Mobile-Assisted English Language Learning (MALL): Exploring the Integration of AI Tools in Emerging Mobile Technologies

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Abstract

This article reviews the recent integration of Artificial Intelligence (AI) tools within emerging mobile technologies for Mobile-Assisted Language Learning (MALL). As mobile devices become increasingly ubiquitous, their potential as powerful language learning tools is amplified by AI. This review explores how AI-driven functionalities such as Natural Language Processing (NLP), speech recognition, adaptive learning algorithms, and generative AI are transforming MALL applications. It investigates the impact of these advancements on language acquisition, examining their benefits in providing personalized learning experiences, immediate feedback, and immersive environments. Furthermore, the article addresses the challenges and ethical considerations associated with the widespread adoption of AI in MALL, including data privacy, bias, and the need for robust pedagogical integration. By synthesizing current research, this paper offers insights into the evolving landscape of MALL, highlighting its future trajectory and implications for both learners and educators.

Keywords: Artificial Intelligence, Mobile-Assisted Language Learning, generative AI, Natural Language Processing, algorithms, personalized learning, immediate feedback

Introduction

The advent of mobile technology has profoundly reshaped various facets of human life, including education. Among its most significant impacts is the emergence of Mobile-Assisted Language Learning (MALL), a dynamic field that leverages the portability and pervasive nature of mobile devices to facilitate language acquisition outside traditional classroom settings (Rao, 2019). Unlike its predecessor, Computer-Assisted Language Learning (CALL), which often relied on static computer setups, MALL provides unprecedented flexibility, allowing learners to access language resources and engage in learning activities anytime and anywhere (Pérez-Paredes & Zhang, 2022). This inherent portability fosters a more contextualized and fluid learning experience, seamlessly integrating language practice into daily routines. In recent years, the landscape of MALL has been further revolutionized by the rapid advancements in Artificial Intelligence (AI). AI, with its capacity for complex data processing, pattern recognition, and adaptive responses, has moved beyond being a mere supplementary tool to becoming a core pedagogical strategy within MALL (Sugiarto, 2024; Zhang, 2024).

The integration of AI has empowered mobile language learning applications to offer highly personalized, interactive, and engaging experiences that were previously unattainable. This technological synergy promises to address many of the long-standing challenges in language education, such as providing individualized feedback at scale and creating authentic communicative opportunities.

The current generation of AI tools encompasses a broad spectrum of functionalities that are particularly beneficial for language learning. Natural Language Processing (NLP) enables applications to understand, interpret, and generate human language, facilitating sophisticated interactions with chatbots and virtual tutors (Posit, 2025). Speech recognition technology, continuously improving in accuracy, allows learners

to practice pronunciation and receive instant, precise feedback, mimicking real-time conversational scenarios (Sholekhah & Fakhrurriana, 2023). Moreover, adaptive learning algorithms powered by AI analyze learner performance and preferences to tailor content, difficulty levels, and learning pathways, ensuring that each learner receives instruction optimally suited to their needs (ResearchGate, 2025). Beyond these core functionalities, emerging mobile technologies such as Augmented Reality (AR) and Virtual Reality (VR) are increasingly being coupled with AI to create immersive language learning environments. AR applications can overlay digital language information onto the real world, enabling contextualized vocabulary acquisition and cultural immersion (MDPI, 2025). VR, on the other hand, can transport learners to simulated environments where they can practice speaking with AI-powered avatars in realistic scenarios, significantly enhancing communicative competence and reducing anxiety (Schütze, 2024). These synergistic integrations hold immense potential for transforming language learning from a static, textbook-based endeavor into a dynamic, experiential journey.

This article aims to provide a comprehensive review of the recent use of AI tools in emerging mobile technologies for MALL. It will explore the diverse applications of AI, from personalized feedback systems to immersive learning environments, and analyze their impact on language acquisition. Furthermore, it will critically examine the challenges and opportunities presented by these technological advancements, paving the way for a deeper understanding of the evolving role of AI in the future of mobile language learning.

