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From Labs to Learning Apps: Analyzing the Evolution and Future of Computer-Assisted Language Learning

Amin Shahini
Department of English Language Teaching, Gorgan Branch, Islamic Azad University, Gorgan, Iran.

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ABSTRACT

The evolution of Computer-Assisted Language Learning (CALL) has transformed language education, integrating advanced technologies and innovative methodologies to enhance linguistic acquisition. This paper explored critical issues in CALL, including learner anxiety, educator preparedness, and inconsistencies in implementation, highlighting the challenges these factors pose to achieving effective outcomes. It examined emerging trends such as augmented reality (AR), gamification, artificial intelligence (AI), and virtual reality (VR), emphasizing their potential to reshape language learning environments through immersive, personalized, and context-rich experiences. Furthermore, the paper underscores the importance of addressing factors influencing reliability and validity in CALL assessments, including test design, administration, and learner characteristics. Drawing on theoretical and empirical insights, it discusses how these advancements align with contemporary pedagogical principles, promoting engagement, motivation, and inclusivity. The study concludes by advocating for a balanced integration of technological tools and sound pedagogical practices, ensuring that CALL continues to adapt to the dynamic needs of globalized, tech-savvy learners while fostering sustainable and effective language education.

KEYWORDS: AI; CALL; Language Learning

INTRODUCTION

Computer-Assisted Language Learning (CALL) represents a dynamic integration of technology and education, reflecting the rapid advances in information and communication technology (ICT) over recent decades. CALL broadly refers to the use of computers and digital platforms to facilitate and enhance language learning and teaching processes. It encompasses diverse instructional strategies that use multimedia resources, interactive applications, and adaptive learning systems for pedagogical purposes. CALL is pivotal in language acquisition, as it not only facilitates access to authentic language materials but also fosters student autonomy by enabling individualized learning paths (Kannan & Munday, 2018). The evolution of CALL began in the 1960s and 1970s with the emergence of early computer-based tools, primarily designed for drilling and practice. These initial systems, such as the PLATO system, introduced structured learning environments focused on grammar and vocabulary acquisition through repetitive exercises. Although innovative for their time, these tools were limited by their simplistic design and lack of interactive and communicative elements, which are crucial for effective language acquisition.

The advent of personal computers in the 1980s and the proliferation of the Internet in the 1990s marked a turning point for CALL. This era shifted the focus from repetitive computer-based exercises to contextualized and interaction-driven methodologies. Multimedia elements, including audio, video, and graphics, became integral to language learning, enhancing learner engagement and simulating real-life communication contexts (Chapelle, 2001). Additionally, the rise of networked environments enabled collaboration across geographical boundaries. Synchronous and asynchronous tools, such as chat rooms and discussion forums, allowed learners to interact flexibly with peers and instructors, further enriching the learning process. In the 21st century, CALL has evolved alongside advances in ICT and a deeper understanding of cognitive and social learning theories. Modern CALL methodologies adopt a holistic approach to language acquisition, emphasizing interaction, engagement, and authenticity. Mobile-Assisted Language Learning (MALL), social media platforms, and game-based environments have emerged as significant tools, offering learners opportunities to practice language skills in

contextually rich scenarios. The integration of artificial intelligence (AI) and adaptive learning systems represents a major innovation, enabling personalized learning experiences tailored to individual needs and preferences (Godwin-Jones, 2018).

Looking to the future, CALL is poised for further transformation. Technologies such as virtual reality (VR) and augmented reality (AR) promise to create immersive environments that replicate real-world scenarios, enhancing communicative competence. Additionally, advancements in data analytics and machine learning could provide valuable insights into student progress and behavior, allowing educators to refine and personalize learning experiences with unprecedented precision. As CALL continues to transcend traditional educational boundaries, its role in shaping the landscape of language learning and teaching remains profoundly significant. By integrating cutting-edge technologies with sound pedagogical principles, CALL is set to redefine language education, making it more interactive, accessible, and effective.

