GLOBAL: Education Language and Humanity Journal
Vol.2, No.2, February 2025, pp. 53~65
ISSN: 3025-9207

AI-POWERED SCAFFOLDING: RETHINKING ENGLISH LANGUAGE TEACHING PRACTICES IN THE DIGITAL AGE

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Article Info

Article history:

Received Jan 5, 2025
Revised Jan 25, 2025
Accepted Feb 28, 2025

Keywords:

English Language Teaching, Scaffolding, Artificial Intelligence, Digital Pedagogy, Adaptive Learning

Abstract

The integration of artificial intelligence (AI) in English Language Teaching (ELT) presents transformative opportunities for adaptive and personalized instructional scaffolding. While the technical capabilities of AI—such as natural language processing and automated assessment—are well-documented, its pedagogical application in scaffolding complex language skills remains underexplored. This conceptual study addresses that gap by synthesizing foundational learning theories, including Sociocultural Theory, Cognitive Load Theory, and Constructivist Learning Theory, to examine how AI tools such as intelligent tutoring systems, chatbots, and adaptive platforms can support learners across different stages of language acquisition. The paper outlines a theoretical framework for AI-powered scaffolding, critically evaluates its ethical implications (e.g., data privacy, algorithmic bias), and proposes strategies for balancing human facilitation with AI augmentation. The findings underscore AI's potential to enhance language proficiency, learner engagement, and metacognitive development. Implications are offered for educators, researchers, and policymakers aiming to integrate AI ethically and effectively within ELT ecosystems.

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INTRODUCTION

The integration of artificial intelligence (AI) into English Language Teaching (ELT) has opened new pedagogical horizons, offering adaptive, personalized, and data-informed scaffolding for language learners. Tools such as intelligent tutoring systems (ITS), AI-powered chatbots, and adaptive learning platforms have introduced dynamic instructional pathways that support real-time feedback and context-sensitive learning assistance (Luckin, 2018; Kukulska-Hulme & Viberg, 2018). These affordances challenge traditional notions of scaffolding, which typically depend on human instructors providing temporary, developmental support as learners build independent language competencies (Wood et al., 1976).

Despite the accelerating presence of AI in education, scholarly work in ELT has largely focused on the technological capacities of AI—such as natural language processing or speech recognition—rather than its pedagogical applications in scaffolding (Zawacki-Richter et al., 2019; Tan et al., 2024; Chen & Xie, 2024). Moreover, the application of AI to scaffold complex language skills—such as discourse competence, pragmatic fluency, and intercultural communication—remains significantly underexplored (Godwin-Jones, 2024; Xia et al., 2024). The existing literature tends to privilege vocabulary acquisition and grammatical accuracy, overlooking how AI can support higher-order communicative and cognitive dimensions of language learning (Glandorf et al., 2025; Abu Qbeita, 2024).

Further complicating this pedagogical gap are unresolved concerns about the ethical deployment of AI in educational settings. Issues such as data privacy, algorithmic bias, over-reliance on automated feedback, and the erosion of learner autonomy are emerging as critical factors that must be addressed if AI is to be responsibly integrated into ELT (Akgun & Greenhow, 2022; Holmes & Porayska-Pomsta, 2022; Chinta et al., 2024).

Therefore, this paper aims to bridge the divide between technological innovation and pedagogical theory by examining how AI-powered scaffolding can be purposefully integrated into ELT. Drawing on theoretical foundations from Sociocultural Theory (Vygotsky, 1978), the Zone of Proximal Development (ZPD), Cognitive Load Theory (Sweller, 1988), and Constructivist Learning Theory (Allen, 2022), the paper investigates how AI technologies can provide adaptive, personalized support across diverse learner profiles. It also critically evaluates key AI tools and platforms used in ELT, assesses their pedagogical utility, and identifies ethical considerations that must guide their implementation.

