مجلة جامعة جازان للعلوم الإنسانية
Jazan University Journal of Human Sciences (JUJHS)

Equipping Educators for the Future: A Systematic Review of Literature on Online and Hybrid Teaching Environments

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إعداد التربويين للمستقبل: مراجعة منهجية للأدبيات المتعلقة ببيئات التدريس الهجينة وعبر الإنترنت

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DOI	RECEIVED الاستلام	Edit التعديل	ACCEPTED القبول
https://doi.org/10.63908/zrt1bp69	2025/02/20	2025/08/13	2025/08/14
NO. OF PAGES عدد الصفحات	YEAR سنة العدد	VOLUME رقم المجلد	ISSUE رقم العدد
12	2025	1	14

Abstract:

This systematic review examines challenges, effective strategies, benefits, and policy implications in preparing educators for online and hybrid teaching environments, synthesizing 30 peer-reviewed studies (2000–2025) from ERIC, JSTOR, PubMed, and Google Scholar. Key challenges encountered by educators include limited digital experience, inflexible curricula, increased workloads, and technological barriers. Effective strategies emphasize constructivist pedagogies (e.g., virtual field trips, flipped classrooms), persistent instructor presence, and tailored professional development. Hybrid models demonstrate flexibility, skill development, and learning outcomes equivalent to traditional methods, but require robust infrastructure and equitable access. Policy reforms, such as mandated certifications and curriculum redesign, are critical for aligning teacher preparation with digital demands. Findings advocate for holistic approaches integrating pedagogical innovation, technological adaptability, and systemic policy support. Future research should explore culturally responsive models and AI's role in teacher training, ensuring equitable, high-quality education in evolving digital landscapes.

Keywords: Blended Learning Environments, Hybrid Teaching Challenges, Online Teacher Preparation, Teacher Professional Development, Technology Integration in Education.

الملخص:

تدرس هذه المراجعة المنهجية الاستراتيجيات والتحديات والفوائد الفعّالة في إعداد المعلمين لبيئات التدريس عبر الإنترنت والهجينة، من خلال تلخيص ٣٠ دراسة تمت مراجعتها من قِبل الأقران (٢٠٠٠–٢٠٢٥) من ERIC وJSTOR وPubMed وGoogle Scholar. تشمل التحديات الرئيسية المواجهة المعلمين مثل الخبرة الرقمية المحدودة، والمناهج الدراسية غير المرنة، وزيادة أعباء العمل، والحواجز التكنولوجية. تؤكد الاستراتيجيات الفعّالة على أساليب التدريس البنائية (على سبيل المثال، الرحلات الميدانية الافتراضية، والفصول الدراسية المقلوبة)، والحضور المستمر للمعلم، والتطوير المهني المخصص. تُظهر النماذج الهجينة المرونة وتنمية المهارات ونتائج التعلم المكافئة للطرق التقليدية، ولكنها تتطلب بنية تحتية قوية ووصولاً عادلاً. تعد إصلاحات السياسات، مثل الشهادات الإلزامية وإعادة تصميم المناهج، أمرًا بالغ الأهمية لمواءمة إعداد المعلمين مع المتطلبات الرقمية. تدعو النتائج إلى اتباع نهج شامل يدمج الابتكار التربوي، والقدرة على التكيف التكنولوجي، ودعم السياسات النظامية. ينبغي للبحوث المستقبلية استكشاف النماذج المستجيبة ثقافيا ودور الذكاء الاصطناعي في تدريب المعلمين، وضمان التعليم العادل وعالي الجودة في المشهد الرقمي المتطور.

الكلمات المفتاحية: بيئات التعلم المختلطة، تحديات التدريس الهجين، إعداد المعلمين عبر الإنترنت، التطوير المهني للمعلمين، دمج التكنولوجيا في التعليم.

1. Introduction

The rapid evolution of digital technologies and the global shift toward remote learning necessitate a reevaluation of teacher preparation programs (Vo, 2024). This systematic literature review synthesizes empirical findings and theoretical insights on strategies, challenges, and benefits in preparing educators for online and hybrid teaching environments. The review addresses the research question: What are the **challenges, effective strategies, benefits, and policy implications** in preparing teachers for online and hybrid teaching environments?

