

Connecting the Past to the Future of Computer-assisted Language Learning: Theory, Practice, and Research

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Abstract

Computer-assisted language learning (CALL) has established itself as a fruitful area of inquiry that contributes to language education and educational technology. CALL has witnessed the endeavor of exploiting technology for robust and meaningful language learning and teaching from scholars over a period of more than fifty years. With the continued advancement of technology, the field of CALL is facing new challenges and possibilities in terms of theory, practice, and research in this new era. Thus, a review of major trends in past CALL and a critical projection of future CALL are needed in order to capture the dynamics and opportunities for future technology-enhanced language learning. This article provides an overview of the evolution of theory and practice in CALL research. The author explores the state of the art and important future areas of inquiry of CALL by addressing emerging technologies. This paper concludes with theoretical and methodological considerations for approaching CALL today and beyond.

Keywords: *CALL, emerging technologies, technology-enhanced language learning*

Introduction

Computer-assisted language learning (CALL) has established itself as an identifiable and fruitful area of inquiry that contributes to the language education community. From the early groundbreaking implementation of mainframe computers for language instruction (e.g., the PLATO project), to the recent cutting-edge innovation of integrating artificial intelligence (AI) and interactive virtual environment into language learning (e.g., Kallioniemi et al., 2015; Vazquez, et al., 2017), CALL has witnessed the endeavor of exploiting technology for robust and meaningful language learning and teaching from scholars over a period of more than fifty years. The changing landscape of CALL reveals that change is the only constant in this field. Not only is the technology evolving rapidly, but the contexts, the means, and the goals of language use are likewise no longer fixed (Chun et al., 2016; Kern, 2014). As we are living in an era of “mega-change,” in which

the future (including but not exclusively CALL) is exciting but uncertain, it is beneficial to review the history of changes in CALL in order to capture the dynamics and opportunities for future technology-enhanced language learning.

Research, theory, and practice are three fundamental pillars that support any applied scientific field (Hubbard & Levy, 2016). A research conducted is supposed to have a theoretical connection, a practice that reflects a theoretical perspective, and results that can inform future practice and theory building (Hubbard, 2008). Indeed, as an applied professional field, CALL is also made up of these three components. In this article, I begin with a critical review of the literature and an overview of theory and practice in past CALL research. I then connect CALL's past to its future by outlining the state of the art in CALL research. I conclude with theoretical and methodological considerations for approaching CALL today in order to yield deeper and richer thinking and understanding of research, theory, and practice for the future of language learning. This article aims to contribute to the field of technology-enhanced language learning by synthesizing major trends in past and present CALL theory, practice, and research. Understanding the relationships between theory, practice, and research will help researchers and educators approach CALL with evolving theoretical lenses and methodological approaches.

CALL Research: A Changing Landscape

Throughout the history of CALL, the major trends in research have been constantly shifting with improvements in technology and language learning ideology. Measurable outcomes based on existing software (Neuwirth & Kaufer, 1992) were a dominant pattern in CALL research in the last century (e.g., Sinyor, 1997). A principal concern in CALL during the last century, which is now an area of decreasing interest, was the effectiveness of CALL compared to traditional learning (Knowles, 1986; Neuwirth & Kaufer, 1992). Today, computers, or other forms of technology they eventually evolve into, have already transformed things in everyday life (including education) on a grand societal scale. How and for what purposes should technology be used in CALL have become a major concern (Beatty, 2010). Therefore, research is now directed into new areas with an expanding scope and nuanced understanding of the role of technology, bringing into focus issues of autonomy (Chik & Ho, 2017; Lai & Zheng, 2018), identity (Chen 2013; Lam, 2000; Schreiber, 2015), community (Gao, 2007; Lam, 2000), and intercultural competence (Hull et al., 2010; Thorne, 2010). For example, Lam (2000) explored online English practices of Almon, a youth who emigrated from Hong Kong to the United States. Almon was frustrated by his English skills and marginalized in his English as a Second Language (ESL) classrooms. However, he was able to get involved in an online global Japanese pop (J-pop) community where he used English to communicate with other J-pop fans from different parts of the world. Almon's L2 digital literacy practices allowed him to negotiate a new identity as a global English user and to overcome the exclusion and marginalization he often felt in ESL classrooms. Such learner-centered research reflected increasingly diverse perspectives and lenses adopted by CALL researchers—quantifiable performance is no longer the only variable to be analyzed.