By synthesizing insights from theory and practice, the study offers a conceptual framework for understanding AI-enhanced scaffolding in ELT. It concludes with evidence-based recommendations for educators, researchers, and policymakers seeking to leverage AI without compromising equity, engagement, or educational integrity.

METHODS

This study adopts a conceptual methodology to explore the pedagogical role of AI-powered scaffolding in English Language Teaching (ELT). Rather than conducting empirical data collection, the approach synthesizes and critically examines current literature, theoretical frameworks, and emerging technological applications. Conceptual research in education is well-suited for clarifying constructs, proposing integrative frameworks, and guiding future empirical studies (Gimbert et al., 2024).

The study employed a selective literature review strategy, focusing on scholarly articles, empirical studies, and theoretical works published within the last decade that examine intersections among AI, ELT, and instructional scaffolding. Particular attention was given to literature on intelligent tutoring systems, adaptive feedback, NLP-driven tools, and ethics in AI-based pedagogy. Inclusion criteria prioritized peer-reviewed sources discussing theoretical underpinnings, pedagogical impact, or practical implementation of AI in language education.

The conceptual analysis was informed by three interrelated educational theories. Firstly, Sociocultural Theory and the Zone of Proximal Development (ZPD), as articulated by Vygotsky (1978), which situate learning as a socially mediated process and underscore the value of scaffolding in supporting learners just beyond their independent competence. Secondly, Cognitive Load Theory (CLT), developed by Sweller (1988), which guided the analysis of how AI tools could balance cognitive demands to facilitate efficient schema construction. Lastly, Constructivist Learning Theory, which emphasizes learner agency, interactive engagement, and the crucial role of prior knowledge in constructing new understanding (Allen, 2022; Walqui, 2006).

AI-based educational scaffolding was interpreted through these theoretical lenses to evaluate its pedagogical alignment and transformative potential. This conceptual triangulation allows for a nuanced examination of how AI not only supplements human instruction but also reshapes the role of guidance in digital language learning contexts.

Furthermore, the analysis included emerging frameworks in AI-mediated instructional design and technology-enhanced ELT, as found in recent works emphasizing AI's analytical, adaptive, and multimodal affordances (Simamora & Tenrisanna, 2023). By integrating theory and technological trends, this method supports the formulation of evidence-informed pedagogical recommendations for AI adoption in language education

RESULTS AND DISCUSSION

The integration of artificial intelligence (AI) into English Language Teaching (ELT) represents a significant paradigm shift, moving beyond traditional instructional methods to offer dynamic, personalized, and adaptive learning experiences. This section delves into the theoretical foundations that underpin AI-powered scaffolding, explores its essential components, highlights various AI tools, and discusses critical evaluation criteria, thus providing a comprehensive overview of AI's transformative role in modern ELT practices.

Theoretical Foundations of AI-Powered Scaffolding in ELT

AI-powered scaffolding is deeply rooted in established learning theories that emphasize guided learning, cognitive optimization, and active knowledge construction. Understanding these theoretical alignments is crucial for harnessing AI's pedagogical potential.

1. Sociocultural Theory and the Zone of Proximal Development (ZPD)

Lev Vygotsky’s Sociocultural Theory posits that learning is a social process, occurring through interaction within a learner’s Zone of Proximal Development (ZPD). The ZPD is the dynamic gap between what a learner can achieve independently and what they can accomplish with the guidance of a more knowledgeable2 other (Vygotsky, 1978). This guidance, known as scaffolding, involves providing temporary support that is gradually withdrawn as the learner develops autonomy. Building on Vygotsky, theorists like Jerome Bruner emphasized the instructional strategies involved in scaffolding, highlighting how teachers provide structured interaction to help learners bridge the gap between their current and potential abilities (Bruner, 1978). Jean Piaget’s work on cognitive development also

contributes to this understanding, albeit from a constructivist lens, stressing the assimilation and accommodation of new information. Barbara Rogoff further extended Vygotsky's ideas by focusing on "guided participation," where learners actively engage in cultural activities with more skilled partners (Rogoff, 1990).