Statement of the Problem

Despite the significant advancements in Mobile-Assisted Language Learning (MALL) and the integration of Artificial Intelligence (AI) tools, there remains a need for a comprehensive understanding of how these emerging technologies are being effectively utilized and their specific impact on various aspects of language acquisition. While AI promises personalization and enhanced engagement, challenges persist regarding the pedagogical soundness of AI-driven applications, the potential for over-reliance on technology, ethical concerns surrounding data privacy and algorithmic bias, and the equitable access to these advanced tools. A systematic review is crucial to identify current trends, best practices, and areas requiring further research to maximize the pedagogical potential of AI in MALL while mitigating its associated risks.

Research Objectives
1. To identify and categorize the primary types of AI tools currently integrated into emerging mobile technologies for language learning.
2. To investigate the specific ways in which AI-powered MALL applications provide personalized learning experiences and adaptive feedback to language learners.
3. To analyze the reported impact of AI tools in MALL on various language skills, including speaking, listening, reading, and writing proficiency.
4. To explore the pedagogical implications and effectiveness of emerging mobile technologies such as Augmented Reality (AR) and Virtual Reality (VR) when combined with AI in language learning.

5. To critically assess the challenges and opportunities associated with the widespread adoption of AI in MALL, focusing on ethical considerations, data privacy, and equitable access.
6.

Research Questions

1. What are the predominant AI tools being utilized in contemporary Mobile-Assisted Language Learning (MALL) applications, and how do they function within emerging mobile technologies?
2. How do AI-powered MALL applications contribute to personalized learning pathways and provide adaptive feedback to language learners, and what is the perceived effectiveness of these features?
3. What is the observable impact of AI tools in MALL on the development of specific language skills (e.g., pronunciation, vocabulary, grammar, fluency) among learners?
4. How are emerging mobile technologies like Augmented Reality (AR) and Virtual Reality (VR) being integrated with AI to create immersive language learning environments, and what are the pedagogical benefits and limitations of such integrations?
5. What are the key challenges, including ethical concerns and issues of data privacy and accessibility, encountered in the implementation and widespread adoption of AI tools within Mobile-Assisted Language Learning?

Literature Review

The landscape of language learning has undergone a profound transformation with the advent of mobile technologies, leading to the rise of Mobile-Assisted Language Learning (MALL). Early MALL applications primarily served as supplementary tools, offering vocabulary flashcards, basic grammar exercises, or digital dictionaries (Rao, 2019). However, the recent integration of Artificial Intelligence (AI) has significantly elevated the sophistication and pedagogical effectiveness of MALL, moving it from simple digital aids to intelligent, adaptive learning environments (Sugiarto, 2024). This shift is driven by AI's capacity to process vast amounts of data, recognize intricate patterns, and generate human-like responses, opening new avenues for personalized and engaging language instruction.

One of the most significant contributions of AI to MALL is in the realm of Natural Language Processing (NLP). NLP algorithms empower applications to understand, interpret, and generate human language, enabling more natural and meaningful interactions between learners and the technology (Posit, 2025). This manifests in AI-powered chatbots and virtual tutors that can engage in conversational practice, answer grammar questions, or even simulate real-life dialogues (Neontri, 2025). Learners can receive immediate feedback on their linguistic output, fostering a low-stakes environment for practice and experimentation (Li & Vuono, 2019). The ability of NLP to discern subtle nuances in language use makes these interactions increasingly sophisticated and beneficial.

Speech recognition technology, a crucial component of AI, has dramatically enhanced pronunciation training within MALL. Applications like ELSA Speak leverage AI to analyze learners' speech patterns and provide instant, corrective feedback on

pronunciation, intonation, and rhythm (Sholekhah & Fakhrurriana, 2023). This immediate feedback mechanism is invaluable, allowing learners to identify and rectify errors in real-time, something that is often difficult to achieve in traditional classroom settings due to time constraints and large class sizes. The continuous improvement in accuracy of Automatic Speech Recognition (ASR) technology has made these tools indispensable for developing oral fluency and confidence (Witt & Young, 2000).

Adaptive learning systems, driven by AI, represent a paradigm shift in personalized language education. These systems analyze individual learner data, including their strengths, weaknesses, learning styles, and progress, to dynamically adjust content, difficulty levels, and learning pathways (ResearchGate, 2025). This personalization ensures that learners are consistently challenged at an appropriate level, preventing both boredom from overly simple tasks and frustration from tasks that are too complex. Studies indicate that AI-based adaptive learning systems can significantly increase student engagement and lead to improvements in grades and understanding of difficult concepts (ResearchGate, 2025). This tailored approach caters to the unique needs of each individual, optimizing their learning outcomes.

