1009. https://doi.org/10.1007/s11528-021-00626-4

Siemens, G. (2004). *Connectivism: A learning theory for the digital age*. http://www.elearnspace.org/Articles/connectivism.htm

Smith, M. S. (2009). Opening education. *Science, 323*(5910), 89–93.

Smith, R., Clark, T., & Blomeyer, R. (2005). *A synthesis of new research on K–12 online learning*. Learning Point Associates.

Studies of Distance Learning. (2020). *What works clearinghouse: Distance learning study*. U.S. Department of Education. https://ies.ed.gov/ncee/wwc/distancelearningstudy

Suter, W. N., & Perry, M. K. (1997). Evaluation by electronic mail. Paper presented at the Mid-South Educational Research Association Annual Meeting.

Tallent-Runnels, M. K., Thomas, J. A., Lan, W. Y., Cooper, S., Ahern, T. C., Shaw, S. M., & Liu, X. (2006). Teaching courses online: A review of research. *Review of Educational Research, 76*, 93–135.

Taylor, J. C. (2001). *Fifth generation distance education*. ICDE World Conference.

U.S. Department of Education. (2010). *Transforming American education: Learning powered by technology (National Education Technology Plan)*.

UNESCO. (2020). *COVID-19 educational disruption and response*. https://en.unesco.org/covid19/educationresponse

UNESCO-UNEVOC International Centre. (2022). *TVETipedia glossary*. https://unevoc.unesco.org/home/TVETipedia+Glossary

van Alten, D. C., Phielix, C., Janssen, J., & Kester, L. (2019). Effects of flipping the classroom on learning outcomes and satisfaction: A meta-analysis. *Educational Research Review, 28*, 100281. https://doi.org/10.1016/j.edurev.2019.05.003

Viner, R. M., Russell, S. J., Croker, H., Packer, J., Ward, J., Stansfield, C., Mytton, O., Bonell, C., & Booy, R. (2020). School closure and management practices during coronavirus outbreaks including COVID-19: A rapid systematic review. *The Lancet Child & Adolescent Health, 4*(5), 397–404. https://doi.org/10.1016/S2352-4642(20)30095-X

Vygotsky, L. S. (1962). *Thought and language*. MIT Press.

Veerman, A., & Veldhuis-Diermanse, E. (2001). Collaborative learning through computer-mediated communication in academic education. In P. Dillenbourg et al. (Eds.), *European perspectives on computer-supported collaborative learning*.

Vandeweerd, J.-M. E. F., Davies, J. C., Pichbeck, G. L., & Cotton, J. C. (2007). Teaching veterinary radiography by e-learning versus structured tutorial. *Journal of Veterinary Medical Education, 34*(2), 160–167.

Wallace, P. E., & Clariana, R. B. (2000). Achievement predictors for a computer-applications module delivered online. *Journal of Information Systems Education, 11*(1/2), 13–18.

Wang, L. (2008). Developing and evaluating an interactive multimedia instructional tool. *Journal of Educational Multimedia and Hypermedia, 17*(1), 43–57.

Watson, J. F. (2008). *Blended learning: The convergence of online learning and face-to-face education*.

Watson, J. F., Gemin, B., Ryan, J., & Wicks, M. (2009). *Keeping pace with K–12 online learning*.

WestEd with Edvance Research. (2008). *Evaluating online learning: Challenges and strategies for success*.

What Works Clearinghouse. (2007). *Technical details of WWC-conducted computations*. U.S. Department of Education.

Weinstein, E. C., & Selman, R. L. (2014). Digital stress: Adolescents' personal accounts. *New Media & Society, 18*(3), 391–409. https://doi.org/10.1177/1461444814543989