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FROM APPS TO AI: HOW DIGITAL TOOLS ARE RESHAPING LANGUAGE INSTRUCTION IN PRIMARY SCHOOLS

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Abstract: *The integration of digital tools into primary-level language instruction has emerged as a transformative force in 21st-century education. This systematic literature review explores how digital technologies—particularly artificial intelligence (AI), gamified applications, and multimodal literacy platforms—are being utilized to enhance language teaching and learning in primary school settings. Using the PRISMA framework, this study synthesizes findings from 48 empirical studies published between 2021 and 2025, focusing on three central themes: (1) the impact of digital tools on student language proficiency and engagement, (2) challenges and strategies in teacher implementation, and (3) the role of digital pedagogies in supporting linguistically diverse learners. Findings indicate that AI-driven systems and gamified learning environments significantly improve oral expression, writing skills, and learner motivation. However, successful integration is often hindered by limited teacher digital competence, infrastructural constraints, and misalignment between tool design and pedagogical goals. The review also highlights the potential of digital tools such as e-blogs, interactive platforms, and speech recognition systems in promoting inclusive and equitable literacy development, particularly for underserved and multilingual students. This review underscores the need for comprehensive teacher training, institutional support, and policy frameworks that facilitate meaningful and equitable use of digital tools in early language education. By identifying current trends, persistent challenges, and future directions, the study contributes valuable insights for educators, researchers, and policymakers aiming to harness technology for more effective and inclusive language instruction at the primary level.*

Keywords: *Digital tools, language teaching, primary education, AI, gamification, systematic literature review*

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Introduction

The integration of digital tools in language teaching has emerged as a transformative force in 21st-century education. In response to global shifts toward digitization, particularly intensified by the COVID-19 pandemic, educators are reimagining instructional strategies to promote engagement, accessibility, and learner autonomy. Language education, especially at the primary level, has become a focal point for the adoption of technology-enhanced pedagogies that support students' cognitive, linguistic, and digital development. These shifts are not merely about substituting traditional materials with digital alternatives; rather, they reflect a pedagogical evolution grounded in interactive learning, gamification, and student-centered approaches (Al-Harbi & Madini, 2024; Almukhanbet et al., 2025; Mondal, 2025b). Globally, statistics indicate a rapid expansion of digital adoption in schools. For example, UNESCO (2023) reported that over 90% of schools in OECD countries now integrate at least one form of digital learning platform into their curriculum, while in Southeast Asia, more than 68% of primary schools have adopted blended or fully online approaches post-pandemic. In Malaysia, the Ministry of Education's *Digital Education Learning Initiative* (2022) revealed that almost 80% of schools nationwide had implemented Google Classroom, Microsoft Teams, or equivalent platforms as their primary digital learning environments. Such statistics underscore the accelerated momentum in digital adoption, particularly at the foundational stages of schooling.

Primary education represents a critical stage where early exposure to digital tools can cultivate essential language skills, critical thinking, and digital literacy. Tools such as digital game-based learning (DGBL), web 2.0 platforms, virtual reality, and mobile-assisted language learning (MALL) have shown promise in enhancing instruction and learner motivation. For instance, the use of gamified environments in English as a Foreign Language (EFL) classrooms has reportedly improved student-teacher interaction and language acquisition, particularly in Saudi Arabian primary schools (Al-Harbi & Madini, 2024). In Malaysia, elective courses integrating digital tools have strengthened students' critical thinking and communication abilities (Almukhanbet et al., 2025), while cross-cultural programs and collaborative online platforms have facilitated intercultural communication among learners (Sandy et al., 2025; Şenel, 2025). Additionally, studies highlight the effectiveness of virtual environments and smartphone-based language learning apps in promoting grammar acquisition, vocabulary retention, and learner autonomy (Hardy-Abeloos et al., 2025; Mondal, 2025; Sack et al., 2025).

