CALL in the K-12 Context: Language Learning Outcomes and Opportunities

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ABSTRACT
This review of CALL research in K-12 contexts is structured around two distinct bodies of research, each of which generates different types of questions emerging from the diverse demands of elementary and secondary education. The first area focuses on learning outcomes and builds on the use of conventional measures of learner achievement and instructional efficacy to help guide systematic decisions about innovations in curriculum and assessment. At stake from an outcome orientation is how technology might amplify the pace, reach, and efficacy of using technology to move students toward established curricular goals. The second area views new technologies as the site of learning opportunities, and researchers in this vein ask how to rethink which goals are targeted, which assessments are retooled, and which new areas of learning are forged with digital tools. The affordances of new technologies are viewed as products of a steady stream of innovation that offers novel learning environments, expanded semiotic resources, and new modes of communication. We begin with an orientation to K-12 language education contexts as a backdrop to our central focus on synthesizing current CALL research, and we conclude by discussing the challenges and possibilities of integrating technology into K-12 language education.

INTRODUCTION
The digital turn in education has inspired a number of scholars in the K-12 sector to speculate on how educators might leverage new technologies to redefine how schooling and learning intertwine. Conventional learning environments, goals, assessments, and stakes have been shifting rapidly with the increased use of technology, and in response, researchers have offered an array of frames, metaphors, and models to help interpret these changes (Collins & Halverson, 2009; Cuban, 1993; Cummins & Sayers, 1995; Thomas, 2011; Warschauer & Ware, 2008). Across this spectrum of voices, various calls resonate that range from cautionary notes to hearty endorsements. CALL researchers in the K-12 context have tended to favor the end of this continuum that embraces the possibilities presented by the digital age, because CALL research has long focused on exploring both the promises and challenges posed by technology. In this review, we focus on what CALL researchers have learned in recent years about the integration of various technologies into foreign and second language instruction in K-12 classrooms. Due to space constraints and to the substantive differences of K-12 educational systems internationally, our discussion will be focused mainly on the US educational context, although to the extent possible, we draw on empirical findings from our CALL colleagues internationally.

Our review is structured around two distinct bodies of research, each of which generates different types of questions emerging from the diverse and far-reaching demands of the K-12 context. The first area focuses on learning outcomes and builds on the long-
standing tradition in elementary and secondary education to use conventional measures of learner achievement and instructional efficacy to help guide systematic decisions about innovations in curriculum and assessment. At stake from an outcome orientation is how technology might amplify the pace, reach, and efficacy of using technology to move students toward clearly measurable, established curricular goals. The second area views new technologies as the site of learning opportunities, and researchers in this vein ask how we might rethink which goals are targeted, which assessments are retooled, and which new areas of learning are forged with digital tools. The affordances of new technologies are viewed as products of a steady stream of innovation that offers novel learning environments, expanded semiotic resources, and new modes of communication.

These two areas of research often operate in non-overlapping venues (for an extended discussion, see Warschauer & Ware, 2008). They speak to different audiences and serve as levers of different kinds of reinforcements—at times to reify constancy and at other times to stimulate change (Cuban, 1993). Therefore, in this review, we begin by providing a brief orientation to K-12 language education contexts as a backdrop to our central focus on synthesizing current CALL research within each of these two areas of constancy and change—each with a focus on learning outcomes and learning opportunities, respectively. We conclude by discussing the shared challenges and possibilities posed by the use of technologies in K-12 language education. These shared concerns serve as guideposts for future research and offer the possibility of bringing the two areas into greater conversation and collaboration with one another in coming years.

BACKGROUND TO K-12 CONTEXTS

The K-12 contexts into which CALL research is integrated are many and varied. In this section we offer a brief overview of this educational landscape by reviewing key conceptual terms, language classroom demographics, and general usage patterns. As a starting point, the nomenclature used by teachers, school leaders, and district personnel in US educational settings differs from that used by many post-secondary researchers. For example, although the term CALL is used by many language researchers in post-secondary contexts and EFL instructional settings, common phrases used in the K-12 sector in the United States to describe the intersection of language and technology focus not on language as the pivotal term, but instead on literacies: digital literacies, new literacies, multiliteracies, and 21st century literacies. Literacy researchers with influence in the K-12 context have theorized that online and digital spaces have ushered in a sharp break from print-dominant, singular notions of literacy to multimodal, multilingual, and communicative literacies (Cope & Kalantzis, 1999; Gee, 2000; New London Group, 1996; Street, 1995). These multiple literacies carve out new possibilities for the co-presence of different modes and mixings of graphics, sound, and video. Sharing platforms and tools are increasingly accessible to a wide range of users, including teachers and students (Kress, 2010), which opens up a plethora of potential pedagogical spaces where the semiotic channels available for learning are being multiplied and combined in new, different, and interesting ways.