INTEGRATION WITH PEDAGOGY

This era also saw increased research into pedagogical frameworks supporting CALL. Constructivist approaches gained traction, emphasizing meaningful, context-driven learning experiences. Studies began focusing on learner agency and collaboration, shifting the research lens from mere technological tools to the methodologies and strategies that optimized technology-assisted language learning (Shadiev & Yang, 2020). The transition from basic programmed instruction in the 1960s to the dynamic, multimedia-rich environments of the 1990s and beyond reflects a deepening understanding of the interplay between technology and pedagogy. By the 2000s, CALL had moved from text-based programs to internet-enabled platforms and interactive multimedia resources, transforming language learning environments. This evolution fostered greater learner interactivity and engagement through the integration of audio, video, and interactive graphics (Guan, Mou, & Jiang, 2020). The historical progression of CALL offers critical insights into the development of contemporary methodologies and the potential for future innovations. As technology continues to evolve, so too does its capacity to enrich and redefine language acquisition and teaching practices.

As discussed the initial iterations of CALL systems were predominantly text-based, relying heavily on drills and repetitive exercises aimed at grammar and vocabulary acquisition. While effective to some extent, these early systems were limited in their ability to address diverse learning styles or simulate authentic language use. However, with advancements in personal computing and the advent of multimedia capabilities, CALL underwent a transformation. Developers began integrating audio and visual elements into learning tools, providing learners with authentic listening contexts and visual stimuli that fostered deeper engagement and a more immersive learning experience (Zhou, 2023). The rise of internet-based resources further expanded the potential of CALL. The proliferation of the World Wide Web enabled the development of interactive platforms with real-time communication capabilities. Social media, online forums, and language exchange websites emerged as significant tools, offering learners the opportunity to connect with native speakers across the globe. These platforms not only facilitated authentic linguistic practice but also promoted cultural exchange, aligning closely with communicative language teaching (CLT) methodologies that emphasize interaction and real-world usage of language (Van Lier, 2004).

One of the promising features of Internet-based CALL was a shift toward constructivist approaches to learning. Online collaboration tools encouraged cooperative learning and peer interaction, fostering not only linguistic skills but also collaboration and teamwork. Platforms like wikis, blogs, and discussion boards allowed learners to co-create content, while instructors provided targeted feedback within simulated real-life communication contexts (O'Dowd, 2021). This interactive, learner-centered approach contributed to more meaningful engagement and contextualized language acquisition.

THE EMERGENCE OF LEARNING MANAGEMENT SYSTEMS AND MORE INDIVIDUALIZED LANGUAGE LEARNING

During the 2000s, the advent of learning management systems (LMS) and platform-based solutions brought further sophistication to CALL. These systems integrated diverse functionalities, including assessment, personalized feedback, and data analytics, which allowed for more individualized learning experiences. Students could progress at their own pace, while instructors gained valuable insights into learner engagement and progress (Levy & Stockwell, 2006). The adaptability of these systems addressed earlier limitations, catering to varied learner backgrounds and proficiency levels. This evolution toward multimedia and internet-based CALL reshaped language education, offering learners richer and more interactive experiences that better mirrored the complexities of real-world communication. Looking ahead, advancements in technology are expected to further enhance these capabilities, making language learning increasingly accessible, adaptive, and effective for diverse populations.

In contemporary contexts, CALL has evolved to incorporate advanced pedagogical frameworks such as communicative language teaching (CLT) and task-based language teaching (TBL), seamlessly integrating them with technological innovations. CLT emphasizes authentic communication and interaction, focusing on the practical use of language. Technological tools such as virtual environments, video conferencing, and social media platforms have been effectively employed to support these objectives. Platforms like Skype and Zoom, for instance, enable real-time interactions with native speakers, immersing learners in authentic linguistic and cultural exchanges (Kessler, 2018). Such experiences enhance speaking skills, build confidence, and provide learners with invaluable exposure to diverse linguistic contexts. The integration of CLT and TBL methodologies with cutting-edge technology highlights the transformative potential of CALL in language education. These tools and frameworks collectively pave the way for a more holistic and engaging approach to language acquisition, ensuring learners are well-equipped for the demands of real-world communication.