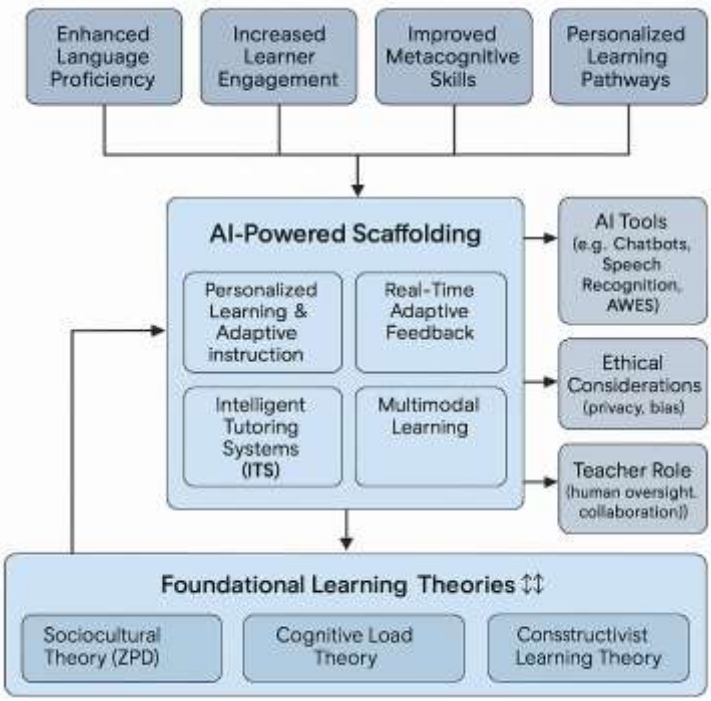

Figure 1: Conceptual Model of AI-Powered Scaffolding in ELT

AI-powered scaffolding aligns remarkably well with the ZPD by providing individualized and adaptive support. Intelligent tutoring systems (ITS), AI-driven chatbots, and adaptive learning platforms can operate within a learner's ZPD by analyzing their performance in real-time, identifying areas of difficulty, and adjusting the level of assistance accordingly. For instance, if a learner struggles with a specific grammatical structure, the AI can offer targeted hints, simplified examples, or rephrase instructions, effectively acting as the "more knowledgeable other." As the learner's proficiency improves, the AI can incrementally reduce the support, fostering independent learning and metacognitive skills. This dynamic adaptation ensures that learners are consistently challenged at an optimal level, preventing both frustration from excessive difficulty and boredom from tasks that are too easy. The sociocultural aspect is addressed as AI can facilitate meaningful interactions, even if simulated, enabling learners to practice language in context (Dwivedi et al., 2023; Kristiawan et al., 2024).

2. Cognitive Load Theory (CLT)

Cognitive Load Theory, developed by John Sweller, centers on optimizing instructional design to reduce cognitive burden and enhance learning efficiency (Sweller, 1988). This theory differentiates among three types of cognitive load. Firstly, intrinsic load refers to the inherent difficulty of the learning material itself. Secondly, extraneous load is the

unnecessary mental effort imposed by poor instructional design. Lastly, germane load represents the mental effort effectively dedicated to processing and constructing schemas.

AI-powered scaffolding directly addresses the principles of Cognitive Load Theory by optimizing instructional strategies to minimize extraneous cognitive load while simultaneously maximizing germane cognitive load. AI algorithms possess the capability to analyze a learner's progress and adapt the delivery of content to their individual cognitive capacity, thereby preventing information overload. For instance, AI can segment complex tasks into smaller, more manageable chunks, offer immediate feedback to rectify misconceptions before they escalate, and present alternative explanations or examples to clarify challenging concepts. This dynamic adjustment ensures that instructional materials are presented in a manner that supports efficient processing, allowing learners to allocate more cognitive resources towards schema construction and achieving a deeper understanding (Chinta et al., 2024; Fitri et al., 2025). Furthermore, AI tools are adept at mitigating the "split-attention effect" by integrating related information into single, coherent presentations, consequently reducing the necessity for learners to divide their attention across multiple disparate sources.