Nowadays, CALL has grown into a multidisciplinary field that covers a broad range of activities. Considering the changing nature of technology, research is at the heart of CALL to ensure that technology can be effectively employed in and beyond classrooms. Ideally, CALL practice should be supported by research and guided by theory so that technology can be harnessed for a more effective and engaging language learning. However, we see that CALL practice and research are sometimes disconnected. In some commercial CALL applications, CALL practice is deliberately promoted as a complete method of language learning without empirical evidence (Beatty, 2010). This is a warning for all the stakeholders in the field of CALL—what seems to be missing is a strong collaboration among researchers, practitioners, consumers, methodologists, and developers in CALL research to create a sustainable development of CALL theory, practice, and research. Conferences, workshops, and webinars that spark meaningful conversations between developers, teachers, and researchers are useful platforms to achieve this goal. Encouraging engagement and strengthening the link between CALL theory, practice, and research is of fundamental importance as the field of CALL continues to evolve into a future of possibilities.

Theory: A Growing Diversity of Perspectives

A number of theories from multiple disciplines have been used to motivate teaching and research in CALL. The interdisciplinary nature of CALL was highlighted in a review that described the theoretical landscape of a CALL journal (CALICO) over the period of 1983 to 2007 (Hubbard, 2008). It was found that there were no dominant theories across a corpus of 166 articles: 113 distinct theory references were extracted and none of the specific theories appeared in more than 6 articles. The study revealed that CALL has been a discipline that embraces multiple perspectives, including, but not limited to, second language acquisition (SLA) theories, linguistic theories, learning theories from psychology, and human-computer interaction (HCI) theories. The absence of “original CALL theory” seemed to position CALL as a consumer of theories rather than a more independent field (Hubbard, 2008; Levy & Stockwell, 2006). However, as some scholars have argued, drawing research bases from multiple perspectives is not necessarily a disadvantage. Perhaps, we do not need a discrete theory of CALL to understand the role of technology in language learning or to separate CALL from other disciplines as technology has been assimilated into our daily lives (Egbert et al., 2007; Hubbard & Levy, 2016).

Among the wide range of theoretical sources adopted by CALL researchers, one discipline, SLA, to which CALL is often said to belong (Hubbard & Levy, 2016), stands out as a major source that has provided a basis for CALL research and practice. For example, early approaches to CALL were grounded in interactionist SLA in which computer prompted learner output then provided comprehensible input to facilitate noticing and the acquisition of grammar and vocabulary (e.g., the PLATO project). Coinciding with the social turn in SLA (Kramsch, 2002), CALL research, influenced by sociocultural theory, started to pay more attention to meaning-based and social perspectives of language.

Technology has been integrated to support collaborative learning and negotiation for meaning (e.g., Harrison & Thomas, 2009; Lam, 2004; Lomicka & Lord, 2012). As the social aspects of SLA are gaining momentum, ecological theories (Kramsch, 2002; van Lier, 2004) and complexity theories (De Bot et al., 2007; Godwin-Jones, 2018) emerged to study language learning as a complex system across time and space, mediated by affordances in the environment and socio-culturally shaped learner perceptions. In response to this theoretical shift, some CALL researchers have modified the theoretical lens to focus on individual learning trajectories and affordances available in technology-mediated environments to gain a deeper and holistic understanding across multiple timescales and spaces (e.g., Blin, 2016; Scholz, 2017).

It is not surprising that CALL has a large reference to SLA theories, given that language learning is a primary component of CALL. However, the argument has been made that CALL also needs to look at the effect of technology during the SLA process (Stockwell, 2014, 2016). As an active promoter of HCI theory inclusion for CALL, Stockwell (2014) raised our awareness on how technology could distribute human cognition and how technology could situate learning on an affective level, which contributes to practical CALL design and critical reflection on CALL practice.