Moreover, the perspectives of teachers play a crucial role in the successful implementation of digital tools. While some educators demonstrate technological fluency and actively engage with digital pedagogies, others encounter challenges related to ICT proficiency, resource constraints, or mismatches between tool functionalities and learning outcomes (Nguyen & Sit, 2025; Saal et al., 2025; Shruthi et al., 2025). Teachers' attitudes, perceived usefulness, and the availability of supportive policies influence their willingness to integrate such tools into their teaching practices. In contexts like South Africa and Vietnam, external variables such as language barriers, infrastructure limitations, and the digital divide further complicate the adoption process (Nguyen & Sit, 2025; Saal et al., 2025). The academic discourse surrounding digital tool integration in language teaching has expanded rapidly, yet there remains a lack of comprehensive synthesis focused specifically on primary education. Most existing research is dispersed across various educational levels, tool types, and regional settings. A systematic review is therefore needed to consolidate findings, identify gaps, and evaluate emerging trends in digital pedagogy for young learners.

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Literature Review

The increasing integration of digital tools into primary language education has reshaped how teachers and learners interact with content, technology, and each other. These tools, ranging from digital games and e-books to artificial intelligence (AI) chatbots and immersive technologies, serve not only to enhance instructional delivery but also to engage learners, individualize learning, and promote key language competencies. A growing body of research demonstrates that digital tools can contribute meaningfully to language development, particularly in the context of English as a Foreign Language (EFL) and early literacy education. However, this integration is not without its challenges, especially concerning teacher readiness, infrastructure, and learner diversity. One key trend in recent studies is the use of digital games to enhance vocabulary, reduce language anxiety, and support language acquisition in immersive contexts. Research on primary students experiencing Foreign Language Anxiety (FLA) found that high-anxiety learners benefitted significantly from digital game-based learning (DGBL), achieving improved vocabulary retention post-intervention (Zhou et al., 2025). Similarly, the incorporation of Minecraft into Sámi language education offered both linguistic and cultural benefits. It supported indigenous language use, emphasized culturally relevant content, and provided insights into teacher preparation for digital competency (Usmani et al., 2025). Complementing this, gamification in health and education was explored in the adaptation of the Gameful Experience Scale (GAMEX) to Turkish. The study confirmed its validity and reliability, offering a tool that can be adapted to evaluate engagement in digital environments, including primary education contexts (Føreland & Äärelä-Vihriälä, 2024). Furthermore, a study using AI-driven ChatGPT counseling interventions among cancer patients showed significant reductions in anxiety and depression, reinforcing the broader applicability of large language models (LLMs) as supportive tools—even within emotionally intense learning or information-processing environments (Shannaq, 2025). ChatGPT's potential has also been evaluated specifically in EFL contexts. Teachers and students in East Java expressed overall positive attitudes toward ChatGPT's ability to enhance language learning experiences. However, concerns about overdependence, language accuracy, and the need for user-friendly interfaces and curriculum alignment were also raised (Akdogan et al., 2025). In parallel, digital storytelling was shown to enhance both speaking and writing competencies. Learners reported improvements in fluency, grammar, and creativity, while teachers highlighted the engaging nature of storytelling in EFL classrooms (Wang et al., 2025).

In addition to games and AI tools, e-books and mobile applications are gaining prominence in primary language learning. For instance, the Epic! e-book app successfully increased reading motivation and comprehension among low-proficiency EFL students. The study emphasized the app's interactive features as key to learner engagement and success (Mondal, 2025a). Similarly, blended learning (BL) was explored in the Bangladeshi context, where English teachers used social media platforms like Facebook Messenger to facilitate communication and support spoken English development. The study highlighted both enthusiasm for BL and the persistent challenges of device access and internet availability (Dobakhti & Mirzamohammadi, 2024). The use of authentic materials in digital contexts also gained attention. In Italian language classes, materials such as advertisements and murals were incorporated into lessons to support real-world communication skills. Students responded positively, indicating that digital representations of authentic content can bridge the gap between classroom learning and real-life application (Limbong et al., 2024). This aligns with another study that examined synchronous online reading, finding strong correlations between digital literacy, higher-order thinking skills (HOTS), and self-regulated learning among Indonesian maritime cadets (Ayre et al., 2024).