3. Constructivist Learning Theory

Constructivism, rooted in the works of Piaget and Vygotsky, posits that learners actively construct knowledge and meaning from their experiences rather than passively receiving information (Piaget, 1954; Vygotsky, 1978). Learning is viewed as an active process of meaning-making, where new information is integrated with existing knowledge. AI-powered scaffolding aligns with constructivist principles by creating interactive and experiential learning environments that promote active engagement and knowledge construction. AI tools can simulate real-world scenarios, provide virtual tutors for conversational practice, and offer personalized feedback that encourages reflection and self-correction. For instance, AI-driven writing platforms do not merely correct errors but often explain the underlying grammatical rules or suggest alternative phrasing, prompting learners to understand why a particular correction is necessary. This approach fosters critical thinking and problem-solving skills, allowing learners to take ownership of their learning process and build their linguistic competence incrementally through guided discovery (Yuan & Hu, 2024; Rabaa'i & Hamouda, 2025). AI also facilitates collaborative learning by providing platforms for peer feedback and group discussions mediated by intelligent agents.

AI as an Essential Component of Scaffolding in ELT

The practical application of AI in ELT extends the capabilities of traditional scaffolding by offering unprecedented levels of personalization, adaptability, and accessibility.

1. Personalized Learning and Adaptive Instruction

AI-powered systems excel at analyzing individual learner performance data, including error patterns, response times, and learning styles. Through machine learning algorithms, these systems can predict areas where a learner might struggle and proactively adapt instructional content and difficulty levels. This personalized approach ensures that every learner receives

support tailored to their unique needs and pace, moving away from a one-size-fits-all model. For example, AI-driven platforms like Duolingo and Rosetta Stone continually adjust lesson difficulty based on user performance, identifying specific vocabulary or grammatical structures that require more practice. This level of dynamic adaptation allows for highly efficient and engaging learning pathways that are difficult to achieve in traditional classroom settings (Al-Smadi et al., 2024; CIDDL, 2023). Furthermore, AI can track user behavior and progress over time, offering insights that inform curriculum design and pedagogical strategies.

2. Real-Time Adaptive Feedback and Error Correction

One of the most significant advantages of AI in scaffolding is its ability to provide immediate and context-aware feedback. Unlike traditional classroom settings where feedback can be delayed, AI tools offer instant corrections and suggestions, allowing learners to identify and rectify errors promptly. This immediate feedback loop is crucial for language acquisition, as it reinforces correct usage and prevents the entrenchment of mistakes. For instance, AI-powered writing assistants like Grammarly and ProWritingAid offer real-time suggestions on grammar, syntax, style, and even tone, explaining the rationale behind their recommendations. Similarly, speech recognition software such as ELSA Speak and Google Speech-to-Text provides instant pronunciation feedback, highlighting specific sounds or intonation patterns that need improvement (Mustapha et al., 2024). Beyond simple corrections, AI can also foster interactive and engaging learning environments through chatbots that simulate real-world conversations, providing context-sensitive feedback and encouraging natural language production (Lee et al., 2023).

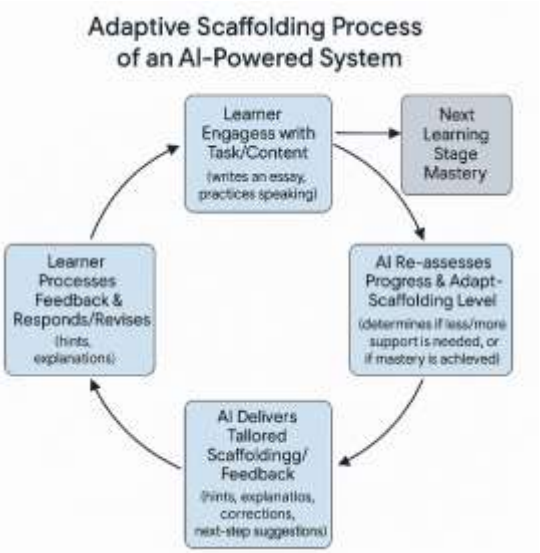

Figure 2: Adaptive Scaffolding Process of an AI-Powered System

3. AI-Enabled Intelligent Tutoring Systems (ITS)

Intelligent Tutoring Systems (ITS) represent a sophisticated application of AI in education, designed to provide personalized instruction and feedback by modeling student knowledge