Preparing teachers for online and hybrid teaching environments is increasingly important as educational contexts evolve to include more digital and remote learning options. This shift necessitates a reevaluation of teacher education programs to ensure educators are equipped with the necessary skills and knowledge to thrive in these settings.

2. Literature Review

2.1 Challenges in Preparing Teachers for Digital Learning

2.1.1 Gaps in Traditional Teacher Education

Anderson and Rivera-Vargas (2020) stated that a critical barrier to effective digital teaching lies in the inherent limitations of conventional teacher education systems. Many educators entering the field today were trained when online learning was not a cornerstone of pedagogical practice, leaving them without firsthand experience in virtual instruction (McNeil, 2016). This gap creates a disconnect between their own educational experiences and the realities of modern classrooms, where digital tools and hybrid models are increasingly central. For instance, teachers unfamiliar with online learning platforms often struggle to design engaging virtual lessons or troubleshoot technical challenges, which can undermine student outcomes in technology-driven environments (Maurya and Yadav 2024). Compounding this issue is the rigidity of traditional teacher preparation programs, which frequently prioritize compliance with state-mandated curricula over innovation. As noted by Graziano and Bryans-Bongey (2018), many programs lack the flexibility to incorporate emerging blended teaching methodologies, as existing accreditation standards and coursework requirements often emphasize face-to-face instruction. This institutional inertia perpetuates a cycle where educators graduate unprepared to navigate the complexities of digital classrooms, despite the growing demand for these competencies. Together, these gaps—rooted in both experiential deficits and systemic inflexibility—highlight the urgent need for teacher education reforms that align with the evolving demands of 21st-century education.

2.1.2 Technological and Pedagogical Barriers

Hybrid teaching environments amplify preexisting challenges by introducing complex technological and pedagogical demands. Teachers navigating dual-modality instruction often face a significantly increased workload, as they must simultaneously design lessons for in-person and remote learners, manage disparate classroom dynamics, and troubleshoot real-time technical issues. This dual responsibility stretches instructional time and energy, often leading to instructors' burnout and reduced instructional quality (Li et al., 2023; Martín et al., 2023). For example, educators may spend hours adapting materials for online platforms or addressing connectivity disruptions during live sessions, diverting focus from core pedagogical goals.

Exacerbating these demands are persistent technological barriers such as unreliable internet connectivity and inadequate access to digital tools, which disproportionately affect under-resourced schools. Bower et al. (2017) emphasize that unstable infrastructure not only disrupts lesson continuity but also exacerbates equity gaps, as students in low-income areas face greater hurdles in accessing hybrid learning. Pedagogically, hybrid models require teachers to master new skills, such as balancing synchronous and asynchronous interactions and fostering engagement across physical and virtual spaces—tasks rarely addressed in conventional training programs. Together, these intertwined technological and pedagogical challenges underscore the need for systemic support, including robust infrastructure investments and targeted professional development, to ensure hybrid environments do not compromise educational quality or equity.

2.1.3 Systemic and Policy Limitations

A critical systemic shortfall in preparing teachers for digital learning lies in the misalignment of educational policies, which frequently prioritize student access to technology over educator readiness. As Archambault et al. (2014) underscore, many state and institutional initiatives focus on expanding broadband connectivity or distributing devices to students, yet neglect parallel investments in teacher training. For instance, programs mandating one-to-one laptop initiatives or subsidizing student subscriptions to online platforms often lack provisions for equipping educators with the pedagogical skills to leverage these tools effectively. This oversight creates a paradox in which students gain physical access to digital resources, while teachers remain underprepared to design meaningful online learning experiences or troubleshoot technical challenges. This paradox results in underutilized technologies and suboptimal outcomes

The roots of this issue are structural. Teacher certification standards and accreditation frameworks in many regions still emphasize traditional classroom management and content delivery, with little emphasis on digital pedagogy or hybrid instruction models. Without policy mandates requiring coursework in online teaching methods or hands-on practicums in virtual environments, preparation programs default to outdated curricula ill-suited for modern educational demands. Consequently, even well-intentioned educators enter classrooms unequipped to navigate platforms like learning management systems (LMS) or employ adaptive assessment strategies in hybrid settings. This systemic neglect perpetuates inequities, as schools in resource-limited areas face compounded barriers—limited technology access for students *and* insufficient training for teachers. Addressing these gaps demands policy reforms that holistically link infrastructure investments with educator competency development, ensuring technology integration aligns with pedagogical expertise.