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Several studies focused on teacher competencies and digital pedagogy frameworks. A structural equation modeling study from Oman explored how e-learning integration, teaching methods, and active learning strategies contributed to knowledge retention, mediated by personalized learning and cognitive load management. Cultural influences emerged as critical factors, suggesting the need for localized pedagogical strategies (Çömez Ikican et al., 2024). In Vietnam, a trichronous model was proposed for EFL delivery across K–12 contexts. Teachers emphasized the need for varied modalities and professional development to support diverse learning preferences and enhance instructional effectiveness (Lintschinger et al., 2025). A broader lens was applied in studies related to health and digital equity, which, although not focused solely on language teaching, offer insights into accessibility and engagement with digital tools. For example, an AI-powered Health Literacy Editor significantly improved the clarity and readability of written health information, suggesting potential for similar applications in language education for simplifying texts and supporting reading comprehension (Fang et al., 2025). Studies on patient portals among linguistically diverse populations, including Limited English Proficient (LEP) Latino and Chinese groups, identified digital disparities and underscored the importance of tailoring interfaces and content to language minorities (Ali et al., 2024; Slamet, 2024).

Data-driven educational modeling is also shaping the future of language technology. A GRU (Gated Recurrent Unit) model with self-attention mechanisms was used to predict student performance in ICT-enabled education, achieving high accuracy and suggesting possibilities for personalized learning pathways in language classrooms (Chen, 2025). Similarly, autoregressive knowledge tracing models have been applied to student learning sequences to predict performance more accurately and adaptively support learners' needs (Tan et al., 2025). Digital storytelling's role in enhancing linguistic and affective learning outcomes was further corroborated in mixed-method studies. Students reported improvements in both speaking confidence and grammatical accuracy, while technical limitations and infrastructure were cited as implementation barriers (Wang et al., 2025). Meanwhile, digital health navigator studies reinforced the value of culturally competent facilitators in supporting digital tool adoption—echoing the importance of teacher digital literacy and cultural responsiveness in primary classrooms (Gordon et al., 2025). Lastly, early childhood and preschool language education are increasingly influenced by mobile apps and digital platforms. A social semiotic analysis of English learning apps in China compared promotional discourses and teacher perspectives. The findings highlighted tensions between affordability and professionalism, pointing to broader issues of quality, equity, and teacher roles in the digital age (Piri & Gjinali, 2025). Similarly, studies exploring ICT use among university students found that learners favored hybrid approaches combining face-to-face and online instruction, with notable differences based on students' academic backgrounds and digital access (Ashish & Anitha, 2025).

Research Questions

Accordingly, this paper aims to address this gap by analyzing recent studies on digital tools used in language instruction, with particular emphasis on pedagogical outcomes, teacher perceptions, and learner engagement in primary school contexts. Specifically, the following research objectives guide this review:

1. To explore what digital tools and AI applications are being used in primary language classrooms and how they contribute to students' language proficiency, engagement, and motivation.

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2. To understand the challenges teachers face when integrating digital tools in language instruction and to identify effective strategies and support systems that facilitate successful implementation.
3. To examine how digital tools affect student engagement, reading comprehension, and writing skills, particularly for linguistically diverse and underserved learners.

By critically evaluating the current landscape, this review contributes to a deeper understanding of how digital innovations are reshaping early language education. It offers valuable insights for researchers, practitioners, and policymakers seeking to design effective, inclusive, and forward-thinking educational strategies.

Methodology

This study adopts the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework to ensure methodological rigor and transparency in conducting a systematic literature review. The PRISMA guidelines provide a structured approach to identifying, screening, and selecting relevant studies, assessing their quality, and synthesizing findings. Following this framework, the research process was divided into four main stages: Identification, Screening, Eligibility Assessment, and Data Abstraction and Analysis. Each stage followed predefined inclusion and exclusion criteria to ensure relevance, reliability, and alignment with the research objectives.