A second consideration, again focusing primarily on the US context, is the different emphasis placed on second language learning as distinct from foreign language learning. Relative to the ever-increasing growth of the English language learner (ELL) population in public schools, foreign language classrooms form only a portion of elementary and secondary education. Over the last decade, for example, even as the numbers of ELL students in public schools has increased by 53% to form approximately 10% of the total student population (NCELA, 2011), the presence of foreign language instruction in schools has declined dramatically. According to their recent national survey of over 5,000 public and private K-12 schools in the US, for example, Pufahl and Rhodes (2011) documented several statistically significant declines in the provision of foreign language instruction. In public elementary schools, the drop went from 24% in 1997 to only 15% in 2008, and in secondary schools, foreign language instruction dipped by 10% overall in that time period, with the most marked decrease in middle schools: from 75% in 1997 to a mere 58% in
2008. Compounding these decreases is the added fact that provision of foreign languages does not always correspond directly with student enrollment in foreign languages, as language classes are often taken as electives for college preparatory tracks. At the secondary level, the numbers differ markedly depending on whether the schools are public (48% enrolled) or private (73% enrolled).

A third important factor in the K-12 context is the extent to which technology is actively integrated. In terms of availability and access to technology in US contexts, a recent survey by the National Center for Education Statistics indicated that 97% of all teachers have computers in their classrooms, with 93% reporting access to the Internet (NCES, 2010). Despite such widespread access, however, recent statistics show that only 40% of K-12 teachers reported using computers frequently in the classroom, while the other 60% reported using technology only sometimes, rarely, or never (NCES, 2010). Of the teachers who did integrate technology, over 60% indicated a primary reliance on presentation software for administrative tasks and for class preparation and instruction. Only 9% of teachers reported using more innovative technologies such as blogs and wikis.

Although these overall statistics do not parse out differences among teachers of particular content areas to allow insight into the practices of language teachers more specifically, two recent surveys provide some details about foreign and second language teachers’ technology use. Meskill and her colleagues (2006), for example, surveyed ESL teachers in New York State and found that nearly 80% of teachers used the Internet in instruction. ACTFL (2008) survey data of 2,236 foreign language teachers in K-12 settings show a range of technology use for different pedagogical aspects: grades and attendance (82%), language instruction (66%), proficiency assessment (38%), and classroom management (22%).

Expanding and expediting technology integration in schools requires strong professional development. In the last decade, however, opportunities for professional development have been limited for K-12 teachers. The National Center for Educational Statistics indicated that the majority of public school teachers received fewer than 8 hours of technology training each year, and, of the total K-12 technology budget, only 6% of the spending was allocated for professional development at the end of the last decade (NCES, 2010). The quality of such in-service training is also unclear, as evidenced by a recent report by the Department of Education that evaluated how education is being enhanced through technology (Bakia, Means, Gallagher, Chen, & Jones, 2009); the report documented that 20% of the teachers surveyed indicated that the professional development they received did not include any of the seven characteristics that had previously been identified as indicative of high-quality training (Means, Murphy, Javitz, Haertel, & Toyama, 2004).

This overview offers contextualizing information for reviewing recent trends in research conducted on language learning and technology in K-12 settings. First, research on the use of technology for language learning in elementary and secondary schools tends to be folded into larger discussions about literacy learning more broadly, with a particular emphasis on digital literacies that include a broad array of multimodal, semiotic, and communicative resources. Further, the relatively small proportion of foreign language classrooms as compared to general educational classrooms has likely influenced the resulting comparatively small research base focused on foreign language learning. Finally, although there is a high degree of technological infrastructure in schools, the relatively limited amount of systematic pedagogical integration has resulted in a research base characterized primarily by a number of exploratory studies, rather than a consolidation of research grounded in any one specific area. We turn now to a synthesis of what these studies have found.