2.2 Effective Strategies for Online Teacher Training

2.2.1 Pedagogical Innovations

Pedagogical innovations are pivotal in equipping educators with the skills to thrive in digital classrooms. Constructivist approaches, such as collaborative problem-solving exercises and immersive virtual field trips, empower teachers to experience learner-centered methodologies firsthand, fostering their ability to design interactive online lessons (Gold, 2019). For example, by participating in group-based simulations, educators develop strategies to facilitate peer-to-peer engagement in virtual settings. Complementing this, flipped learning models reverse traditional instruction by having teachers independently explore instructional content—such as video lectures or digital modules—before applying concepts in live, interactive sessions. This approach not only cultivates self-directed learning habits but also models how to prioritize active engagement over passive content delivery in online environments (Creely and Lyons, 2022). Additionally, scaffolding techniques, such as incremental skill-building tasks paired with mentorship, provide structured support as teachers adapt to digital tools. Virtual practicums further reinforce competence by simulating real-world scenarios—like managing hybrid classroom disruptions or designing LMS-based assessments—in risk-free settings, bridging the gap between theory and practice (Cole and Kritzer, 2009; Moore and Hong, 2022). Together, these innovations reimagine teacher training as a dynamic, participatory process, aligning pedagogical strategies with the demands of modern digital education.

2.2.2 Technological Integration

Effective technological integration in online teacher training hinges on tools and frameworks that foster connection, engagement, and skill mastery. Persistent instructor presence—maintained through weekly video updates, timely discussion board interactions, and virtual office hours—plays a critical role in building trust and community among educators. For instance, Cole and Kritzer (2009) found that instructors who regularly contributed to forums and shared

personalized video messages mitigated feelings of isolation, creating a collaborative atmosphere where teachers felt supported while navigating new technologies. Navarro and McGrath (2022) further emphasize that this consistency helps model best practices for maintaining student engagement in virtual settings.

Contextual barriers manifest differently across educational systems. In Saudi elementary EFL settings, Elmahdi et al. (2025) found that 78% of teachers reported curriculum-tech misalignment as their primary implementation hurdle, with only 32% receiving adequate training on digital tools despite nationwide ICT infrastructure investments." In parallel, Learning Experience Design (LXD) leverages technology to create immersive, experiential training environments tailored to educators' needs. Wong et al. (2022) demonstrate how LXD principles, such as iterative prototyping and user-centered content organization, enhance STEAM educators' self-efficacy. For example, courses designed with interactive simulations or project-based modules allow teachers to experiment with digital tools—like coding platforms or virtual labs—in a structured yet flexible manner. This hands-on approach not only builds technical proficiency but also empowers educators to translate these skills into dynamic classroom practices. Together, persistent presence and LXD illustrate how intentional technological integration can transform teacher training from a transactional process into an engaging, competency-driven journey.

2.2.3 Professional Development Models

Effective professional development for online teaching hinges on models that blend individualized skill-building with communal support systems. Tailored training programs address educators' diverse needs by focusing on context-specific competencies, such as mastering digital tools like Zoom breakout rooms or Canvas LMS, and strategies for time management in asynchronous environments. By aligning training with teachers' daily challenges—such as balancing virtual office hours with lesson planning— Tailored training programs directly boost confidence and reduce technostress (Ahmed et al., 2022). For example, schools might offer modular workshops where educators select sessions based on gaps in their skillset, ensuring relevance to their unique classroom contexts.

Complementing these individualized approaches are collaborative learning communities, which leverage peer networks to foster adaptability. Platforms like virtual PLCs (Professional Learning Communities) or social media groups enable educators to share resources, troubleshoot challenges, and co-design hybrid lesson plans. Rice and Deschaine (2020) highlight that such communities cultivate a culture of continuous learning, where teachers iteratively refine practices through feedback and collective problem-solving. For instance, a district-wide online forum might host monthly "tech challenges," encouraging educators to experiment with new tools and report outcomes to peers. Together, tailored training and collaborative communities create a dual framework: one that equips teachers with foundational skills while nurturing the agility required to navigate evolving digital landscapes.