As Hubbard and Levy (2016) argued, it is not enough to just focus on what theories have been used in CALL. Understanding how theories have been incorporated into CALL leads to a deeper understanding of the development of technology-enhanced language learning. Based on past research, Hubbard and Levy (2016) summarized that theories might be absent, borrowed singly, assembled in an ensemble, instantiated, adapted, synthesized, constructed, and refined in technology-enhanced language learning. As CALL is evolving to become a more mature field, we see that theories in CALL demonstrate lesser dependence on the original sources and greater relevance to CALL specific contexts through mindful conceptualizing and contextualizing. However, the question of how well theories have been incorporated into CALL research and practice is left unanswered. Ideally, such a rich theoretical foundation built in CALL should guide and enrich researchers' practice, leading to a greater coherence. However, this rich theory base can be easily misused. As Levy and Stockwell (2006) critically pointed out, with many theories available, it has been noted that theories can be easily and thoughtlessly selected to more or less fit certain CALL projects as a marketing tool for the study/product, resulting in a phenomenon they called "theory buffet." Undoubtedly, theory plays an important role in illuminating research and practice, thus, it should not be treated as a gap simply to be filled in a paper (Hubbard & Levy, 2016), or a tool to sell certain artifacts. For CALL researchers, it is important to critically evaluate and reflect on this trend of multiple theories. It is essential to be aware and thoughtful of the intention when incorporating theory into CALL research and practice design in order to sustain a diverse and dynamic scholarly field.

Practice: An Evolving Relationship Between Digital Tools and Learners

The ways in which CALL researchers conceptualize technology in language learning are greatly influenced by the constant change of theory and technology itself. In addition, the local context, institutional environment, and individual experience further complicate the choice of technology and how it is used. Therefore, practice in CALL is extremely complex and in a constant state of change. In order to provide an overview of how CALL has been used for language learning and teaching, I expanded the familiar CALL metaphor of tool and tutor (Levy, 1997), categorizing CALL practice into tool, medium, simulation, and ecology.

CALL as Tool

At the early stage of CALL practice, Behaviorism dominated the learning principles and Long's Interaction Hypothesis was gaining interest in SLA, thus, CALL established its role of content delivery and practice tool: providing stimulus, receiving response, and giving immediate feedback. At that time, computers were viewed as drillmasters for language learning, not only because of the theoretical beliefs that language skills could be separated and mastered by a large amount of input and output, but also because technologies, in the form of computers, were not advanced enough to provide authentic communication (Otto, 2007). As technologies continued developing in the 1980s, CALL evolved into a more interactive and less drill-and-kill tool, most typically in the form of an interactive video disc. The content became more multimodal and engaging—combining video, audio, animation, or text graphics. Learners could interact with these content multiple times by playing back and/or doing exercises after the first review. Although the media had been enriched, in essence, CALL still served as a means for delivering instructional materials.

CALL as Medium

With the social turn in both SLA (e.g., sociocultural theory) and technology (e.g., internet, social networking sites) in the 21st century, more attention has been paid to CALL as a space to provide direct communication between learners and interlocutors of the target language. For example, MIT's Cultura project, in which students from different cultures exchanged ideas and co-constructed an understanding of each other's linguacultural backgrounds, evoked a number of structured telecollaborative projects in CALL. Twitter, one of the popular computer-mediated communication (CMC) tools, was used to construct a virtual learning community between American students and their French peers to share inquiries and knowledge (Lomicka & Lord, 2012). Researchers have begun to explore unstructured online interactive activities (e.g., social media, online forum) in which learners actively participate. These spaces were found to provide valuable language learning opportunities, allowing learners to construct new identities, build learning communities, and interact in L2 to negotiate meaning (Codreanu & Combe, 2018; Harrison & Thomas, 2009; Lam, 2004; Yang et al., 2014).

CALL as Simulation

With the value of meaningful communicative practices being recognized by researchers, effort has been made to provide learners with goal-oriented, context-rich, engaging and interactive simulations. For example, Mills (2011) designed a global simulation course where students created francophone characters on Facebook that lived virtually in the Parisian building, wrote in the first person to collectively describe a murder mystery in the building. The collective narrative turned out to be engaging and motivating for French L2 learners. Many CALL simulations appear in the form of games. With a growing global game industry and increasing interest in educational gaming, cutting-edge technologies have been invested in this kind of CALL design. For example, Kallioniemi et al. (2015) described a project for German learning called Berlin Kompass, in which students were immersed in sequential 360-degree panorama images, collaborating with one another to complete a number of search-based tasks. Integrating augmented reality (AR) into game design, Thorne & Hellermann (2017) introduced a quest-type mobile AR game (in multiple languages) in which learners played the role of an agent from the future to save the earth from environmental degradation. These new technologies empower CALL simulations by engaging embodied cognition and situated interaction in the process.