Identification

To identify relevant studies, a comprehensive search strategy was implemented using academic databases such as Scopus and Web of Science (WoS). Keywords and Boolean operators were carefully selected to capture the breadth of literature related to digital tool integration in primary language education. These keywords included terms such as *"digital tools," "language teaching," "primary education," "ICT integration," "AI in education," "gamification,"* and *"e-learning."* Search strings were constructed using combinations of these terms, ensuring coverage across various disciplines including education, computer science, psychology, and social sciences. Table 1 presents the exact search strings used for each database.

Table 1. Search Strings Used for Systematic Review

Source	Search String
Scopus	TITLE-ABS-KEY(("digital tool*" OR "ICT" OR "technology") AND ("language teach*" OR "English learning") AND ("primary school*" OR "elementary education")) AND (LIMIT-TO(SUBJAREA, "EDUC") OR LIMIT-TO(SUBJAREA, "SOCI") OR LIMIT-TO(SUBJAREA, "PSYC") OR LIMIT-TO(SUBJAREA, "COMP") OR LIMIT-TO(SUBJAREA, "MATH") OR LIMIT-TO(SUBJAREA, "ARTS")) AND (LIMIT-TO(PUBYEAR, 2021) OR LIMIT-TO(PUBYEAR, 2022) OR LIMIT-TO(PUBYEAR, 2023) OR LIMIT-TO(PUBYEAR, 2024)) OR LIMIT-TO(PUBYEAR, 2025)) AND (LIMIT-TO(LANGUAGE, "English")) AND (LIMIT-TO(DOCTYPE, "ar")) AND (LIMIT-TO(SRCTYPE, "j")) AND (LIMIT-TO(PUBSTAGE, "final"))
Web of Science	(("digital tool*" OR ICT OR technology) AND ("language teaching" OR "English learning") AND ("primary school*" OR "elementary education")) (Topic) AND Article (Document Types) AND English (Languages) AND (2021

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	OR 2022 OR 2023 OR 2024 OR 2025) (Publication Years) AND (Education OR Social Sciences OR Computer Science OR Psychology OR Arts & Humanities) (Research Areas)

These search strategies yielded a total of 496 publications during the initial phase of the systematic review.

Screening

During the screening phase, duplicate records were first removed, followed by a thorough evaluation of titles and abstracts to assess relevance. The inclusion criteria were:

1. Focus on integration of digital tools in formal language teaching contexts at the primary level.
2. Presentation of empirical data (qualitative, quantitative, or mixed methods).
3. Publication date between 2021 and 2025.
4. Written in English.
5. Published in peer-reviewed journals indexed by Scopus, Web of Science (WoS), or ERIC.

Exclusion criteria included non-empirical publications (opinion pieces, editorials), inaccessible full texts, studies marginally related to language teaching, or research outside primary education. After removing 41 duplicates and excluding 297 studies at the title/abstract stage, 229 articles were retained for full-text review.

Table 2. Inclusion and Exclusion Criteria

Criterion	Inclusion	Exclusion
Language	English	Non-English
Timeframe	2021–2025	Published before 2021
Literature Type	Peer-reviewed journal articles	Books, reviews, conference proceedings, editorials
Publication Stage	Final published version	In press or unpublished manuscripts
Subject Area	Education, language learning, ICT, AI, digital pedagogy, primary education	Other unrelated disciplines
Population Focus	Studies involving primary school learners or teachers	Secondary, tertiary, or adult-focused studies

After applying these criteria, 270 papers were retained for full-text analysis.

Eligibility

In this phase, the 229 full-text articles were carefully reviewed. Articles were excluded if they lacked empirical data, were unrelated to primary language teaching, or addressed ICT use without pedagogical focus. After this rigorous process, 48 empirical studies were deemed eligible for inclusion in the final synthesis.

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Data Abstraction and Analysis

A qualitative thematic analysis was conducted on the final pool of 48 studies. Key data points extracted included:

- Study context (e.g., country, school type).
- Participant characteristics (students, teachers, sample size).
- Type of digital tool (e.g., game-based learning, AI, VR, MALL).
- Implementation strategy (in-class, online, hybrid).
- Primary outcomes (language proficiency, motivation, digital literacy).