2.3 Hybrid Teaching Environments: Opportunities and Challenges

2.3.1 Benefits of Hybrid Modalities

Hybrid teaching environments offer transformative advantages that address the evolving needs of modern education. Foremost among these is *flexibility and accessibility*, as hybrid models allow learners to engage with content at their own pace and location, accommodating diverse schedules and enabling participation for geographically dispersed or time-constrained students, such as working professionals or caregivers (Mirzoeva et al., 2024; Turdiev, 2024). For instance, asynchronous components empower students in remote areas to access high-quality instruction without relocating, democratizing educational opportunities.

Additionally, hybrid modalities uniquely foster skill development by requiring learners to navigate both digital and in-person collaboration. Students cultivate problem-solving abilities as they troubleshoot technical challenges, adapt to varied communication platforms, and synthesize information across formats. Teamwork skills are further honed through virtual group projects and cross-modal peer feedback, preparing learners for

digitally integrated workplaces (Cunnington et al., 2023).

Critically, research confirms that hybrid models achieve equivalent learning outcomes to traditional methods. Mirzoeva et al. (2024) found that students in hybrid programs demonstrated comparable competency levels in core subjects, dispelling concerns about diluted rigor in blended formats. This parity is particularly evident when hybrid designs emphasize active learning strategies, such as flipped classrooms or project-based assessments. By merging the accessibility of online learning with the relational depth of in-person interaction, hybrid teaching not only matches conventional efficacy but also expands educational equity and relevance in a technology-driven world.

2.3.2 Operational and Logistical Challenges

Hybrid teaching environments introduce complex operational demands that strain educators and institutions. Teachers often grapple with heightened workloads, as they must design lessons that cater simultaneously to in-person and remote learners, manage divergent participation dynamics, and troubleshoot unexpected technical disruptions. For instance, facilitating group discussions or real-time polls becomes logistically cumbersome when coordinating across modalities, often resulting in fragmented student interaction and diminished engagement (Li et al., 2023; Woolfitt, 2023). This dual focus not only elongates preparation time but also risks instructor burnout, particularly in under-resourced settings where support systems are lacking.

Compounding these challenges are persistent technical barriers. Audio-visual inconsistencies—such as lagging video feeds, muffled audio, or incompatible software—frequently disrupt lesson continuity, forcing teachers to divert attention from pedagogy to troubleshooting (Bower et al., 2017). Additionally, unequal access to reliable internet or devices among students exacerbates participation gaps, as remote learners may disengage due to connectivity issues or hardware limitations (Nebrida and Bangud, 2022). For example, a student joining via a low-bandwidth connection might miss critical segments of a live demonstration, widening achievement disparities. Together, these operational and technical hurdles underscore the need for robust infrastructure, standardized protocols, and proactive IT support to mitigate disruptions and ensure equitable learning experiences in hybrid models.

2.3.3 Best Practices for Implementation

Successful implementation of hybrid teaching hinges on intentional design and adaptive assessment strategies. Central to this is the integration of technology and pedagogy to prioritize interaction and real-time feedback. Raes et al. (2019) emphasize that platforms like interactive whiteboards, discussion forums, and video conferencing tools should be embedded into course design to facilitate synchronous and asynchronous collaboration. For instance, tools such as Padlet or Miro enable learners to co-create mind maps during hybrid sessions, bridging the gap between in-person and remote participants. Guerrero-Quiñonez et al. (2023) further advocate for "smart classroom" setups, where automated attendance tracking and AI-driven analytics help instructors identify disengaged students and tailor interventions dynamically.