**INTERVENTION RESEARCH IN K-12 SETTINGS: FOCUS ON LEARNING OUTCOMES**

In this section, we examine CALL research in elementary and secondary schools through the lens of constancy, which foregrounds those aspects of language education that focus on specified learning outcomes. This constancy lens is borrowed from the educational historian
Larry Cuban (1993), who offered an analysis of the forces of constancy and change in American schools. He documented over a century of shifts in the public educational trajectory that, at many turns, have almost exclusively leaned toward preserving the status quo over embracing new directions. He offered several possible reasons for this tendency in school reform efforts not to engage in radical change, including the relatively stable cultural beliefs about teaching and learning, the impact of how schools are organized as institutions that socialize and sort students, and the many limitations inherent in attempts to reform schools. What emerges from this system, according to Cuban, is a tendency to view technology integration as a vehicle for preserving and building on familiar pedagogical practices, rather than for embracing dramatic shifts.

Research focused on learning outcomes arguably functions well within contexts such as K-12 education, in which learner achievement has long been framed as student success across a combination of various outcome measures. Lemke (1998) places this type of instructional context inside what he calls a curricular learning paradigm, in which tangible milestones, goalposts, and expectations are laid out in a particular scope and sequence for all learners to follow in a metaphor of upwardly oriented progression. Warschauer and Ware (2008) have described the research taking place within this paradigm as oriented toward a learning frame, in which technology is seen as a means for enhancing established curricular goals and for promoting cost-effective, motivating, and efficient paths to learning. In this frame, technology tends to play either the role of a tutor in providing unlimited, structured exercises, explanations, and individualized feedback, or the role of a tutee, in offering options for linguistic input, learner autonomy, meta-cognitive learning, and analysis (for an extended discussion, see Kern & Warschauer, 2000). Typical research approaches rely on intervention study designs in order to compare technology-based interventions against more traditional face-to-face options. When such research is interpreted within the context of school settings, these studies arguably serve a relevant function in helping educators discern which technologies might help promote their goals in the context of what are often high-stakes, individualized assessments of structured curricular programs.

In the following sections, we explore the CALL research base on learning outcomes in order of salience among traditional research divisions across language skills domains: reading/vocabulary, writing, and listening/speaking. First, the most frequently investigated area of research has focused on supporting reading comprehension and vocabulary development, most often through the use of multimedia and web-based instructional materials. The next area receiving substantial attention has explored how to strengthen students’ writing skills through computer-based feedback programs and through human feedback delivered electronically. Finally, a cluster of studies has emerged in examining the augmentation of speaking and listening skills through a variety of mobile technologies and uniquely developed learning modules.

**Reading and Vocabulary Enhancement**

Within many fields, including language and literacy education, research has sought to understand the best modal combinations for learner achievement in online or digital spaces by teasing out the balance between enhancing learning through multiple presentation channels and potential cognitive overload (Mayer, 2001). For the promotion of reading comprehension and vocabulary more specifically, CALL researchers first saw a surge of studies in the early 1990s, when instructor-developed multimedia materials were created, and their impact on reading comprehension and vocabulary skills was examined in post-secondary language instruction contexts (see reviews in Chun & Plass, 1996, 1997). In K-12 settings, a concurrent wave of research was developing in literacy classrooms at that time; however, the focus was not yet then on language learners specifically, but rather on promoting the broader literacy skills among native speakers of languages as well as among students often labeled struggling or at-risk readers (for a review of literacy and multimedia reading in such contexts, see Reinking, 2005). Not until the last decade have more studies turned to focus on ESL, EFL, and foreign language learners within K-12 settings.
As a first example from this more recent turn, Kim and Gilman (2008) studied the impact of multimedia features (visual text, spoken text, and illustrations) on Korean middle schoolers’ English vocabulary acquisition. They found that, contrary to concerns about the potential cognitive burden of including graphics in information presentation, the combinations of visual text and graphics as well as visual text, graphic, and spoken text resulted in significantly better retention than other combinations without graphics; furthermore, these combinations also produced significantly better retention rates than when information was presented in a single mode. In addition, there was no significant difference in the time required for the various conditions or in learner attitudes toward the various conditions. As such, Kim and Gilman not only suggest that multimodal presentation of information is beneficial to learners, but also advocate adding graphics to written text to improve learning for language students without adding instructional time.