CALL as Ecology

The current philosophy of CALL puts the learner in an agentic and centered role in language learning. Indeed, in a naturalistic setting, where CALL can be any leisure time activity such as watching YouTube videos or playing games in a foreign language, motivated and autonomous learners are able to assemble multiple resources and navigate CALL based on their needs and goals. In this sense, CALL is no longer limited to one single source or artifact. The new metaphor of ecology considers CALL as an ecosystem where physical, social, and symbolic factors are intertwined with learning across multiple timescales, underscoring the complexity of CALL. Many CALL researchers who work within an ecological framework adopt a holistic lens to understand CALL. For example, Chik (2014) examined how gamers actively organized gaming practices by using personal experience and community resources over space and time as a long-term language learning development. Chik and Ho (2017) explored how autonomous learners managed to use multiple CALL resources as both recreational and learning activities over a period of five years. They found that technology and language learning were intertwined with different life stages and each participant crafted their own learning journey. When viewing CALL as ecology, scholars share the belief that there is no one best tool or way to learn a language. Understanding individual differences and affordances in the complex system contributes to empowering learners by offering different choices and approaches to language learning.

CALL as (?)

The incredible advances of technology over the past fifty years have evolved the computer to a state way beyond the projections of the past. When researchers dealt with the old mainframe computer in the last century, they would most probably not have thought that

one day, interacting with a small handheld device would be a normal part of life. New relationships between computer and humanity emerge with the continued advancement, transforming the way we conceptualize the role of technology in language learning. The sophisticated language processing system of today holds promises to create a new role of CALL as an interlocutor, since some learners might already have considered chatting with an AI chat bot as a way to learn and practice foreign languages. Although sounding far-fetched with the current state of technology, coupled with the intricacies and complexities of language, it has been pictured in science fiction that one day wearable AI real time translation systems will replace the need for foreign language learning. Such imagination drives us to reflect on the uniqueness of human language. In the future, technology might evolve to allow highly accurate real time translating capabilities. However, the machine is still producing a sequence of digital 0s and 1s in essence, without the analog intricacies present in human communication. In this sense, language learning is unlikely to be replaced by AI translation, because human language is a dynamic context-sensitive system that is unique to each individual language system that cannot simply be tackled by math nor even a single “master language” to be translated to. Viewing this from a macro perspective, it seems that the goal of AI translation is to funnel all varieties of human language into a single form of language, which would erode all the innate cultural backgrounds of individual languages. AI could be a double-edged sword—serving as a useful assistant for learners to acquire a second language with the assistance of AI chat bots, however also serving to erode language learning by distributing the cognitive load of learning a second language to the AI instead.

Learning languages is more than mastering skills. It is about opening a door to explore and appreciate different ways of thought. It is about learning to understand and respect people from different parts of the world as we share this one planet. Before we incorporate new technology into CALL practice, it is essential to stop and reflect on the end goal. This is a reason a question mark was put in the title of this section, projecting the future practice of CALL with an expectant and critical mind.

Research: Connecting CALL’s Past to its Future

State of the Art: Immersive Technologies, MALL, ICALL

CALL—the collective term we use to refer to a wide range of technologies and related approaches to teaching and learning foreign languages, is a term with a long history. Today, computers are simultaneously becoming less visible yet more ubiquitous. The emphasis has moved towards technology in different forms, rather than just on the commonly associated computer itself. An alternative term, technology-enhanced language learning (TELL) has also been used by scholars as a more inclusive term. Emerging technologies, such as AR and virtual reality (VR), may have enormous potential for language learning. For example, by layering more information onto the physical environment, we can enable learners to interact with linguistic landscapes within real life. A more colorful and rich environment such as AR compared to the flatness of a textbook might be more effective in implementing language instruction as language itself is multi-

faceted and complex, allowing learners to better link what they see in real life with the language that they are learning. In an AR word-learning project from MIT, Vazquez et al. (2017) designed a prototyped platform offering contextualized, media-rich, object-to-word, and word-to-object word learning experience in the physical world augmented by technology. In addition to AR, VR allows learners to be totally immersed in a target language environment, which may benefit those who are not able to travel overseas to fully immerse themselves in the home country of the language that they were intending to learn. It also has the potential to enhance some language-specific learning needs. For example, Wu et al. (2013) proposed that a VR-based Chinese calligraphy learning application could enhance engagement and motivation of learning Chinese characters due to the interactivity associated with using VR. Language educators can expect to see more research and practice in AR and VR in the near future.