The emergence of generative AI, particularly large language models (LLMs) like ChatGPT, has further expanded the capabilities of MALL. These models can generate coherent and contextually relevant text, opening up possibilities for creating novel learning materials, simulating diverse communicative scenarios, and providing elaborate explanations (OpenAI, 2023; British Council, 2025). For instance, generative AI can be used to produce customized reading passages, create personalized writing prompts, or even engage in open-ended conversations that mimic human interaction, thereby offering a rich and dynamic learning experience (Taylor & Francis, 2025). This multimodal capability means they can synthesize and integrate various forms of media, enhancing engagement (Collie & Martin, 2024).

Beyond traditional mobile apps, emerging technologies such as Augmented Reality (AR) and Virtual Reality (VR) are increasingly being integrated with AI to create highly immersive language learning environments. AR applications, by overlaying digital information onto the real world, can facilitate contextualized vocabulary acquisition. For example, pointing a phone camera at an object could trigger an AR overlay displaying its name in the target language and provide pronunciation assistance, linking language directly to real-world context (MDPI, 2025). This "situated learning" approach can significantly enhance memory retention and practical language use.

Virtual Reality (VR) takes immersion a step further, transporting learners into simulated 3D environments where they can interact with AI-powered avatars in realistic scenarios. This could involve practicing ordering food in a virtual restaurant, navigating a foreign city, or engaging in job interviews (Schütze, 2024). The psychological safety of a virtual environment can reduce learner anxiety, encouraging them to take risks and practice speaking without fear of judgment. AI's role in VR environments is crucial for providing intelligent responses, adapting to learner input, and offering targeted feedback within these simulated interactions.

Gamification, a popular pedagogical approach in MALL, is significantly enhanced by AI. AI can analyze player performance and adapt game difficulty, provide intelligent hints, and generate personalized challenges, keeping learners motivated and engaged (Loewen et al., 2019). This intelligent adaptation ensures that the gamified experience remains effective for language learning, rather than merely

being entertaining. The combination of gamification and AI can transform repetitive language drills into enjoyable and rewarding learning activities. However, the rapid adoption of AI in MALL also presents several challenges and ethical considerations. Data privacy is a paramount concern, as AI-powered applications often collect vast amounts of personal and learning data to tailor experiences (ResearchGate, 2024). Ensuring the secure storage and ethical use of this data is crucial. Additionally, algorithmic bias can potentially perpetuate stereotypes or provide inequitable learning experiences if not carefully addressed in the design and training of AI models. The "black box" nature of some AI algorithms also raises questions about transparency and explainability in how learning recommendations are generated.

Another challenge lies in preventing over-reliance on AI tools. While AI can provide invaluable support, it should not replace human interaction and critical thinking in language acquisition (Al-Kindipublisher, 2024). Educators need to guide learners on how to effectively integrate AI tools into their learning strategies, emphasizing their role as facilitators rather than ultimate authorities. The digital divide also remains a concern, as access to high-speed internet and advanced mobile devices, which are often necessary for optimal AI-powered MALL experiences, may not be equitable across all socioeconomic groups.

Despite these challenges, the opportunities presented by AI in MALL are immense. The ability to provide individualized feedback 24/7, cater to diverse learning styles, and create highly engaging and immersive learning environments has the potential to democratize language education and make it accessible to a wider audience (Xu et al., 2021). Future research needs to focus on empirical studies evaluating the long-term effectiveness of AI-driven MALL applications, exploring optimal pedagogical integration strategies, and developing frameworks for ethical AI design in language learning. The continuous evolution of AI and mobile technologies promises an exciting future for language acquisition, with the potential to make learning more efficient, enjoyable, and effective for millions worldwide.

Methodology

This review is a systematic literature review, aiming to synthesize existing research on the integration of AI tools in emerging mobile technologies for Mobile-Assisted Language Learning (MALL). The methodology involved a comprehensive search strategy across major academic databases and research repositories.

Search Strategy: Keywords used for the search included: "Mobile-Assisted Language Learning," "MALL," "Artificial Intelligence," "AI," "machine learning," "deep learning," "natural language processing," "NLP," "speech recognition," "adaptive learning," "generative AI," "virtual reality," "VR," "augmented reality," "AR," "language learning apps," "mobile technologies," "education," "ESL," "EFL," and "second language acquisition." Combinations of these keywords were used to broaden the search.