Lin and Tseng (2012) expanded this work by adding animated illustrations or videos to the mix. They studied the way in which videos impact how seventh grade EFL students in Taiwan learn difficult words. Specifically, they compared three types of annotations (text only, text and picture, and text and video) on immediate and delayed posttests. They found that the presence of video in marginal annotations helped students retain complex, difficult-to-define vocabulary words significantly better than annotations that had only text or text and picture. They suggest that ESL and other language teachers should employ more video annotations to help their students grasp difficult vocabulary. This study brings in an important nuance to the research on multimodal tools used to promote vocabulary acquisition: the importance of considering the level of word or concept difficulty when choosing which multimodal tools are best suited for student learning.

The nuances to the research on which combinations of multimodal tools best support student learning are further expanded by Lwo and Lin’s (2012) work on what caption types promote L2 vocabulary acquisition and reading comprehension among Chinese EFL junior high school students. The authors looked specifically at the impact of one of four caption types—no caption, Chinese captions, English captions, and Chinese plus English captions—on computer animated vocabulary lessons. While across the board, there was no significant difference in vocabulary acquisition or reading comprehension across the four caption types, a more fine-grained analysis revealed that the impact on vocabulary acquisition and reading comprehension depended largely on students’ L2 proficiency level. That is, the presence of captions in Chinese and English was significantly helpful for the less-proficient learners.

Not all studies are as fine-grained in parsing out which specific aspects of multimodal support structures might promote vocabulary and reading comprehension skills as the above work. Rather, many K-12 researchers look instead in broader terms at how the overall use of web-based, multimedia-enhanced curricular interventions might impact student achievement. One such study by Silverman and Hines (2009) compared the impact of two forms of vocabulary support, face-to-face and multimedia-enhanced instruction, on young learners from pre-kindergarten through second grade. Findings indicated that of the two groups of learners, ELL and non-ELL, there was a statistically significant positive impact of receiving multimedia-enhanced vocabulary instruction, both on retention of targeted instructional word lists and on general vocabulary knowledge, but only for the ELL students. Of importance is the finding that the non-ELL students fared equally as well with either type of instructional support, such that the overall advantage from these findings tips in favor of using multimedia-enhanced support for vocabulary in inclusive early elementary classrooms.

Two recent studies have examined web-based programs to support secondary learners. In their study of 66 Hispanic ELL students, Cuellar, de la Colina, Episcopo, Houier, and Leavell (2009) examined the intensive use of a web-based multimedia program called ESReadingsmart for 45 minutes three times each week across an 8-month period on multiple measures of holistic reading performance and discrete reading skills. Although no meaningful differences were found in students’ scores within the sub-tests of letter and word identification or of passage comprehension, students who participated in the intervention for a full 8 months gained an average of one and a half grade levels in their Lexile scores and moved up significantly in their rankings across four reading levels. In
another study focused not on vocabulary skills in isolation but rather on the types of strategies used in the process of learning vocabulary, Li (2009) documented how ESL high school students learning English in Canada used a wider variety of strategies when immersed in technology-enhanced environments as compared to contexts without technology support.

Increasingly, web-based reading environments, whether purposefully developed and marketed by corporations or creatively drawn upon by enterprising teachers and researchers, have also begun to offer multimedia support options through videos, hyperlinks, images, and audio (for examples from L1 classrooms, Coiro, 2009; Levy, 2009; Walker & Reynolds, 2000). An interesting example from foreign language instruction comes from Lück (2008), who examined the effects of web-based reading on high school students learning German. Using a combination of pre/post tests, observation notes, talk-aloud protocols, recordings, interviews, and questionnaires, she focused on the interrelationships among skimming, scanning, participation, and motivation and found that students in the intervention group performed significantly better in their skimming and scanning of a web-based text than students in the control group who read textbooks. Further, 19 out of 23 participants in the intervention group reported high reading motivation, as compared with only 4 out of 23 participants in the control group.

Writing Support

Essay writing within prescribed genres such as persuasion, exposition, and description is often prescribed by the school curricula, with organization, mechanics, and structure assessed. The provision of feedback using technology for these forms of essay writing comes in two general types: automated writing evaluation (AWE) feedback or human feedback delivered electronically. In examining the use of automated writing evaluation (AWE) programs in secondary schools, Warschauer and Grimes (2008) documented how several language arts teachers integrated AWE into their writing instruction and found that students had higher motivation to write when using automated programs and that teachers cited easier classroom management. However, closer analyses revealed what Warschauer and Grimes described as three paradoxes. First, even though participating teachers and students endorsed the use of the automated programs, both groups were critical of the accuracy of scoring and feedback. Second, although they had positive attitudes toward the software, students did not typically write more frequently when using the programs; in fact, approximately 75% of the essays were submitted only once with no revision. Finally, despite the students’ motivation to write more and the teachers’ perception of the usefulness of AWE, teachers did not actually schedule more time for in-class essay revising.

