

### Abstract

This chapter discusses current issues in second language learning and also how state-of-the-art technologies are being used to assist second language learners. Five key pedagogical approaches that facilitate second language learning are presented, along with technologies used for second language learners that exemplify aspects of these approaches. Strengths of these technologies and their limitations are discussed. The chapter concludes with some recommendations for designing and implementing sustainable technologies for second language learning.

Key words: second language learning, technology-enhanced language learning, instructional design, language and culture, computer assisted language learning, robot assisted language learning.

## Using Technology To Facilitate Second Language Learning

### Introduction

While the acquisition of one's first language and additional languages share some similarities, such as the order in which aspects of language are developed, the processes are very different. Every child with normal cognitive resources acquires a first language. Babies and toddlers make sense of and begin to use their native language without explicit teaching, acquiring fluency naturally in a few years. In contrast, not everyone is successful in learning a second language, and most second languages are learned in purposeful educational settings.

In this chapter, we present the challenges that second language learning (SLL) students currently face in schools worldwide, and the increased demand this has incurred for inclusive educational contexts. We overview effective pedagogical approaches to second language learning and how the computer-assisted language learning (CALL) community has attempted to address various aspects of second language learning. Also, a trend in SLL research and pedagogy pays great attention to the social and cultural context of language learning. Reflecting this trend, new tools like advanced communications tools and embodied technologies (e.g., virtual agents and humanoid robots) have been used to add social and emotional richness to conventional CALL. Next, we discuss appropriate research questions and methodologies to examine the efficacy of advanced technology-based environments for SLL that have become increasingly sophisticated in functionality and features. Finally, we conclude with recommendations for designing technology-based SLL environments to increase sustainability and scalability in public education.

### The Educational Need of Second Language Learners

The ease of global travel and communication enables many families to voluntarily move abroad to pursue enhanced career opportunities. At the same time, political and economic challenges worldwide have contributed to an increasing number of people involuntarily displaced from their homeland (Canagarajah, 2017). This number has been as high as 65.3 million people in recent years, and more than half of all refugees and immigrants globally in 2014 and 2015 were children (United Nations High Commissioner for Refugees, 2015). In many countries, second language fluency – often in English – is a requirement for economic opportunity and prosperity in life. Many children study English as a second or foreign language as early as kindergarten and throughout their formal education to enhance these opportunities.

Although second language acquisition may occur in natural settings, formal schooling is an important resource for learners to develop essential skills in the target language and culture. Schooling in a second language, however, can be a challenging and even alienating experience for some learners. Children who are not fluent in the target language and local culture commonly enter school already behind academically and socially. Around the world, evidence shows that learners not fluent in the target language consistently fall behind in scholastic achievement, from English language learners in the United States (e.g., Kena, Musu-Gillette, Robinson, Wang, Rathbun, Zhang, & Dunlop Velez, 2015; Saunders & Marcelletti, 2013), to Chinese native-speaking learners acquiring Korean in university settings (Yan & Cheng, 2015), or immigrant students learning German in Germany (Kigel, McElvany, & Becker, 2015).

Gaining target language fluency sufficient to succeed can be challenging for many second language learning (SLL) students (Sayahi, 2015). Technology has the potential to mitigate some

of these challenges and has been used in varying ways around the world to this end. In particular, technology has greatly expanded the opportunities many second language learners learn and practice discrete aspects of the target language. At the same time, ample opportunity still remains for improving applications, so they can better address a variety of learner needs. In the following section, we examine recent literature on SLL pedagogies and how technologies have been used in line with these pedagogies.

### Recent SLL Research & Contributions of Technologies

Many SLL students lag behind native-speaking peers in achievement throughout their education since SLL students have difficulties in understanding instruction when their target language skills are not yet proficient (Garbadi & Mady, 2015; Umansky, Valentino, & Reardon, 2016). A variety of accommodations have been provided in the classroom, ranging from none at all, to ad hoc solutions, to institutionalized programs of varying quality (Garbadi & Mady, 2015; Marx & Saavedra, 2014). Nonetheless, substantial constraints prevent SLL learners from having opportunities to participate in and engage with core and advanced curriculum in their schooling (Umansky, et al., 2016). In examining the research on effective pedagogy for second language learners, the authors have identified five pedagogical approaches: i) *providing systematic instruction and collaborative activities*, ii) *addressing SLL learners' unique needs*, iii) *developing balanced second language skills*, iv) *creating supportive language learning contexts*, and v) *using learners' first language and native culture*. As we explain these approaches below, we also present how instructional technologies are being used to address each of these approaches to some degree.