and dynamically adapting to their learning needs. These systems offer both cognitive scaffolding (guiding learners through problem-solving steps) and metacognitive scaffolding (encouraging learners to reflect on their learning processes). ITS assesses a learner's strengths and weaknesses, provides hints when they are stuck, and offers remediation when errors occur. Prominent examples include AutoTutor, which simulates human tutoring by asking questions and providing feedback, and Carnegie Learning's MATHia, which adapts math instruction based on individual student performance. In ELT, ITS can guide learners through complex linguistic tasks, such as essay writing or argumentative discourse, providing structured support that evolves with the learner's progress (Elshoubaki, 2025; Steenbergen-Hu & Cooper, 2014).

4. AI's Role in Multimodal Learning and Language Acquisition

AI platforms are increasingly leveraging multimodal learning, integrating text, audio, and visual elements to enhance comprehension and retention in ELT. For instance, AI-driven applications can combine written exercises with spoken prompts and visual aids, catering to diverse learning styles and improving overall language acquisition. Google Expeditions, for example, offers virtual field trips that allow learners to experience different cultural contexts while practicing language in an immersive environment. Similarly, AR/VR applications like ImmerseMe utilize AI to create realistic conversational scenarios, enabling learners to practice speaking and listening in a safe and engaging virtual space. This multimodal approach makes learning more dynamic and effective, especially for complex language skills that require contextual understanding and application.

AI Tools for Scaffolding in ELT

The market for AI tools designed to scaffold English language learning is rapidly expanding, offering a diverse array of functionalities. Among these, chatbots and virtual assistants have become prominent, exemplified by tools like Duolingo's chatbot and Google's Bard (Gemini). These platforms facilitate conversational practice, answer language-related queries, and deliver immediate feedback on sentence construction and vocabulary usage, enabling learners to engage in simulated dialogues, receive error corrections, and gain nuanced linguistic explanations.

Another significant category is speech recognition software, with applications such as Google Speech-to-Text, ELSA Speak, and iTutorGroup. These tools leverage AI to analyze spoken language, providing instant feedback on crucial aspects like pronunciation, intonation, and fluency, thereby empowering learners to independently refine their speaking skills.

Furthermore, adaptive learning platforms like Rosetta Stone and Duolingo utilize sophisticated AI algorithms to personalize content, dynamically adjust difficulty levels, and create customized learning paths. This personalization is driven by individual learner progress and performance data, ensuring that learners are continuously challenged within their Zone of Proximal Development (ZPD).

Automated writing evaluators also represent a crucial segment of AI-powered scaffolding tools. Grammarly and Turnitin AI, for instance, offer detailed feedback encompassing grammar, spelling, punctuation, style, and even plagiarism detection. More advanced systems can extend their support to suggestions for coherence, organization, and the development of argumentative structure, thereby comprehensively scaffolding the writing process.

Lastly, AI-based translation and transcription applications like DeepL and Microsoft Translator play a supportive role by providing instant translations or transcriptions. While not primary scaffolding tools in the traditional sense, they are invaluable aids for learners in comprehending complex texts or spoken discourse, and can also serve as effective references during language production.