Equally critical is continuous assessment, which sustains engagement by providing frequent, actionable feedback. Guerrero-Quiñonez et al. (2023) highlight strategies like weekly reflection journals, peer evaluations, and low-stakes quizzes to monitor progress and adjust instruction. For example, a hybrid course might use gamified quizzes via Kahoot! to assess comprehension during live sessions, while asynchronous discussion boards host peer feedback loops on group projects. This approach not only keeps learners accountable but also cultivates a growth mindset by framing feedback as an iterative process rather than a summative judgment. Together, these practices—rooted in purposeful technology use and responsive assessment—create a cohesive hybrid ecosystem that balances flexibility with academic rigor, ensuring all students thrive regardless of modality.

2.4 Policy and Program Design for Digital Readiness

2.4.1 State and Institutional Policy Reforms

Systemic digital readiness in education necessitates policy reforms that institutionalize competency standards for blended teaching. A foundational step

mandates certifications in hybrid pedagogy to ensure educators receive formal training in designing and delivering instruction across modalities.

Graziano and Bryans-Bongey (2018) argue that such certifications—covering competencies like LMS navigation, asynchronous engagement strategies, and equitable assessment design—should be integrated into licensure requirements, similar to traditional classroom management training. For example, states might require teachers to complete accredited courses on blended learning frameworks as a condition for certification renewal. Concurrently, policies must align with evolving educator needs to bridge gaps between institutional mandates and classroom realities. Archambault et al. (2014) stress that top-down initiatives often fail when disconnected from teacher input, such as deploying costly technologies without training. Effective reforms involve collaborative policymaking—like statewide task forces where educators co-design standards—to ensure tools and training address actual challenges, such as managing hybrid student cohorts or addressing digital divides. For instance, a district might revise its technology budget to prioritize teacher-requested tools like interactive polling software over generic hardware purchases. By anchoring policies in practitioner insights and mandating relevant certifications, institutions can cultivate a workforce adept at navigating the complexities of modern digital education.

2.4.2 Curriculum Redesign and Certification

Revamping teacher education curricula to reflect the demands of digital instruction is essential for fostering pedagogical agility. A cornerstone of this effort is the integration of hybrid pedagogy into core coursework, ensuring educators master frameworks for blending in-person and online modalities. Graziano and Bryans-Bongey (2018) advocate for embedding modules on topics such as synchronous/asynchronous lesson design, universal design for learning (UDL) in digital spaces, and ethical considerations in data-driven instruction. For instance, a revised curriculum might require pre-service teachers to co-develop hybrid units that balance face-to-face discussions with virtual collaborative projects, cultivating hands-on competency.

Complementing this pedagogical focus is the reinforcement of courses on digital tools and instructional design. Rice and Deschaine (2020) stress that educators need structured training in leveraging platforms like Google Classroom, Nearpod, or H5P to create interactive content tailored to diverse learners. Such courses could scaffold skills incrementally—beginning with basic tool navigation and progressing to advanced competencies like gamifying assessments or analyzing LMS analytics to personalize instruction. By certifying these skills, institutions signal mastery of hybrid teaching standards, aligning with policy mandates for digital readiness. For example, a university might offer a "Digital Teaching Specialist" micro-credential, validating proficiency in designing accessible, technology-enhanced curricula. Together, curriculum redesign and certification ensure educators are not only familiar with digital tools but also adept at harnessing them to foster inclusive, engaging learning environments.

Preparing teachers for online and hybrid environments requires addressing systemic gaps in traditional education, adopting evidence-based pedagogical strategies, and leveraging hybrid models' benefits while mitigating challenges. Policy reforms and curriculum redesign are critical to bridging the gap between institutional readiness and evolving educational demands. Future research should explore scalable training frameworks and culturally adaptive models to ensure equitable digital learning experiences.

AI integration requires ethical literacy components. Elmahdi et al. (2025) advocate for mandatory 'algorithmic awareness' modules in teacher certification, where educators learn to audit AI tools for cultural bias and accessibility barriers before deployment.

3. Methodology

The methodology for this systematic review followed a structured approach to identify, analyze, and synthesize relevant studies. The search strategy encompassed four academic databases—ERIC, JSTOR, PubMed, and Google Scholar—using keywords such as *"online teacher preparation,"*

"hybrid teaching challenges," "teacher professional development," and *"technology integration in education."* Inclusion criteria prioritized peer-reviewed articles published between 2000 and 2024, with a focus on empirical studies, theoretical frameworks, and policy analyses related to K–12 and higher education contexts.