Task-based language teaching (TBLT) emphasizes completing meaningful tasks that reflect real-world language use, fostering contextualized and practical learning experiences. Integrating technology into TBLT enhances its effectiveness, offering interactive and engaging tools tailored to individual learners' needs. For example, Zhang and Zou (2023) highlight digital tools such as simulation software, gamified applications, and collaborative platforms that support task-based learning. These technologies engage learners in problem-solving activities that require cooperation, negotiation, and communication, closely mirroring authentic language use. Collaborative platforms for writing and project-based tasks further encourage critical thinking and creativity, as learners articulate ideas and negotiate meaning in digital environments. Technology also plays a crucial role in delivering immediate feedback, an essential element for language acquisition. Many digital applications incorporate adaptive learning mechanisms that assess performance and provide real-time personalized feedback. Kessler (2018) underscores that this immediate corrective feedback enables learners to self-regulate and refine their language skills more efficiently than traditional methods, potentially accelerating their progress. Interactive features such as quizzes, language games, and apps cater to diverse learning preferences, making reinforcement and review more engaging and effective.

The integration of technology into methodologies like TBLT and communicative language teaching (CLT) reflects a transformative shift in language education. Technology is no longer just a supplementary tool but an integral component of the learning process, ensuring that language acquisition becomes increasingly interactive, personalized, and relevant to learners' lives. As educators and researchers continue to explore new technological applications within these frameworks, it is evident that these methodologies create effective and adaptable learning environments. The ongoing evolution of CALL demonstrates its dynamic nature, consistently responding to learners changing needs and the rapid advancement of digital resources.

MOBILE-ASSISTED LANGUAGE LEARNING

The emergence of mobile-assisted language learning (MALL), a significant subset of CALL, has further revolutionized the language learning landscape by integrating mobile devices such as smartphones and tablets into the process (Burston & Giannakou, 2022). This shift aligns with the ubiquity of mobile technology,

fundamentally altering how learners access materials, engage with peers, and receive feedback. MALL is particularly impactful in promoting learner autonomy and fostering personalized learning experiences.

Empirical studies underscore the efficacy of mobile applications in developing linguistic skills, especially speaking and writing. For instance, Sun et al. (2017) found that mobile apps designed for language practice significantly improved students fluency and pronunciation, illustrating the power of interactive tools in enhancing oral communication. Mobile environments also provide ample opportunities for practice, a critical factor in achieving language mastery. Moreover, MALL facilitates social interaction among learners, creating immersive and collaborative language experiences. Ma (2017) investigated the role of social networking features within mobile apps, emphasizing their effectiveness in fostering peer feedback and active communication. Through discussion forums and collaborative tools, learners refine their writing and express their ideas dynamically, enhancing their linguistic abilities in an interactive setting.

Gamification is another key innovation in MALL, boosting learner motivation and engagement. Mobile applications often incorporate game-like features such as progress tracking, rewards, and challenges, transforming language acquisition into an enjoyable and less intimidating process. Research consistently shows that gamified approaches lead to better learning outcomes and sustained interest in language study. The adaptability of mobile technology further broadens its appeal, accommodating diverse learning styles and preferences. Learners can choose apps that align with their goals and needs, fostering a student-centered approach to language acquisition. This personalization, combined with the ability to access resources anytime and anywhere, positions MALL as a significant advancement in CALL. By integrating TBLT, CLT, and MALL, modern language education creates dynamic, inclusive, and effective learning environments. These technologies and methodologies collectively provide learners with the tools to navigate complex linguistic and cultural contexts, ensuring that language learning remains accessible, engaging, and deeply relevant to the challenges of a globalized world.

ARTIFICIAL INTELLIGENCE

Parallel to this, the integration of AI into CALL marks a transformative leap, enabling tailored educational experiences for individual learners. AI-driven tools, such as intelligent tutoring systems, adapt instructional content to the specific needs and preferences of learners. Larsen-Freeman (2018) highlights how AI can assess student performance in real time, seamlessly adjusting curricula to match their language acquisition stage. This dynamic adaptability fosters learner autonomy, empowering students to take ownership of their learning journey. AI also enhances CALL by analyzing diverse learner data—such as performance metrics and emotional responses—to create personalized learning modules. Intelligent systems use natural language processing to provide immediate feedback on spoken and written inputs, addressing errors promptly and reinforcing correct usage. This approach aligns with constructivist principles, emphasizing self-directed learning while boosting linguistic competence (Chen, 2024).