Table 1: AI Tools for ELT Scaffolding: Functionalities and Pedagogical Benefits

AI Tool Category/Example	Key Functionalities	ELT Skills Scaffolds	Theoretical Alignment
Chatbots & Virtual Assistants	Conversational practice, Q&A, sentence construction, vocabulary	Speaking fluency, pragmatic competence, conversational skills	ZPD, Constructivism
Speech Recognition Software	Pronunciation analysis, intonation feedback, fluency assessment	Speaking accuracy, pronunciation, fluency	ZPD, CLT
Adaptive Learning Platforms	Personalized content, adaptive difficulty, customized paths	Vocabulary acquisition, grammar application, reading comprehension	ZPD, Constructivism, CLT
Automated Writing Evaluators	Grammar, spelling, syntax, style, coherence feedback	Writing accuracy, essay structuring, critical thinking	ZPD, Constructivism
AI-based Translation/Transcription	Instant translation, spoken text transcription	Reading comprehension (with assistance), listening comprehension, cross-cultural understanding	CLT

Evaluating AI Tools for Scaffolding in ELT

While the potential of AI in scaffolding is immense, a critical evaluation of these tools remains essential to ensure their effective and ethical integration into English Language Teaching (ELT) practices. Several key criteria guide this evaluation.

Firstly, accuracy is paramount, as the effectiveness of AI tools heavily relies on their precision. In the context of language learning, this translates to reliable performance in understanding and processing diverse accents, dialects, and complex grammatical structures. Inaccuracies, conversely, can lead to learner frustration and, more critically, the reinforcement of errors, undermining the very purpose of scaffolding.

Secondly, the pedagogical value of AI tools must be rigorously assessed. These tools should not merely automate existing tasks but must genuinely enhance pedagogical outcomes. This implies that they should align with sound educational principles and effectively complement human instruction rather than seeking to replace it. Tools demonstrating high pedagogical value will ultimately facilitate deeper learning, foster critical thinking, and contribute significantly to developing communicative competence in learners.

Thirdly, user engagement is a crucial factor for the successful implementation of AI scaffolding tools. Effective tools are inherently engaging and motivating, leveraging features such as gamification, intuitive interactive interfaces, and personalized learning pathways to significantly boost learner participation and retention. Conversely, tools that are difficult to navigate or prove uninspiring are likely to be underutilized, negating their potential benefits.

Fourthly, adaptability is a hallmark of the most effective AI tools. The best systems are highly adaptable to various learning preferences, proficiency levels, and diverse cultural contexts. They possess the capacity to adjust their scaffolding strategies dynamically based on individual learner needs, thereby providing a wide range of targeted support.

Finally, ethical considerations are non-negotiable in the deployment of AI in education. Data privacy is a paramount concern, given that AI systems often collect vast amounts of personal and performance data, necessitating robust security measures and transparent data policies. Algorithmic bias must also be diligently addressed, ensuring that AI tools do not inadvertently perpetuate or create unfair advantages or disadvantages for specific learner groups, which can arise from biases in their training data. Furthermore, maintaining a crucial balance between AI-provided feedback and human facilitation is vital; AI should augment human teaching, enhancing educators' capacity to deliver differentiated instruction without diminishing the essential human connection and nuanced judgment that teachers uniquely provide (Dwivedi et al., 2023; Al-Fahad et al., 2024). To navigate this evolving landscape responsibly, educators must be equipped not only with access to AI-driven tools but also with the critical AI literacy required to evaluate, guide, and adapt these technologies meaningfully within diverse and dynamic educational contexts (El Miri et al., 2025).

Table 2: Ethical Considerations and Mitigation Strategies for AI in ELT

Ethical Challenge	Description/Impact	Mitigation Strategy/Recommendation
Data Privacy	Collection and storage of sensitive learner data, potential misuse, breaches	Robust data encryption, transparent data policies, anonymization, consent mechanisms

Algorithmic Bias	AI reflects biases from training data, leading to unfair or inequitable outcomes	Diverse and representative training data, regular algorithm audits, human oversight, explainable AI
Learner Autonomy	Over-reliance on AI, reduced critical thinking, diminished human interaction	Promote AI literacy, encourage human-AI collaboration, emphasize teacher's role, balance AI with traditional methods
Digital Divide	Unequal access to AI tools due to socio-economic or technological disparities	Ensure equitable access, provide necessary infrastructure, affordable solutions, policy support for digital inclusion
Over-reliance on AI Feedback	Learners might solely depend on AI, hindering development of self-correction	Train learners to critically evaluate AI feedback, integrate human feedback, foster metacognitive skills