#### *Providing Systematic Instruction and Collaborative Activities*

What we know about good instruction and curriculum holds true for second language learning. Well-planned instruction with clear goals and strong organization, in general, benefits all learners. Especially, a volume of research attests to the effectiveness of systematic and explicit instruction on SLL outcomes (Ardasheva, Wang, Adesope, & Valentine, 2017; August, McCardle, & Shanahan, 2014). Collaborative learning is acknowledged as another effective strategy for second language learners (Baker, Lesaux, Jayanthi, Dimino, Proctor, Morries, Gersten, Haymond, Kieffer, Linan-Thompson, & Newman-Gonchar, 2014; Garbadi & Madi, 2015). Collaboration in homogenous and heterogeneous groups (Bowman-Perrott, deMarín, & Mahadevan, 2016) can provide many opportunities to practice the target language formally and informally with peers.

A volume of work in computer assisted language learning (CALL) has provided systematic and explicit instruction on learning grammar, vocabulary, and pronunciations with ample opportunity for repeated practice. In particular, mobile learning (i.e., mobile apps and games) has been increasingly used in both first and second language learning contexts with learners of all age groups (Shadiev, Hwang, & Huang, 2017). Meta-analytic studies report that SLL is one of the most studied domains with mobile devices (Liu, Scordino, Geurtz, Navarrete, Ko, & Kim, 2014; Shadiev et al., 2017). Language-learning mobile applications (e.g., *Duolingo*, *Memrise*) provide systematic instruction in which second language learners practice developing vocabulary and grammar. The portability of mobile devices allows seamless transfer from home to classroom and also provides flexible interfaces like touch screens and speech recognition features (Judge, Floyd, & Jeffs, 2015). Yet, researchers have yet to fully explore the short- and long-term effects of these applications on SLL. In addition, instructors often have difficulty in

making the applications part of their instruction since integrating mobile app activities into course learning objectives is often challenging.

Collaborative reading and writing are popular areas in recent CALL research and practice, using advanced online technologies like wikis, blogs, or web-based word processing tools (Bikowski & Vithanage, 2016; Kessler, 2017). For example, digital annotation tools (DATs) (e.g., *eComma*, *Hylighter*, *Classroom Salon*) allow instructors to upload texts so that students can read, highlight, and have virtual threaded discussions with one another. When they write an essay collaboratively using wikis, students give the peers feedback on their writing. Recent research in this area investigates SLL student perceptions of collaborative reading (Nor, Azman, & Hamat, 2013), the effectiveness of DATs on reading comprehension (Yeh, Hung, & Chiang, 2017), and other linguistic, literary, and social affordances for language learners and teachers (Blyth, 2014; Thoms & Poole, 2017). While such technologically mediated collaboration offers much potential for authentic, collaborative experiences in SLL, the majority of the research to date has almost exclusively been carried out with adult SLL students. Much more empirical work is needed, which deals with young learners in public schools and at home is needed.

#### *Addressing SLL Learners' Unique Needs*

SLL students often face the simultaneous challenges of learning academic content and skills while learning the target language and culture. It is a demanding, multifaceted process. Traditional classroom practices alone are insufficient to assist SLLs in meeting these demands, which is, perhaps, a major cause for the widening achievement gap with native-speaking peers as the students advance through school (Goldenberg, 2015). Students with limited second language

fluency are simply unable to fully engage with information they cannot understand. Effective instruction for SLL students should be adaptive to the needs of these students.

Blended language learning and teaching involve the use of classroom instruction and online learning to support personalized learning experiences without sacrificing the quality of classroom instruction and in-person interactions (Rubio & Thoms, 2013). Through this personalization, learners can often adjust the content, pace, and location of their learning according to their preferences (Powell, Watson, Staley, Patrick, Horn, Fetzer, Hibbard, Oglesby, & Verma, 2015). When implemented properly with the necessary resources, technologies, and training for both instructors and students, the overall effectiveness of blended learning for SLL is equal to or better than face-to-face instruction (Gruba, Cárdenas-Claros, Suvorov, & Rick, 2016).