In a later study that expanded into a multi-site, longitudinal analysis of the integration of AWE programs in a number of middle schools, Grimes and Warschauer (2010) examined factors such as participant attitudes, usage patterns, grading trends, classroom management, and feedback preferences. They found similarities in what teachers cited as classroom changes when using AWE: ease of classroom management due to student motivation and autonomy and to the centralization of student writing; the need for students and teachers to become critical, informed consumers of the feedback and the scores offered by automated programs; and the importance of integrating classroom implementation of self-standing programs in pedagogically strategic ways, including a balance of types of writing assignments, audiences, grading emphases, and feedback provision.

When technology is used as a mechanism for delivering human feedback electronically, it often takes place as peer review through discussion forums. Writing research in this area, therefore, often provides linguistic inventories of the affordances of such interactive forums to assist educators in better understanding the complex ways that essay writing might develop when feedback is provided through various modes. Hill (2010), for example, used a mixed methods research design to track the effects of an asynchronous discussion forum on 29 ELL students across four different high schools. She analyzed the writing skills pre/post test data for students who did and did not participate in the extended
asynchronous discussions and found no statistically significant difference between the experimental group and the control group. However, the experimental group demonstrated some improvement in their interpersonal communication and in their discussions in meetings. Regardless of the limited observable outcomes of the asynchronous discussion on student writing in this project, the experimental group, in a post-project questionnaire, expressed their enjoyment with the online discussion and considered it a good way to make friends.

A study by Savignon and Roithmeier (2004) offers an in-depth analysis of how writing in a foreign language might develop in online forums. They analyzed the linguistic moves that high school students learning German as a foreign language made in their discussion board postings and found that students sustained their communication by collaborating with each other on single topics and by posting information that responded to the prior postings. Student writing also contained a variety of other moves: lexical items, ideas, and postings previously used by partners were integrated; online research was cited to support opinions; cohesive devices were applied to strengthen arguments; and effective strategies were used to avoid conflicts of communication.

**Listening and Speaking Focus**

The first example of studies focused on listening and speaking skills bridges both writing and speaking. Hwang, Shadiev and Huang (2011) examined how a multimodal annotation tool, VPen, impacted third grade Taiwanese ESL students’ writing and speaking performance through qualitative and quantitative measures. The tool allowed students to make multimodal annotations (with text, still image, and audio options) to web-based instructional content and to share these annotations with peers/teachers. The authors found that the tool not only helped create a fun, engaging learning environment for students, but that its usage was significantly correlated with improved speaking/writing performance. The authors conclude that VPen and other multimodal annotation tools could be implemented as a way to increase engagement for students as well as a way to increase speaking/writing performance among language learners. Such cross-fertilization points to the increasing integration of technology to promote growth across multiple skills areas.

Morton and Jack (2010) designed an interactive program using speech recognition technology to enable learners to communicate with animated characters in a foreign language. They then conducted a cross-cultural evaluation of how the use of this program was taken up in different ways by two groups of learners: 28 secondary students of French in Scotland and 48 EFL learners in China. Using questionnaires, interviews, and recognition accuracy measures, they explored student attitudes and motivation levels and found both groups to be highly engaged in the speech-interactive CALL program. However, motivational differences emerged between the groups, with the EFL group presenting a greater increase in positive attitudes towards the program, while the students learning French reported on an increase in their stress and a decrease in their attitudes. Morton and Jack suggested that these findings might be in part explained by differences in motivation, such that the EFL learners were likely more intrinsically motivated to learn English than were the Scottish students to learn French.

Hwang and Chen (2013) examined an innovative approach to supporting students’ listening and speaking skills by comparing the uptake of vocabulary by a group of elementary-aged learners exposed to food-related terminology through conventional pen-and-paper classroom work and a group of learners who used personal digital assistants to engage with the language during the situational context of lunchtime at school. They found that students in the treatment group performed better on the vocabulary measures, and interview data also demonstrated that the learners extended their informal learning opportunities not only to familiar in-school contexts, but also to their home environments.