From an initial pool of 45 studies, 30 were retained after a two-stage screening process. First, abstracts were evaluated for alignment with the review's scope. Secondly, full-text reviews were considered to assess methodological rigor and relevance. Thematic analysis was then applied to categorize emergent patterns in the literature. Four overarching themes were identified: (1) challenges in teacher preparation, (2) effective strategies for online/hybrid teaching, (3) policy and program design recommendations, and (4) benefits and outcomes of hybrid learning environments. This analytical framework ensured a comprehensive synthesis of insights while addressing the review's central research question.

4. Findings

4.1 Challenges in Teacher Preparation

The literature highlights several systemic challenges in preparing educators for online and hybrid environments. A prominent issue is the lack of firsthand experience with digital learning among many teachers, which impedes their ability to effectively leverage technology in instruction (McNeil, 2016). Exacerbating this challenge is the rigidity of traditional teacher preparation programs, which often fail to incorporate emerging pedagogies due to inflexible state-mandated curricula (Graziano and Bryans-Bongey, 2018). Hybrid teaching environments further exacerbate these difficulties by increasing teachers' preparation workload and creating barriers to student engagement, as educators must simultaneously manage in-person and remote learners (Li et al., 2023; Martín et al., 2023). Additionally, technical limitations, such as unstable internet connectivity and insufficient institutional infrastructure, pose significant obstacles to seamless implementation (Bower et al., 2017). These challenges collectively underscore the need for adaptive strategies and systemic reforms in teacher education.

4.2 Effective Strategies for Online Teacher Training

Studies identify several evidence-based strategies to enhance online teacher training. Constructivist approaches, such as collaborative exercises and virtual field trips, promote participatory learning by encouraging educators to engage dynamically with digital tools, fostering positive attitudes toward online instruction (Gold, 2019). Persistent instructor presence, achieved through discussion boards, weekly video messages, and interactive "ask me anything" sessions, is critical for building community and reducing isolation in virtual settings (Cole and Kritzer, 2009; Navarro and McGrath, 2022). Scaffolding techniques, combined with flipped learning models, allow educators to shift focus from passive content delivery to active problem-solving during synchronous sessions (Cole & Kritzer, 2009). Learning Experience Design (LXD) further strengthens training outcomes by prioritizing self-efficacy and content mastery, particularly in STEAM disciplines (Wong et al., 2022). Finally, tailored programs that address context-specific needs—such as digital literacy gaps and time management challenges—significantly boost teachers' confidence and satisfaction in online environments (Ahmmed et al., 2022). Collectively, these strategies emphasize adaptability, interactivity, and personalized support as pillars of effective online teacher preparation.

4.3 Benefits of Hybrid Teaching Environments

Hybrid teaching environments offer distinct advantages that address evolving educational demands. A key benefit is their inherent flexibility, enabling students to access content at their own pace and accommodate diverse schedules, which supports learners with varying needs and commitments (Turdiev, 2024). Additionally, these environments foster critical skill development, such as problem-solving, leadership, and collaborative teamwork, equipping students with competencies essential for modern workforce readiness (Cunnington et al., 2023). Importantly, research demonstrates that hybrid models achieve learning outcomes equivalent to traditional in-person instruction, with students attaining comparable

levels of content mastery and technical proficiency (Mirzoeva et al., 2024). These benefits collectively underscore hybrid teaching's potential to balance accessibility, skill enhancement, and academic rigor in contemporary education.

5. Discussion

The synthesis of literature underscores that preparing teachers for online and hybrid environments demands a holistic approach integrating pedagogical innovation, technological adaptability, and policy reform. A central tension lies in balancing the inherent challenges of hybrid models—such as increased workload, technical barriers, and engagement disparities—with their potential to expand accessibility and foster 21st-century skills. For instance, while hybrid learning offers flexibility for students (Turdiev, 2024), its success hinges on institutional investments in infrastructure and ongoing teacher support, such as technical training and reduced administrative burdens (Bower et al., 2017; Li et al., 2023). Without such systemic backing, educators risk burnout, and inequities in resource distribution may widen.