Furthermore, AI extends beyond personalization by fostering collaborative learning environments where students interact with both AI agents and peers. These platforms simulate real-life language scenarios, encouraging interaction and enhancing linguistic practice through diverse and engaging methods. As Chen (2024) notes, such environments enrich the acquisition process by integrating authentic contexts with innovative tools. Advances in machine learning and data analytics promise even greater sophistication in AI-driven CALL. Conversational agents like chatbots offer unsupervised opportunities for linguistic practice, simulating real-world conversations in controlled environments. These interactions build learner confidence and competence, bridging the gap between classroom instruction and practical application. The impact of AI in CALL is multifaceted, reshaping language learning methodologies while fostering a culture of self-directed study. As the field evolves, AI′s role in creating interactive, personalized, and immersive language education experiences will continue to grow.

VIRTUAL EXCHANGE

Another notable innovation in CALL is VE, which connects learners across geographical boundaries for authentic communication and interaction. This methodology emphasizes collaboration, intercultural engagement, and real-time conversations, enriching the language acquisition process. O′Dowd (2021) highlights VE as a tool for fostering linguistic competence and cultural understanding, aligning with Vygotsky′s social constructivist theories (1962, 1978, 1987) that emphasize the role of social interaction in cognitive development. By engaging in collaborative tasks, learners negotiate meaning, provide peer feedback, and practice reflective skills, all of which enhance their communicative competence. Platforms like Tandem and Edmodo facilitate synchronous and asynchronous communication through text, audio, and video, creating diverse interaction opportunities (Gillespie, 2020).

VE also immerses learners in authentic cultural contexts through interactions with native speakers. This exposure sharpens pragmatic skills and intercultural competence, essential in today′s globalized world. Insights into cultural nuances, idiomatic expressions, and sociolinguistic norms add depth to learners language skills, supporting the holistic nature of language acquisition (Byram, 2009). Innovations such as Augmented Reality (AR) and Virtual Reality (VR) further enhance VE by providing immersive, context-rich scenarios. These technologies replicate real-world situations, promoting critical thinking and problem-solving skills while bridging classroom learning and practical application (Gillespie, 2020). Despite its benefits, VE faces challenges, including technological access disparities, digital literacy gaps, and potential intercultural misunderstandings. Addressing these issues through equitable access to technology and comprehensive training for both instructors and learners is crucial for its success (O′Dowd, 2021). VE within CALL represents a paradigm shift toward collaborative, authentic, and culturally enriched language learning experiences. Its evolution is poised to influence not only language teaching methodologies but also learners perceptions of language acquisition in an interconnected world.

CHALLENGES OF CALL

While CALL has transformed language learning, it is not without challenges. Technological disparities among learners and institutions pose significant obstacles. Bailey and Lee (2020) identify that variations in access to equipment, internet connectivity, and digital literacy exacerbate existing inequalities in language education. These disparities hinder the effective implementation of CALL solutions, creating an uneven educational landscape where learners with limited access miss out on technological advancements. Bridging this digital divide is essential to ensuring equitable language learning opportunities across diverse populations. Learner anxiety presents a significant challenge to the effectiveness of CALL environments. Mei, Brown, and Teo (2018) highlight how the use of technology can evoke feelings of apprehension or inadequacy, particularly among students who are less tech-savvy or lack confidence in their language skills. Such anxiety can deter students from fully engaging in interactive CALL activities, thereby negating the potential benefits of these platforms. Overcoming this barrier requires educators to adopt tailored strategies that alleviate learners fears and optimize their participation in CALL contexts.