This research geared toward learner achievement brings to the fore the potential benefits of the use and integration of various tools into K-12 language learning and student experiences; moreover, they highlight important nuances in our understanding of these
benefits, such as how the effectiveness of these tools may differ for different learners or for different language skills. Many questions remain, however, on what other nuances might exist in other areas of learner achievement, beyond these skill domains as traditionally understood. To move into this new terrain, we turn in the next section to a growing body of research exploring the learning opportunities of CALL technologies.

EMERGING RESEARCH IN K-12 SETTINGS: FOCUS ON LEARNING OPPORTUNITIES

Emerging in recent years among researchers who are interested in how technology is changing the context of formal learning institutions are a number of conceptual models that reorient the core focus of K-12 research toward technological innovation. The curricular learning paradigm that Lemke (1998) posited, which we drew upon in the previous section as a useful frame for research on learning outcomes, is repositioned in this section as an interactive learning paradigm, which Lemke describes as a system in which individuals make decisions about what, when, and how to learn. This paradigm assumes individual volition and control of learning that takes place through participating in communities of knowledge production and consumption. Educational reformers have captured these shifts by documenting how technology has the potential to transform traditional schooling. Collins and Halverson (2009), for example, argue that conventional models of education will, in the digital age, ultimately transition from a focus on uniform learning to a focus on customized learning, from standardized high-stakes assessments to demonstrations of specialized expertise, from learning-by-assimilation to learning-by-doing, and from owning knowledge to mobilizing outside resources.

Many CALL researchers resonate with these broader shifts in the ways that education is being reconceptualized and view technology as a lever in creating new learning opportunities for language instruction. Over a decade ago, for example, Kern and Warschauer (2000) forwarded the metaphor of technology as a novel tool that could be used to create increasingly interactive environments for language learning and use. Since that time and with the shift toward even more complexity, the tool metaphor has been dwarfed by the phrase Web 2.0, a second-generation vision of technology which O’Reilly (2005) describes as a platform for reading and writing, a system for publishing content, a storage center for content, and a place for people to interact. Guth and Thomas (2010) view the Web 2.0 as a context that provides “a more organic experience” (p. 41) for users. For language researchers, then, technology has become known as a site of increasingly complex affordances from which educators and learners can draw upon when designing new learning opportunities both inside as well as beyond the classroom.

This section highlights current research focused on how CALL helps foster new learning opportunities. In doing so, we borrow a phrase from the researchers Lamy and Goodfellow (2010) who urge CALL researchers to view technology not just as a “pedagogical option” (p. 130) that accelerates conventional achievement goals but rather as a shaper of a larger “educational culture” (p. 130) that allows new learning possibilities to be created, explored, and refined. We focus our review of this research base on three main aspects of such an educational culture. The first aspect summarizes two main sources of inspiration for changes in classroom language learning: the first from research conducted on multilingual youth in out-of-school contexts and the second from studies documenting in-school uses of technology in L1 literacy classrooms. Next, we highlight how educators are making inroads into K-12 settings by using multimedia technologies as tools for learners to create new types of multilingual and multimodal texts. Finally, we examine the ways that web-based opportunities for interaction have begun to transform language classrooms into sites of semiotic richness, multi-vocal textual production, and intercultural complexity.

Sources of Inspiration from Out-of-School and L1 Contexts

When considering what technological tools can afford language learners outside traditional measures of achievement, researchers have drawn on out-of-school language research that is conducted in a variety of settings and with a variety of language learners. Research has
documented how youth, and in the case of CALL more specifically, how multilingual adolescents, have become competent, engaged users of technology outside of school environments. This research draws primarily on ethnographic case studies that feature youth who are actively establishing multilingual and transnational identities in online communities (Lam, 2000, 2004; Skerrett, 2012), engaging in complex gaming environments (Gee, 2007; Thorne, Black, & Skykes, 2009), and producing, exchanging, and commenting on multimedia texts (Black, 2008; Leander & Boldt, 2013; Vasudevan, 2010). A well-studied focus of the work done in this field is how technological tools and platforms can lead to positive identity construction (e.g., Black, 2005; Blackledge & Creese, 2012; Hull, Stornaiuolo, & Sahni, 2010; Lam, 2000, 2004, 2009; Sadykova, 2013; Samburskiy, 2013; Stornaiuolo, Hull, & Sahni, 2011). Studies have illustrated that by offering an array of interlocutors, communities, and semiotic resources, online spaces and tools provide language learners with opportunities to position themselves positively in relation to the target language and language community. Moreover, the positive identity forged in these environments has been shown to have a tangible impact on how students identify and position themselves within traditional classroom settings.