Coding Procedure:

1. Two researchers independently performed open coding on the extracted findings.
2. Codes were compared, and similar codes were grouped into broader axial categories.
3. Categories were refined through iterative selective coding to identify overarching themes (e.g., "student engagement," "pedagogical innovation," "challenges and barriers").
4. The process was inductive, allowing themes to emerge from the data rather than being pre-imposed.

Inter-Rater Reliability:

- To ensure coding reliability, the two coders independently coded a 20% random sample of the studies.
- Inter-rater reliability was assessed using Cohen's Kappa (κ). A value of 0.82 was obtained, indicating strong agreement (Landis & Koch, 1977).
- Any discrepancies were resolved through discussion and consensus. Where disagreements persisted, a third expert coder was consulted.
- Following reconciliation, the coding framework was finalized and applied consistently across all studies.

Expert Validation:

To enhance validity, two subject-matter experts in digital pedagogy and primary language education reviewed the coding scheme and thematic structure. Their feedback informed refinements to theme definitions, ensuring alignment with both theoretical and practical dimensions of digital tool integration. This rigorous, multi-layered approach ensured that the findings were trustworthy, transparent, and replicable, addressing both methodological reliability and content validity.

The overall process of article identification, screening, eligibility assessment, and inclusion is summarized in the PRISMA flow diagram (Figure 1).

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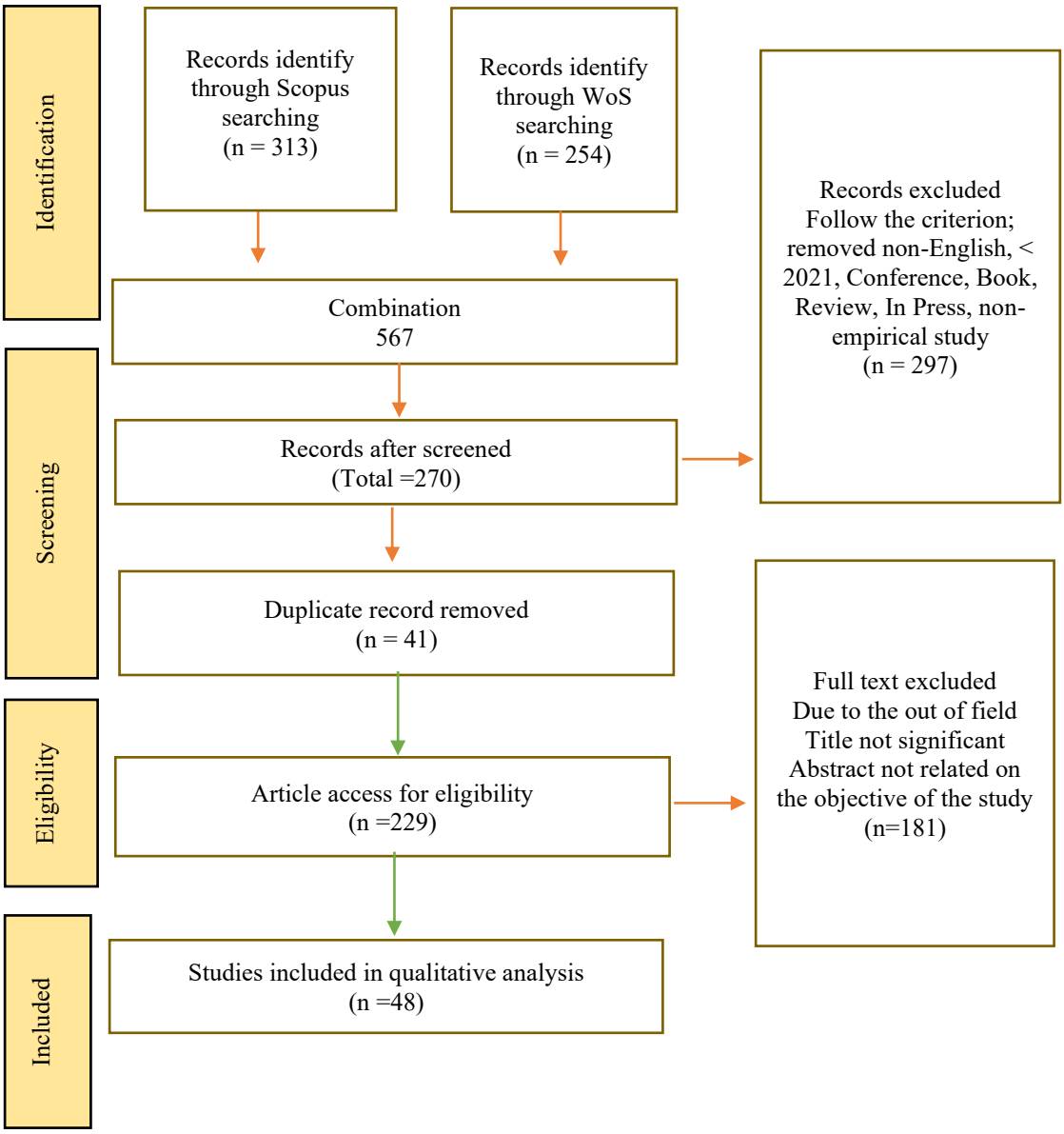