Constructivist methodologies emerge as a critical pedagogical framework, aligning with findings that interactive, learner-centered strategies—such as flipped classrooms and collaborative projects—enhance both teacher confidence and student outcomes (Cole and Kritzer, 2009; Gold, 2019). These approaches not only address engagement challenges but also mirror the problem-solving and teamwork skills that hybrid environments aim to cultivate (Cunnington et al., 2023). However, the literature reveals a disconnect between these evidence-based practices and current policy landscapes. Many state and institutional policies prioritize expanding student access to online learning (Archambault et al., 2014) while neglecting parallel mandates for teacher training, leaving educators underprepared to navigate hybrid modalities. This gap highlights the urgency of reforms such as integrating online pedagogy into certification requirements, funding professional development programs, and incentivizing research on scalable training models.

Our findings confirm Martín et al.'s (2023) observation that hybrid teaching creates unsustainable workloads as educators simultaneously design for in-person and remote learners—a challenge amplified by Li et al.'s (2023) documentation of engagement fragmentation. These operational hurdles intersect with Bower et al.'s (2017) identification of infrastructure gaps, particularly in under-resourced schools where Nebrida and Bangud (2022) note connectivity barriers disproportionately impact marginalized students. Crucially, these challenges reflect McNeil's (2016) foundational diagnosis of experiential gaps in teacher preparation, where traditional programs fail to address digital pedagogy (Graziano and Bryans-Bongey, 2018)."

Our findings on workload challenges resonate with Elmahdi and Daweli's (2025) emotional labor framework in TESOL contexts. Their identification of 'digital emotional dissonance' underscores the need for future PD programs to incorporate socio-emotional components alongside technical training, particularly for language educators navigating hybrid environments.

Ultimately, the findings advocate for a paradigm shift in teacher education—one that embraces flexibility, centers on experiential learning, and aligns policy with the realities of digital-age classrooms. Future research should explore longitudinal impacts of these strategies and address geographic and cultural disparities in implementation.

This systematic literature review sought to address the central research question: *What are the effective strategies, challenges, and benefits in preparing teachers for online and hybrid teaching environments?* The findings, synthesized below, directly respond to this inquiry while advancing the broader objective of reimagining teacher education for digital-age demands.

5.1 Addressing Challenges in Teacher Preparation

The review identified **systemic gaps in traditional teacher education**, such as educators' lack of firsthand digital learning experiences and rigid curricula resistant to innovation (Graziano and Bryans-Bongey, 2018; McNeil, 2016). These barriers align with the objective of diagnosing obstacles to equitable digital readiness. Hybrid environments exacerbated these challenges through increased workloads and technical inequities

(Bower et al., 2017; Li et al., 2023), underscoring the urgency of institutional reforms.

Constructivist approaches—validated by Gold's (2019) virtual field studies and Cole and Kritzer's (2009) flipped classroom models—prove essential for mitigating engagement challenges. Wong et al.'s (2022) LXD framework further demonstrates how immersive simulations build teacher self-efficacy, while Ahmmed et al.'s (2022) tailored PD models address technostress through context-specific tool training (e.g., Zoom/Canvas mastery). These strategies collectively respond to Rice and Deschaine's (2020) call for 'pedagogical agility' in digital environments.

5.2 Validating Effective Strategies

The research question's focus on effective strategies was met through evidence supporting constructivist pedagogies (e.g., flipped classrooms, virtual practicums) and persistent instructor presence (Cole and Kritzer, 2009; Gold, 2019). These strategies directly address the objective of enhancing pedagogical agility, demonstrating how learner-centered approaches bridge theory-practice gaps. Tailored professional development models (Ahmmed et al., 2022) further highlighted the need for personalized, competency-based training—a critical insight for achieving workforce readiness.

The disconnect between student technology access and teacher readiness (Archambault et al., 2014) necessitates Graziano and Bryans-Bongey's (2018) proposed certification mandates. Our analysis extends this by demonstrating how Rice & Deschaine's (2020) micro-credentialing model could institutionalize hybrid pedagogy competencies, while Guerrero-Quiñonez et al.'s (2023) smart classroom research underscores the need for curriculum reforms prioritizing AI-driven analytics alongside UDL principles.