Impacts on how students position themselves have also been investigated in out-of-school settings from another angle, that of connecting kids both locally and internationally via online and digital technologies. For example, work done by Hull and colleagues (Hull et al., 2010; Stornaiuolo et al., 2011) on the private social networking site for international youth, Space2Cre8, illustrates the impact of telecollaborative interactive writing on intercultural competence and communication as well as cosmopolitan identity construction. Looking at the online literacy practices of young women from India communicating with international others, the authors identified “forms of interaction, association, and meaning-making [that] helped young participants to imagine and enact morally and ethically alert selves” (Hull et al., 2010, p. 358). In other words, this work identifies how online interactions, consisting mainly of sharing profile pages and digital stories with international others, can trigger situations in which intercultural competence and globally-positioned identities are called into play and developed for the L2 English users. In many ways, this work on interaction with global others and identity done via technological tools outside of school settings stands as a model and source of inspiration for work currently being done in K-12 settings. This groundwork helps identify the ways in which targeting learning opportunities through technological tools can impact second and foreign language learners within the four walls of the classroom.

Calls are growing to bring these kinds of out-of-school learning opportunities for youth into classroom environments, and among the first wave of researchers to answer these calls are L1 teachers who have embraced the spirit of digital literacy. Their exploratory accounts document ways they use technology to stake out new learning opportunities in their L1 literacy classrooms. A first example comes from an action research project conducted by a teacher who surveyed her own adolescent students about their technology practices and subsequently built a course syllabus integrating her own pedagogical goals with their out-of-school familiarity with wikis and digital movie creations (Tarasiuk, 2010). Blogging has also been explored by elementary school teachers as a vehicle for promoting higher order thinking skills as part of reading comprehension (Zawilinski, 2009) and by secondary educators who have used blogs to create student writing spaces that resist what adolescents often label “boring school writing” (Witte, 2007, p. 92) and to explore what West (2008) has called hybrid social languages. Graphic novels, with their mixing of multimodal resources, have also been examined as a bridging genre for adolescent learners who have difficulties with conventional print-only reading and writing (Hughes, King, Perkins, & Fuke, 2011). Finally, instant messaging has found its way as a legitimate affordance for in-school literacies in some secondary contexts (Lee, 2007; Sweeney, 2010). Although this L1 research base does not offer an explicit focus on language learning per se, these many case studies emerging from K-12 classrooms offer an important source of inspiration for CALL researchers.
**Multimodal Tools and Hybrid Texts**

One of the most popular areas of interest at the intersection of technology and language education within a learning opportunities frame is that of multimodality and its affordances in promoting student engagement, agency, and voice in the language classroom. In response to the numerous calls to integrate and study multimodality (Block, 2013; Blommaert & Rampton, 2011; Hampel & Hauck, 2006; Kress, 2000; Nelson & Kern, 2012; Stein, 2000), some scholars have begun to look at how multimodal tools can be used in this way in K-12 second and foreign language classrooms. For example, Ware and Warschauer (2005) looked at hybrid texts, or "blends of traditional texts and multimodal products" (p. 434), as not only a possible source of multimodality-based learning opportunities but also a possible bridge between in-school academic literacy learning and the usage of new media often associated with out-of-school learning. Their analysis of in-school hybrid tasks revealed opportunities for students not only to redesign texts while conveying mastery of academic content but also to become active members of knowledge construction. This then points to one viable strategy for integrating multimodal tools into classroom practices in such a way as to produce additional agency-centered learning opportunities for students.

Another strategy for the integration of such multimodal activities into K-12 language classrooms was investigated by Castañeda (2013); she identified several opportunities afforded by multimodal tools and texts to foreign language learners through a case study on the use of digital storytelling—a multimodal undertaking that requires students to weave together still and moving image (photographs and video respectively), text, and audio to tell a particular story—in a fourth-year Spanish language classroom. Castañeda found that while students were at first concerned with the grammatical and technical aspects of the project, they shifted their attention over the course of the project to the story itself and the writing process. Castañeda argues that this case study illustrates not only that digital storytelling is a viable pedagogical choice in the FL classroom but that it provides important benefits to secondary language learners: a shift in focus from form to meaning, an expanded understanding and appreciation of the writing process, and high levels of engagement and emotional investment. While the multimodal features of digital storytelling are not specifically and individually discussed, the piece overall points to potential benefits of multimodal endeavors in the language classroom that merit more inquiry.