Figure 1. Flow diagram of the proposed searching study (Moher et al., 2009)

Results and Findings

Theme 1: Enhancing Language Learning through Digital Tools and AI Integration

Digital tools, particularly those leveraging artificial intelligence (AI), have significantly transformed language teaching in primary education. The integration of discrete speech units for child-centered AI applications has demonstrated promising outcomes in preserving children's privacy while maintaining the efficacy of Automatic Speech Recognition (ASR) systems (Dutta et al., 2025). These ASR models, trained on datasets like My Science Tutor Children's Conversational Speech Corpus (MyST), achieve a word error rate (WER) of 15.7%, comparable to state-of-the-art end-to-end models despite their smaller size and faster training time (Dutta et al., 2025). This highlights the potential of lightweight, privacy-preserving AI tools in supporting young learners' language development without compromising data security. In another study, an AI-powered application was developed and implemented over 16 weeks to enhance the oral expression skills of 40 fifth-grade students. The results revealed significant

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improvements in pronunciation, fluency, and conversation skills, alongside increased student motivation and adaptability to individual learning needs (López-Minotta et al., 2025). This underscores the effectiveness of AI-driven tools in personalizing language instruction and fostering learner engagement. Similarly, generative artificial intelligence (GAI) has shown remarkable potential in educational settings, particularly in personalized learning and adaptive assessment. However, challenges such as domain knowledge comprehension and equitable access to technology persist, emphasizing the need for collaborative efforts between educators and researchers to harness GAI's full potential (Lang et al., 2025).

The use of interactive app-based games in bilingual Physical Education (PE) settings has also demonstrated dual benefits in enhancing English proficiency and promoting sustainable learning practices. A mixed-methods approach involving 120 elementary school students showed statistically significant improvements in both language acquisition and PE conceptual understanding, highlighting how gamified digital tools can support interdisciplinary learning while aligning with global sustainability goals (Sumardiyani & Ambarini, 2025). Additionally, the Remote Adult Language Experiment (ReAL-E) tool, which measures communication abilities in adults through online speech and language tasks, offers scalable solutions for assessing language skills across different age groups. While primarily designed for adult populations, ReAL-E's methodology provides insights into developing similar tools for younger learners, expanding the scope of digital assessments in language education (Lancaster et al., 2025). Moreover, innovative approaches to formative writing assessment using AI-enhanced systems have emerged as valuable tools for improving student writing competency. In Morocco, an Interactive Curves Graph system combined automated analysis with stakeholder engagement to provide objective, real-time feedback to 190 students across seven classes. Teachers found that the system enhanced pattern detection, supported multi-directional communication, and improved pedagogical decision-making (Es-Sarghini & Boumahdi, 2025). This demonstrates the capacity of AI-integrated platforms to facilitate more accurate and responsive writing instruction tailored to individual student needs.