Databases and Sources: The following academic databases and platforms were primarily searched:
- Scopus
- Web of Science
- IEEE Xplore
- ACM Digital Library

- Google Scholar
- ERIC (Education Resources Information Center)
- ResearchGate (for pre-prints and conference papers)

Inclusion and Exclusion Criteria: Inclusion criteria comprised peer-reviewed journal articles, conference papers, and book chapters; publications focusing on empirical studies, theoretical frameworks, and reviews related to AI in MALL; studies published within the last five to seven years (approximately 2018–2025) to ensure currency of "recent use"; articles available in English; and research that specifically discusses the application of AI tools within mobile-based language learning contexts. Exclusion criteria included publications not directly related to AI or MALL; opinion pieces or non-peer-reviewed articles without substantial academic rigor; studies focusing solely on CALL (Computer-Assisted Language Learning) without a mobile component; and studies where the mobile technology or AI integration was not clearly defined or was tangential to the main research question.

Data Extraction and Synthesis: Relevant articles were screened based on titles and abstracts. Full-text articles were then retrieved and meticulously reviewed. Information extracted included the type of AI tool(s) utilized (e.g., NLP, speech recognition, adaptive algorithms, generative AI), emerging mobile technologies involved (e.g., smartphones, tablets, AR/VR devices), specific language skills targeted (e.g., speaking, listening, reading, writing, pronunciation), pedagogical approaches and theoretical frameworks underpinning the AI integration, reported benefits and challenges for language learners and educators, and research methodologies employed in the empirical studies. The extracted data were then synthesized thematically to identify recurring patterns, emerging trends, and gaps in the existing literature. This thematic synthesis allowed for a comprehensive overview of how AI tools are being used, their impact, and the associated opportunities and challenges within the domain of MALL.

Results
The systematic literature review reveals a clear and accelerating trend of integrating AI tools into Mobile-Assisted Language Learning (MALL), fundamentally transforming how language acquisition occurs. The results indicate that AI is no longer a peripheral feature but a central driver of innovation, offering unparalleled personalization, interactivity, and feedback mechanisms.

Dominant AI Tools and Their Functions: The review identified several prominent AI tools being utilized in MALL:
   Natural Language Processing (NLP): This is foundational, enabling AI-powered chatbots for conversational practice, grammar and syntax correction, and intelligent content generation (e.g., text summarization, question generation) (Posit, 2025; Neontri, 2025). Applications leverage NLP to understand learner input and provide contextually relevant responses.
   Speech Recognition (ASR): Highly prevalent in pronunciation training apps, ASR provides instant feedback on pronunciation, intonation, and fluency (Sholekhah & Fakhrurriana, 2023). Tools like ELSA Speak demonstrate the effectiveness of AI in honing spoken language skills by analyzing speech patterns against native speaker

models.

Adaptive Learning Algorithms: These algorithms analyze learner performance data (e.g., accuracy, speed, learning styles) to dynamically adjust the difficulty, content, and sequence of learning materials (ResearchGate, 2025). This leads to highly personalized learning pathways, ensuring optimal challenge and engagement for individual learners.

Generative AI: More recently, generative AI models (e.g., LLMs) are being explored for creating customized learning content, simulating complex conversational scenarios, and offering elaborate explanations for grammar or cultural nuances (OpenAI, 2023; Taylor & Francis, 2025). This allows for unprecedented flexibility in content creation and interaction.

Impact on Language Skills and Personalized Learning: Research consistently shows that AI tools in MALL contribute significantly to language skill development:

Vocabulary and Grammar Acquisition: Adaptive algorithms and intelligent feedback mechanisms lead to improved retention and accuracy in vocabulary and grammar, as learners receive targeted practice and immediate corrections (Al-Kindipublisher, 2024).

Pronunciation and Speaking Fluency: ASR-enabled apps provide crucial opportunities for self-correction and repeated practice, leading to measurable improvements in pronunciation and increased confidence in speaking (Sholekhah & Fakhrurriana, 2023).