CONCLUSION

This paper has comprehensively explored the transformative potential of AI-powered scaffolding in reshaping English Language Teaching (ELT) practices in the digital age. By integrating insights from Sociocultural Theory and the Zone of Proximal Development, Cognitive Load Theory, and Constructivist Learning Theory, we have elucidated how AI systems can provide personalized, adaptive, and highly efficient learning support. The discussion highlighted various AI tools—including chatbots, speech recognition software, adaptive learning platforms, and automated writing evaluators—each offering unique functionalities that enhance different facets of language acquisition. We emphasized that AI's role is not merely supplementary but fundamentally redefines pedagogical approaches by offering real-time adaptive feedback, enabling personalized learning pathways, and fostering engaging multimodal learning environments. Ultimately, AI-powered scaffolding holds immense promise for optimizing cognitive processes, promoting active knowledge construction, and guiding learners through their Zone of Proximal Development more effectively than ever before.

Despite its vast potential, it is imperative to acknowledge the limitations of the current study. As a conceptual paper relying on a synthesis of existing literature and theoretical frameworks, it does not present empirical data or direct observational findings. Consequently, the practical efficacy and specific impact of AI-powered scaffolding tools in diverse real-world ELT contexts, particularly across different learner demographics and educational settings, remain areas requiring further empirical validation. The insights provided herein are based on theoretical alignment and reported functionalities, necessitating rigorous empirical research to confirm their pedagogical effectiveness and address implementation challenges.

Based on this analysis, we offer several recommendations for key stakeholders to maximize the pedagogical potential of AI in ELT. For educators, it is crucial to develop robust AI literacy to critically evaluate, integrate, and adapt AI tools effectively into their teaching practices. Emphasis should be placed on fostering human-AI collaboration, where AI

augments teaching capacity rather than replacing the indispensable role of human teachers in providing nuanced guidance and socio-emotional support. Professional development programs are essential to equip teachers with the skills to leverage AI for differentiated instruction, lesson planning, and formative assessment.

For researchers, future studies should prioritize empirical investigations into the actual impact of AI-powered scaffolding on specific language skills, such as discourse competence and pragmatic understanding, and across diverse learner populations, including those with varying proficiency levels and cultural backgrounds. Studies focusing on the long-term effects of AI integration, the development of optimal human-AI interaction models, and the pedagogical effectiveness of specific AI tool combinations are also warranted.

For policymakers and developers, efforts must be directed towards ensuring equitable access to AI technologies, providing the necessary infrastructure, and developing affordable solutions to mitigate the digital divide. Furthermore, robust ethical guidelines and regulatory frameworks are needed to address critical concerns such as data privacy, algorithmic bias, and learner autonomy. Promoting transparency in AI algorithms and ensuring accountability in their design and deployment are vital to building trust and fostering inclusive learning environments.

Looking ahead, the future of AI in ELT lies not in replacing human teachers but in enhancing their capacity to deliver increasingly differentiated and effective instruction. Collaborative AI—such as intelligent peer feedback platforms and AI-mediated study groups—holds significant promise for scaffolding not only individual learning but also collaborative discourse and intercultural communication (Lee et al., 2023; Al-Smadi et al., 2024). AI-driven analytics can further inform lesson planning, diagnostics, and formative assessment, freeing teachers to focus on communicative interaction and the socio-cultural dimensions of language learning (Gimbert et al., 2024; Zhang & Aslan, 2021). By embracing this paradigm shift responsibly, AI-powered scaffolding can become a transformative force, capable of personalizing, scaling, and sustaining instructional support beyond the confines of traditional classrooms, ultimately enriching the English language learning experience for a global community of learners

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