Furthermore, studies have explored the integration of multimodal literacy practices using digital tools to support emergent bilinguals in English-only classrooms. Over the course of a year, eight young children used digital ensembles—such as images, videos, and audio recordings—to express their comprehension of picturebooks. The findings revealed that these students actively transformed available digital resources to make meaning, suggesting that multimodal approaches can empower linguistically diverse learners by providing multiple avenues for expression and interpretation (Brown et al., 2025).

Theme 2: Challenges and Strategies in Digital Pedagogy Implementation

Despite the promise of digital tools, their implementation in primary education is often accompanied by pedagogical and technological challenges. For instance, automatic essay scoring (AES) systems face difficulties in cross-prompt scoring due to the variability in writing styles and prompt-specific requirements. To address this, the Enhanced Prompt-aware Cross-prompt Essay Trait Scoring (EPCTS) model was introduced, integrating part-of-speech (POS) features and syntactic analysis to improve scoring consistency and generalization capabilities. EPCTS achieved state-of-the-art performance, particularly under low-resource conditions, demonstrating its potential to support educators in efficiently evaluating written work (Xu et al., 2025).

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Moreover, the transition to online teaching during the COVID-19 pandemic exposed gaps in digital competence among French language teachers at Algerian universities. Teachers faced challenges such as unfamiliarity with digital platforms, connectivity issues, and declining student motivation. Despite these hurdles, they exhibited resilience by adopting social media, videoconferencing, and teleworking tools to maintain instructional continuity (Benabbes et al., 2025). This highlights the importance of teacher adaptability and the necessity for institutional support in facilitating effective digital transitions. Similarly, Arabic-speaking immigrant and refugee older adults in Canada encountered digital barriers that constrained their ability to engage with ICTs independently. The study emphasized the role of smartphones as critical tools for enhancing digital agency and social connectedness, underscoring the need for tailored digital literacy programs that cater to diverse user needs (Salma et al., 2025). Intercultural competence and digital literacy integration in foreign language teaching within Spanish universities revealed that while digital tools are widely used, they are often disconnected from intercultural components (Bobadilla-Pérez et al., 2025). Most programs prioritize linguistic proficiency and soft skills like empathy but fail to fully integrate technology with intercultural frameworks (Bobadilla-Pérez et al., 2025). This suggests a gap in preparing future educators to utilize digital resources effectively for fostering inclusive and culturally responsive classrooms. Furthermore, studies on bilingual education in physical education contexts indicate that while app-based games can promote language acquisition, their success depends on careful alignment with curriculum goals and pedagogical strategies. Therefore, strategic planning and continuous professional development for educators are essential to maximize the benefits of digital integration (Sumardiyani & Ambarini, 2025).

Additionally, research in the UK highlighted the widespread use of digital tools in second language classrooms, yet evaluations indicated varying levels of adherence to established language learning principles. Although 89% of surveyed teachers reported using digital devices, only a fraction ensured that software supported key aspects like output generation and social interaction. This discrepancy suggests a need for better alignment between digital tool design and pedagogical best practices to ensure that technology enhances rather than hinders language acquisition (Janjić & Coventry, 2025). A separate study in China examined how primary and secondary school English as a Foreign Language (EFL) teachers utilized digital bridging initiatives—strategies that link in-class and out-of-class learning experiences through technology. Two dimensions were identified: inward bridging (using digital tools to reinforce classroom content) and outward bridging (connecting classroom learning to students' digital lives outside school). Factor analyses revealed that teachers' awareness of students' out-of-class digital behaviors strongly influenced their outward bridging practices, highlighting the importance of contextual sensitivity in digital pedagogy. Moreover, school culture and educator identity beliefs played mediating roles, indicating that systemic support and teacher self-perception are crucial for successful digital integration (Lai & Shi, 2025).