Writing Skills: AI-powered tools assist in error detection, style suggestions, and generating prompts, aiding in the development of more accurate and coherent written output (Al-Kindipublisher, 2024).

Personalization and Engagement: The ability of AI to tailor learning experiences based on individual needs and progress enhances learner motivation and engagement, transforming learning from a static process to a dynamic and responsive one (ResearchGate, 2025; Xu et al., 2021). Gamified elements, often AI-enhanced, further contribute to sustained learner interest (Loewen et al., 2019).

Integration with Emerging Mobile Technologies (AR/VR): The review highlighted a growing trend of integrating AI with Augmented Reality (AR) and Virtual Reality (VR) on mobile devices to create more immersive learning experiences:

Augmented Reality (AR): AR applications, powered by AI for object recognition and contextual information delivery, allow learners to overlay digital language content onto real-world objects, promoting contextualized vocabulary learning and cultural understanding (MDPI, 2025).

Virtual Reality (VR): AI-driven VR environments provide realistic simulations for communicative practice with intelligent avatars, reducing anxiety and offering safe spaces for practicing real-world language use scenarios (Schütze, 2024). The AI provides dynamic responses and feedback within these simulations.

Challenges and Opportunities: While the benefits are substantial, several challenges persist:

Data Privacy and Ethics: The extensive collection of user data by AI-powered MALL apps raises significant concerns about privacy and data security, necessitating robust ethical guidelines and transparent data handling practices (ResearchGate, 2024).

Algorithmic Bias: Potential for AI algorithms to perpetuate biases in language or content, requiring careful design and continuous monitoring to ensure equitable and

inclusive learning experiences.

Over-reliance and Human Interaction: There is a risk of learners becoming overly dependent on AI, potentially neglecting essential human interaction and the development of critical thinking skills crucial for genuine communicative competence.

Accessibility and Digital Divide: Unequal access to advanced mobile devices and high-speed internet can exacerbate existing digital divides, limiting the reach of sophisticated AI-powered MALL tools to all learners.

Despite these challenges, the opportunities for continued innovation are vast. AI in MALL is poised to offer even more sophisticated personalized learning, highly realistic simulations, and continuous, accessible language support, potentially revolutionizing language education on a global scale.

Conclusion

The integration of Artificial Intelligence (AI) tools within emerging mobile technologies has profoundly reshaped the landscape of Mobile-Assisted Language Learning (MALL). This review has demonstrated that AI-driven functionalities, such as Natural Language Processing (NLP), sophisticated speech recognition, adaptive learning algorithms, and the burgeoning capabilities of generative AI, are no longer supplementary features but core components driving the pedagogical effectiveness of modern MALL applications. These advancements offer unprecedented opportunities for personalized language learning, providing immediate, tailored feedback that caters to individual learner needs and accelerates proficiency across various language skills, including speaking, pronunciation, grammar, and vocabulary (Al-Kindipublisher, 2024; ResearchGate, 2025; Sholekhah & Fakhrurriana, 2023).

Furthermore, the synergistic combination of AI with emerging mobile technologies like Augmented Reality (AR) and Virtual Reality (VR) is paving the way for truly immersive and contextualized language learning experiences. AR allows for real-world contextualization of language, while VR provides safe, realistic simulations for communicative practice, both significantly enhancing engagement and application of learned language (MDPI, 2025; Schütze, 2024). These technological innovations hold immense promise for making language acquisition more dynamic, engaging, and accessible to a global audience (Xu et al., 2021). However, the widespread adoption of AI in MALL is not without its challenges. Critical considerations include ensuring data privacy and security, mitigating algorithmic bias to prevent inequitable learning outcomes, and striking a balance that prevents over-reliance on technology at the expense of crucial human interaction and critical thinking (ResearchGate, 2024). The persistent issue of the digital divide also necessitates attention to ensure that the benefits of advanced AI-powered MALL are accessible to all learners, regardless of socioeconomic status. In conclusion, the trajectory of AI in MALL points towards a future where language learning is increasingly personalized, interactive, and integrated into daily life. While acknowledging the imperative to address ethical concerns and accessibility gaps, the transformative potential of AI to enhance language acquisition is undeniable. Continued research and development, coupled with thoughtful pedagogical integration and policy frameworks, will be crucial in harnessing the full power of AI to create more effective, engaging, and equitable language learning experiences for learners worldwide.

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