With technology becoming more portable, mobile-assisted language learning (MALL) is also an emerging field that brought a large amount of expectation (Stockwell, 2016). The ubiquity and portability of mobile devices such as smartphones mean that an average person can utilize their mobile device for language learning at any location and at any time. Additionally, mobile devices have the advantage of context-sensitivity with the aid of location-based content (Han, 2019). With the help of AR, learners can link language learning with their environment by associating what they see in real life with the language that they wish to learn, allowing them to interact with their surroundings in an immersive way. With the advent of smartphones that could enable access to various resources and applications potentially useful for language learning, MALL is an up and coming field with compelling opportunities worth researching.

As we anticipate the widespread use of AI in all aspects of life, we are expecting to see its revolutionary use in language teaching and learning as well. Intelligent CALL (ICALL), a term referring to applying AI techniques in CALL (Schulze, 2008), is a young field full of possibilities. In the near future, ICALL may move far beyond providing individualized feedback for correcting grammar or morphology: we may be able to see our AI assistant in a physical presence with an emotion-expressing face and communicate with them as if with a live human being, by combining AI with immersive technologies like AR and VR. These AI assistants can be used to engage learners in extensive language practice, or even deliver customized instruction as they understand the emotion and needs of the learners better. This nuanced relationship between AI and learners will definitely motivate more research in CALL.

Approaching CALL Today: Understanding Individuals and Complex Environments

The choice of theoretical lens and methodological approaches is highly dependent on research questions and contexts. It is still good to see a range of theories and methods being utilized to approach CALL. Ideally, these different perspectives will keep contributing to a more comprehensive body of knowledge for CALL. After reviewing major trends in past CALL practice and theory, my attention has been drawn to the fact that CALL, whether it is structured or autonomous, is a highly unpredictable and

personal experience, same as the nature of learning itself—it is in fact a personal journey. It is not possible to generalize one best way/tool to learn/teach languages. The emphasis should be placed on the variety of individual trajectories instead of generalization. As Godwin-Jones (2018) argues, although it sounds ironic to focus on individual difference in an era of big data, learner corpora that collect a variety of L2 developments can be helpful in identifying variation, and in providing different approaches and alternative ways to different individuals to “make possible individualized learning environments” (p. 20). In this sense, ecological theory and complexity theory, focusing on the individual, the development, and the system, serve as robust research lenses for approaching CALL today. Case studies provide in-depth information about individual development. Together, they can constitute a valuable learner corpus to enrich our understanding of CALL practice and learner experience. Narrative approach (e.g., journals, reflections, interviews) allows for a deeper understanding of attitudes, beliefs, and perspectives in certain contexts. Observation data (e.g., recordings of CALL activities), collected via ethnographic methods (both online and face-to-face), help capture the dynamics in the process of development. Artifact data (e.g., digital products composed by learners), collected across platforms and timescales, make a contribution to exploring learning achievement and identity construction. With multiple data sources, data triangulation ensures a holistic and objective interpretation of a complex CALL learning trajectory for individual language learners.

Doubtless, in the future, we will return to reflect on and update our theoretical lenses and methodological approaches to get ready for a new landscape of CALL. It is worth noting that the future of CALL seems to be pushing towards self-directed learning with the assistance of AI and immersive technologies. Perhaps it would also serve CALL better to look at it with a theoretical lens of autonomous learning, as the most cutting-edge technology would not be of much use if the learner does not embrace it. We should however continue to embrace and harness future state of the art technology such as AI assisted AR and VR, due to the fact that these tools could help future language learners encode information more effectively, by providing them with a gateway, linking what they learn with what they experience in real life.

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