Theme 3: Impact of Digital Tools on Student Engagement and Literacy Development

Digital tools have been instrumental in improving student engagement, reading comprehension, and writing skills across various educational contexts. An integrative approach combining information and communication technology (ICT) with reading instruction has shown positive effects on students' digital literacy and reading comprehension. A study involving 400 elementary school students found that the use of ICT-enhanced reading strategies led to improved comprehension and enthusiasm, suggesting that technology can serve as a catalyst for more interactive and meaningful literacy experiences (Hamsiah & Lutfin, 2024). Similarly, electronic blogs were found to enhance writing expression skills among primary school pupils

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in Jordan, with statistically significant improvements observed regardless of gender. This indicates that digital writing platforms can foster inclusive learning environments where all students benefit equally from enhanced feedback mechanisms and peer interaction (Al-Barakat et al., 2025). Visual literacy strategies, when integrated into traditional curricula, have also demonstrated cognitive benefits such as improved problem-solving and vocabulary acquisition. In West Bengal, India, the use of flashcards, picture books, and ICT applications contributed to higher engagement and reduced anxiety in second language acquisition, particularly for English learners (Dey & Munshi, 2025). These findings support the notion that multimodal approaches can make language learning more accessible and enjoyable for young learners. Additionally, the T-Shape Literacy Model, which encourages close reading and literary analysis using digital tools, has shown large effect sizes in improving metalinguistic knowledge and creative writing among students from low socio-economic backgrounds. This model illustrates how structured digital interventions can bridge educational disparities and empower historically underserved populations (Wilson et al., 2024).

Moreover, a pilot intervention in New Zealand schools demonstrated that the T-Shape Literacy Model significantly improved students' ability to analyze literary texts and identify language features. Nine teachers working with Year 5–8 students employed digital tools to explore how authors use language to create mood and atmosphere. The results showed large effect sizes in researcher-designed assessments, particularly in close reading and language feature identification. Students in the intervention group outperformed control group peers in standardized writing tests, although no significant differences were observed in reading comprehension (Wilson et al., 2024). This suggests that digital literacy models can be particularly effective in developing expressive language skills and metalinguistic awareness, even if broader reading comprehension gains require additional scaffolding. Further evidence of the impact of digital tools comes from a study in Jordan that investigated the use of e-blogs for writing instruction. The experimental group, taught using blog-based methods, showed statistically significant improvements in writing expression compared to the control group. Importantly, the effectiveness of e-blogs was consistent across genders, reinforcing the idea that digital writing platforms can support equitable learning opportunities. The study recommended expanding access to digital tools in public schools to ensure that all students can benefit from technology-enhanced writing instruction (Al-Barakat et al., 2025).

Finally, a systematic review of digital clinical skills teaching in medical education found that digital tools not only maintained but sometimes surpassed the effectiveness of traditional in-person instruction. Meta-analysis showed a mean difference increase of 1.93 in assessment scores for digital learning compared to conventional methods, despite high statistical heterogeneity. Student satisfaction was generally higher with digital formats, and one study noted cost-effectiveness advantages. These findings suggest that well-designed digital tools can be powerful enhancers of skill acquisition and engagement, especially when blended with traditional methods to provide a comprehensive learning experience (McGee et al., 2024). Collectively, these findings demonstrate that well-implemented digital tools can significantly enhance literacy development, provided that they are thoughtfully integrated into pedagogical practices and supported by appropriate teacher training and institutional frameworks.

Conclusion

The integration of digital tools into primary language education has demonstrated substantial potential to transform how young learners acquire and engage with language. Emerging technologies such as artificial intelligence, gamified learning platforms, and multimodal

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literacy strategies have made instruction more interactive, personalized, and student-centred, leading to improvements in oral expression, writing proficiency and overall language development through adaptive feedback and enhanced motivation. Gamified and app-based approaches further support interdisciplinary learning and sustained engagement, yet their successful implementation is often constrained by limited teacher digital competence, infrastructural barriers, and mismatches between tool capabilities and pedagogical goals. Addressing these challenges demands comprehensive teacher training, robust institutional support and policy frameworks that ensure equitable access to digital resources. Moreover, while tools like e-blogs, visual literacy aids and interactive platforms have proved effective especially for linguistically diverse learners their impact depends on thoughtful curricular integration and adherence to learner-centred pedagogies. Ultimately, digital tools hold transformative promise for redefining primary-level language instruction, but realising this potential requires sustained investment in professional development, infrastructure and research-informed design to achieve inclusive and lasting educational outcomes.

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