Another critical obstacle to CALL implementation lies in educators preparedness and acceptance of technological methodologies. While many educators acknowledge the advantages of integrating technology into language teaching, not all possess the necessary skills or confidence to utilize these tools effectively. Bailey and Lee (2020) stress the importance of professional development programs to equip educators with the competencies required to navigate digital environments successfully. Without adequate training and institutional support, educators may default to traditional methods, limiting CALL's transformative potential. Resistance to adopting new methodologies often stems from entrenched beliefs about teaching and learning, perceived complexity of technology, and insufficient institutional backing. Additionally, the lack of uniformity in CALL approaches can result in inconsistent language acquisition outcomes. Variations in CALL implementations across programs and platforms create fragmented learning experiences for students. The absence of standardized evaluation measures further complicates learners ability to track their progress effectively. These disparities, compounded by technological limitations and educators readiness, hinder students efforts to achieve language proficiency.

Addressing these interconnected challenges is crucial for CALL′s continued evolution and its efficacy in diverse educational contexts.

FUTURE DIRECTIONS

The future of CALL is bright, with emerging technologies like AR and gamification reshaping the educational landscape. AR, for instance, blends digital content with real-world environments to create immersive learning experiences. Through AR, language learners can interact with contextualized linguistic input, fostering deeper engagement and retention. Applications that overlay vocabulary or grammar rules onto everyday settings enable learners to forge tangible connections with the target language (Parmaxi & Demetriou, 2020). Dunleavy and Dede (2014) emphasize that AR′s ability to visualize and manipulate language in real time not only enhances comprehension but also motivates learners, particularly those who excel through experiential learning. Gamification further revolutionizes CALL by incorporating game-like elements such as points, levels, and leaderboards into language learning frameworks. This approach creates dynamic and engaging experiences that inspire learners agency and persistence. Studies show that gamified environments drive extrinsic motivation through immediate feedback and rewards, reinforcing language practice and retention (Chapelle & Sauro, 2017). Gamification also accommodates diverse learning styles by integrating competition and collaboration, promoting inclusivity in language education. Advances in AI and machine learning promise even greater personalization in CALL. Adaptive learning technologies tailor language instruction to individual learners progress and challenges, providing instant feedback loops that cater to a broad spectrum of abilities. AI-driven assessment tools offer nuanced insights into learners capabilities, enabling targeted interventions and enhancing educational outcomes.

VR also holds transformative potential for CALL by simulating real-world conversational contexts. VR environments enable learners to practice speaking skills in realistic scenarios without geographical constraints. By providing a safe space for dialogue, VR reduces anxiety often associated with language practice, fostering confidence and fluency. These innovations could fundamentally reshape language education by emphasizing authenticity and practical application. CALL's trajectory continues toward user-centered approaches characterized by interactive technologies such as AR and gamification. These innovations enhance language education efficiency, boost learner engagement, and accommodate diverse needs. The interplay of emerging technologies suggests a reimagined language learning environment that redefines how language acquisition is conceptualized and practiced in the digital era. Historically, CALL has evolved significantly, transitioning from behaviorist models of repetitive drills in the 1960s to constructivist frameworks emphasizing interaction and communication. The integration of multimedia resources, online platforms, and mobile technologies has expanded language learning′s reach and accessibility, aligning with contemporary pedagogical theories that prioritize student autonomy and engagement (Warwick, 2022).

Today, activity-based learning and collaborative practices dominate CALL methodologies. Gamification, AR, and virtual linguistic environments exemplify these trends, offering immersive experiences that enhance motivation and contextualize language use (García-Sánchez, 2022). AI and machine learning further personalize learning experiences, catering to individual needs and providing real-time feedback. These advances align with neurological theories of language acquisition, accommodating diverse student preferences and improving pedagogical effectiveness (Blin, 2020). Looking ahead, CALL innovations point to more integrated and adaptive learning environments. AI will enable deeper customization and predictive analytics, while data-driven insights will enhance learning outcomes and user engagement (Quyang & Zhang, 2024). Virtual and augmented reality technologies promise to revolutionize language education by simulating real-world interactions and cultural contexts. The ongoing evolution of CALL highlights the importance of research and adaptability to emerging technologies. By combining innovative tools with established pedagogical theories, CALL can continue to meet the needs of a globalized and interconnected world (Li, 2018; Shadiev & Yang, 2020).

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