5.3 Balancing Hybrid Opportunities and Complexities

Hybrid teaching's flexibility and skill development benefits (Cunnington et al., 2023; Mirzaeva et al., 2024) affirm its potential to democratize education, aligning with the objective of optimizing accessibility. However, operational challenges like engagement disparities (Woolfitt, 2023) complicate implementation, emphasizing the need for design frameworks that prioritize interaction and equity (Raes et al., 2019). While hybrid models demonstrate Mirzoeva et al.'s (2024) validated learning equivalence and Cunnington et al.'s (2023) skill-development benefits, Woolfitt's (2023) engagement fragmentation research reveals implementation risks. This tension mirrors Raes et al.'s (2019) synchronous learning paradox: Flexibility advantages depend on Guerrero-Quiñonez et al.'s (2023) 'intentional technology integration'—where tools like Miro boards must be coupled with Boelens et al.'s (2017) four-design principles for blended learning.

5.4 Policy and Curriculum Implications

Findings on educational policy reforms (Archambault et al., 2014) and curriculum redesign (Rice and Deschaine, 2020) directly respond to the research question's call for systemic solutions. Mandating certifications in blended pedagogy and integrating technology into accreditation standards emerged as actionable pathways to institutionalize digital readiness.

6. Conclusion

While AI offers personalization benefits, Elmahdi et al. (2025) found that 42% of vocabulary tools systematically disadvantaged dialect speakers, exemplifying Woolfitt's (2023) engagement disparities in technology-mediated environments.

The Sudanese case (AbdAlgane and Elmahdi, 2025) exemplifies how hybrid learning's benefits must be contextualized to extreme environments. While achieving remarkable 78% access retention amidst conflict, the study reveals how socioeconomic gaps and absent career pathways can undermine even successful emergency implementations - directly validating our finding that technological solutions require parallel social support systems.

The transition to online and hybrid teaching environments necessitates a transformative approach to teacher preparation, grounded in curriculum innovation, sustained professional development, and systemic policy alignment. Redesigning teacher education programs to integrate blended pedagogies—such as flipped classrooms, Learning Experience Design (LXD), and virtual practicums—ensures educators acquire

both technological proficiency and adaptive instructional strategies. Equally critical is the institutional commitment to ongoing training that addresses emergent challenges, from digital literacy gaps to hybrid classroom management, while fostering collaborative communities of practice.

Constructivist principles, persistent instructor presence, and tailored training models emerge as pillars of effective preparation, enabling educators to navigate the complexities of dual-modality instruction while maintaining student engagement and equity. However, the realization of these goals hinges on policy reforms that prioritize educator readiness alongside student access, such as mandating online teaching certifications and funding infrastructure upgrades.

Future research must investigate the long-term efficacy of these strategies across diverse contexts, particularly how culturally responsive models and evolving technologies—such as AI-driven tools—reshape teacher training. By bridging gaps between theory, practice, and policy, educational systems can empower teachers to thrive in dynamic digital landscapes, ensuring equitable and high-quality learning experiences for all students.

McNeil's (2016) generational training gap analysis necessitates longitudinal studies on virtual practicums (Moore & Hong, 2022). Simultaneously, Archambault et al.'s (2014) policy-equity framework demands investigation into culturally responsive AI adaptations—particularly for Nebrida and Bangud's (2022) documented resource-disadvantaged contexts.

7. Contributions to the Field

By synthesizing evidence across 30 studies, this review advances three key contributions:

- **Pedagogical**: Constructivist and technology-integrated strategies are non-negotiable for modern teacher preparation.
- **Structural**: Hybrid models require rethinking workload distribution and infrastructure investments to prevent burnout and inequity.
- **Policy-Driven**: Systemic alignment of curricula, certifications, and funding is essential for scalable, equitable digital education.

7.1 Future Directions

While the review achieved its objectives, persistent gaps—such as longitudinal studies on virtual practicums and culturally adaptive training models—highlight opportunities for further research. The findings collectively advocate for a paradigm shift in teacher education, where digital fluency is not an add-on but a foundational competency.

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