Although blended learning in SLL has some benefits for learners due to its potential for personalized instruction, it still can be challenging for some students. The autonomous nature of blended learning requires learners to be highly motivated to work on their own (Blake & Arispe, 2012). Noteworthy, there are some accessibility concerns. Network bandwidth varies place to place, and the digital divide still exists among learners throughout the world (Hilbert, 2016; Ortega, 2017). Finally, blended language learning and teaching is almost exclusively used in higher education. A few recent studies have started exploring blended learning with primary and secondary students (O'Callaghan, McIvor, McVeigh, & Rushe, 2016).

### *Developing Balanced Second Language Skills*

All four aspects of language – speaking, reading, writing, and listening – must be purposefully addressed in SLL instruction. Oral language development is necessary for SLLs to be able to interact with the environment and integrate into the classroom (Snyder, Witmer, & Schmitt, 2017) and the second language community. Although listening skills are not often

directly addressed in second language teaching, there is a predictive relationship between early listening comprehension and later reading comprehension performance (Richards-Tutor, Baker, Gersten, Baker, & Smith, 2016). Reading and writing skills are also key areas of academic language development. Oral and written language development activities should be integrated into the content area classroom, so that language learners can have consistent, structured writing opportunities while learning academic content (Baker et al., 2014). Teachers should plan explicit time for speaking, reading, writing, and listening practice each week to ensure that all areas are regularly addressed in the process of language development, as well as providing plenty of authentic opportunities for SLL learners to use the target language (Gilakjami & Sabouri, 2016).

Providing opportunities for the development of discrete language skills has been prolific in CALL research. As previously mentioned, much work on second language writing has focused on collaborative writing in digital environments (Grosbois, 2016; Strobl, 2014), as well as collaborative and social reading (Blyth 2014; Thoms & Poole, 2017; Thoms, Sung, & Poole, 2017). Multimedia presentations have been found to facilitate the acquisition of vocabulary for young learners (Silverman & Hines, 2009). Also, the incorporation of multimedia glosses (e.g., pictures and/or videos alongside translations of words) in digital reading texts facilitates vocabulary acquisition and results in better overall reading comprehension (Yanguas, 2009).

For oral proficiency, videoconferencing tools (e.g., *Skype Mixxer*, *Talk Abroad*) allow learners to engage in online discussions synchronously with others and practice second language speaking outside of the physical classroom (Blake, 2016; Bryant, 2013). Other asynchronous tools, like *VoiceThread*, allow oral-based, threaded discussions, where learners first view and listen to a video of another student's response to a prompt, formulate their own oral response, and upload this to a virtual thread for others to view. This recorded-video-based activity offers

second language learners planning time, as well as improved oral language skills (Gorjian, Hayati, & Pourkhoni, 2013; Guillén & Blake, 2017).

### *Creating Supportive Language Learning Contexts*

The social context of learning is recognized as a critical factor in the educational success of all learners. Especially in public school settings, inclusive and supportive contexts are a necessity, in which SLL students feel respected and encouraged to participate (Gonzalez, Eades, & Supple, 2014). Such contexts help students develop positive learner identities that lead to their investment in the learning process (Kayi-Aydar, 2015), and facilitate their motivation to learn the target language (Dörnyei & Al-Hoorie, 2017; Ushioda, 2016). When students identify themselves with the language community, they can see the language as a crucial vehicle for developing cross-language and cross-cultural friendships and academic and economic opportunities (Darvin & Norton, 2015; Lee, 2016; Takeuchi, 2016). These benefits make their efforts to learn the language worth the challenges.

Technological applications that facilitate social and emotional aspects of second language learning have not been common in SLL research. Recently, embodied technologies such as virtual pedagogical agents (animated on-screen characters) and humanoid robots are used occasionally to promote social and relational experiences in second language learning. In a study (Carlotto & Jaques, 2016), a pedagogical agent tutored Brazilian college students learning English grammar. Students liked to learn with the agent and performed better in a posttest than those students who did not have an agent. Robot-assisted language learning (RALL) is emerging as a way to add a social and interactive context to language and literacy instruction for second language learners. Some examples include RALL-E, an embodied robot who tutors teen students learning Chinese as a second language ([www.alelo.com/rall-e-project/](http://www.alelo.com/rall-e-project/)), and a stuffed-animal

robot that acts as a storytelling partner for young ESL children as they develop oral language skills ([www.media.mit.edu/projects/storytelling-companion/overview](http://www.media.mit.edu/projects/storytelling-companion/overview)). Also, the robot *Skusie*, acts as a playmate for preschool- to kindergarten-aged ESL children and assists in the development of early literacy skills (Kim & Smith, 2017). These robots are presently in the early stages of development and have only been tested in a few classrooms or lab settings. Much more work is needed to fully understand how RALL can complement and advance conventional CALL research, facilitating all aspects of SLL.

### *Using Learners' Native Language and Culture*

Several studies have established that, when the first language is enhanced and used as a mediating tool when acquiring the second language, learners improve their progress in learning (Ellis, 2015; Ghobadi & Ghasemi, 2015). The first languages of SLL students therefore are important assets that can help learners make sense of the target language in the learning process. Similarly, much research in multicultural education emphasizes the value of accessing and building on second language learners' native cultures in the classroom (Ladson-Billings, 2014; Moll, 2015; Paris & Alim, 2014). They acknowledge the multilingual and multicultural realities in which SLL students live (Ortega, 2017). To be effective, second language instruction should support learners using their first language as a linguistic resource while engaging in the language learning activities.

Telecollaboration is a way to connect classes of geographically dispersed learners via online for the development of language and/or intercultural competence (Helm, 2015). It allows students to use their first language when they reflect on first and second language cultural issues. For example, in a Skype-based tool called *The Mixer* (<https://www.language-exchanges.org/>), SLL students use their first language when interacting with native target language speakers in an

informal, synchronous tutoring environment (Bryant, 2013). Yet, CALL approaches that highlight and make use of learners' native languages and cultures have not been common.

Most recently, Kim and colleagues (Kim, 2016; Kim, Marx, & Nguyen, 2017) have been exploring the design of a bilingual robot that encourages young children (English-speaking and Spanish-speaking) to use their first language in their collaborative interactions. This work is part of a larger collection of research on culturally responsive computing (CRC) that seeks to connect classroom learning to students' indigenous cultural and linguistic heritage. CRC fosters the transfer of culturally and linguistically diverse knowledge and skills to learning school topics, as well as to developing students' positive identities (Lachney, 2017). This is a new body of research; much research is needed to better understand its potential.

In examining key work in technology-based SLL, it is clear that the current technologies have potential to address challenges in SLL although there are limitations to overcome. The greatest strength might be the opportunities that they provide for language learners to repeatedly practice the target language skills inside and outside the classroom. Some growing opportunities for collaboration using network technology are also promising for adult learners. Given the vulnerability of young children, open network-based technologies should be used on a limited basis and with great caution. Alternatively, humanoid robots seem to have much potential in supporting social and collaborative contexts for young learners as a robot acts as a communicative partner. As mentioned previously, however, humanoid robot technology is in the very early stage of development. There is a long way to go before it is proved as a viable SLL tool, particularly to be used on a broad scale. In the following section, we discuss how technology applications for SLL can be improved through new approaches to research and development.

### Critical Research Questions and Methodologies

As implied in the five pedagogical approaches, language learning is a socio-cognitive process where learners' cognitive, social, and cultural experiences synergistically work together to bring about successful language acquisition (Ellis, 2015; Vygotsky, 1978). Nevertheless, meta-analytic studies find that much of the CALL research to date is heavily focused on the cognitive aspects of second language learning (Ellis, 2016; Sung, Chang, & Liu, 2016) and usually limited to linguistic forms and rules (e.g., grammar, phonetic symbols, and vocabulary). Similarly, much research in CALL, perhaps due to its emphasis on achieving discrete skills, has been conducted in controlled instructional settings. CALL research relies heavily on quantitative measures (e.g., pre- and post-tests and other self-report surveys) to assess learners' second language performance and to evaluate the effectiveness of technology programs. In general, such proficiency measures present an incomplete picture of the second language learning process.

Research in technology-based SLL could be expanded to holistically examine learners' target language uses in natural settings. Both quantitative and qualitative data can inform researchers about language learning not only as a product but can also examine the processes of SLL. Thanks to technological advances, it is possible to capture visual and auditory information of learners while they engage in the learning process. For example, in a study on a robot assistant for children's language development (Westlund, et al., 2015), children's facial expressions were captured by a camera on a tablet and analyzed to assess children's emotional engagement in the task. In another study (Bassiou, et al., 2016), secondary-school students' conversations were recorded over time while students engaged in collaborative group work. Using advanced speech

software, the pitch and intensity of their speech were analyzed to help researchers assess learners' participation patterns during collaboration.

Also, designing technologies to support both cognitive and socio-cultural aspects of SLL might be a complex and demanding process that involves a variety of advanced features, multidisciplinary design expertise, and iterative testing and refinement. Meaningful research in technology-based SLL therefore could pay as much attention to the design processes of effective programs (and also ineffective programs) as the end products, so the research can inform future designers about what works and what does not. Findings from this kind of research will foster the instructional design and technology communities that evolve productively and constantly.

To summarize, the robust investigation of technology-based SLL environments may give equal attention to the language learning processes and the technology design processes, starting with two sets of holistic questions: 1) *How do learners' intellectual and social experiences evolve as they engage with the program?* and 2) *What does it take to design a technological tool that supports the intellectual and social development of SLLs?* These questions may be complemented with specific granular questions that reflect the particulars of the research context and the needs of target learners and teachers at hand. Obviously, both numerical and descriptive data will inform researchers complementarily, helping to find genuine answers that present the whole picture of SLL as both outcome and process.

#### Designing Sustainable and Scalable Technologies for SLL

From our discussion thus far, several implications can be drawn for designing and adopting sustainable and scalable SLL programs. First, SLL research highlights the integral relationship between language development and social contexts, as well as the importance of valuing and building on native languages and cultures. Approaches to designing technologies for

SLL will likely be sustainable when they afford spaces for learners to use the language and culture of their everyday lives (Ladson-Billings, 2014; Paris & Alim, 2014). These everyday skills and sources of knowledge can orient learners to the target language and culture.

Although the application of interactive technologies for SLL has been prolific commercially and educationally, meta-analytic research reports that theoretical grounds for learning activity designs in many applications are often lacking (Liu et al., 2014). Too often designers seem to immediately start experimenting with new technologies. The educational potential of technological devices should be leveraged and confirmed through robust designs that are grounded in established learning theories (Sung et al., 2016). Design projects that are carefully founded on theory and practice are more likely to lead to sustainable and scalable products.

In addition, the design of SLL technology requires adroit orchestration of all factors involved in learning and teaching (Dillenbourg, Nussbaum, Dimitriadis, & Roschelle, 2013). Having a clear understanding of learners, contexts, and educational missions is crucial for designers to succeed. A designer's prior assumptions about learners and content may be rooted in his or her own experiences and biases associated with his or her own cultural contexts rather than the contexts of the learners at hand. Ideally, the goals and perspectives of teachers, administrators, and parents along with learners' expectations should be taken into consideration from the early stages of technology design for SLL. Through this comprehensive understanding, researchers and designers will be able to understand the unique challenges of the target learners and the particular demands of the learning context(s). This, in turn, can lead to solutions that are both effective and feasible. Resulting products should be user-friendly and affordable so all stakeholders can have easy access.

Finally, although CALL researchers have taken advantage of advanced technologies for enhanced SLL over the decades, young SLL students in public schools are still in great need of quality resources and exemplary pedagogies, as discussed previously in this chapter. On one hand, CALL research should be communicated to practitioners more effectively to benefit SLL practices. On the other hand, technology applications must make room for teacher involvement, embedding teacher materials as a core component of the package (Kessler, 2016). Since encouragement from a teacher has a significant influence on students' language use inside and outside the classroom (Lai, Li, & Wang, 2017), the teachers' role in facilitating broad use of technology-based SLL should not be overlooked. To increase scalability of SLL tools, teachers need to develop proficiency in using technology-enhanced programs and, at the same time, technology programs should allow SLL teachers to customize the content to suit their unique needs. To this end, researcher/teacher partnership is crucial. Working closely with teachers in a dialogic process, researchers and designers should be willing to not only share their expertise but also adjust their design goals flexibly to meet classroom needs.

To conclude, technology-enhanced SLL environments that i) provide systematic instruction and collaborative activities, ii) address SLL learners' unique needs, iii) develop balanced second language skills, iv) create supportive language learning contexts, and v) use learners' first language and native culture, have a great deal to offer SLL students, enabling rich and successful language learning experiences. A genuine understanding of second language learners – their needs, the resources they bring to the learning scene, and the social contexts in which they are placed – should guide sustainable research and design efforts.

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