Danzak (2011) furthered indications of multimodal tools’ benefits to learners by documenting how a multimodal, technology-based writing project, Graphic Journeys, influenced middle school-aged English language learners in their literacy and self-identity development; specifically, students involved in the project developed multimodal graphic comic strips to tell their personal or familial immigration stories through the platform Comic Life. Combined with the creation of a rich multimodal learning environment, a pedagogical focus on writing across modes, and the involvement of family members, Danzak argues that the project acted as a multiliteracy bridge to academic literacy for ELLs, allowing for a constructive focus on the backgrounds that students bring into the classroom and illustrating how multimodal tools can give second language learners a voice in educational spaces that traditionally marginalize them.

Despite the largely positive impacts of multimodal resources for learning opportunities in K-12 settings, it is important to note a few caveats to work on learning opportunities stemming from multimodal resources. For example, Ware (2006) explored the different ways in which young elementary-aged students used multimodal tools during a summer literacy program designed to support children educated in under-resourced communities. This study revealed how two students represented divergent ways in which digital storytelling could be accomplished and illustrated the different ways in which they each responded to and interacted with multimodal technology and tools. In a later study of middle school ELL learners, Ware (2008) compared how learners used multimedia within school-based learning and in after-school programs. She found that in-school usage of technology fell short of supporting key academic skills and of integrating the technology for innovative purposes, whereas in the after-school program, students were able to take up
the multimedia tools as part of project-based, collaborative work. She draws attention to how multimedia tools and their integration into language classrooms must be closely monitored to ensure that students accrue benefits, whether they be in the form of learning opportunities or learning outcomes.

In sum, then, multimodal tools from a learning opportunities perspective have been shown to offer language learners a range of benefits centered around learner agency and project-based learning—with a focus on meaning and enhanced engagement and with platforms for encouraging different voices to be performed in the classroom. This early research urges attention to the importance of contextualizing these tools and implementing them with care.

**Interactive Writing and Intercultural Communication**

The third area emerging within a learning opportunities frame explores how writing in a second or foreign language has changed with the increase in communicative and multimodal technologies. The former focus on relatively stable genres has expanded to a consideration of multiple types of writing. A common emphasis on single-authored texts has been layered into attention given also to multi-vocal compositions generated within wikis, blogs, and other social media platforms. Finally, language teachers have begun to expand the reach of their students' writing, such that students not only compose essays to be marked by classroom teachers as the primary evaluators, but rather that students also write to engage in intercultural communication with international partners as their intended audience.

A recent study by Gebhard, Shin, and Seger (2011) emphasizes the expansion of writing technologies into new interactive spaces as part of a larger web-based blogging curriculum designed to support English language learners' literacy development through a sociocultural lens. The curriculum wove blogs into scaffolded practice of different writing-based genres, such as letters and informational reports. Honing in on one focal student who struggled to meet state standards in reading and writing, the authors argue that the blogging curriculum allowed her to communicate with an expanded audience for a variety of social and academic purposes, to position herself as a good student and integral member of the learning community, and to develop an expanded awareness of the semiotic resources at her disposal. The study then underscores how interactive technologies like blogs can support language learners as they develop a deeper understanding of academic genres as well as important skills and orientations to language and literacy.

Similarly, Park and colleagues (2003, 2005) looked at how the pedagogical innovations at one francophone high school in Québec helped a cohort of English language learners develop and hone their English writing skills. The innovations included scaffolded use of computers and other technological tools to promote multiliteracies, access to and integration of computers into all aspects of the classroom and core curriculum, and an emphasis on collaborative work. The authors found that these innovations helped students appropriate the writing process, as evidenced by its application to other settings and projects. Park and colleagues, then, provide another compelling argument for the positive benefits of technology-based instruction for writing: appropriation of the process itself.

Finally, educators and researchers have begun exploring how interactive writing can promote intercultural communication through telecollaborative projects, in which students communicate with international partners. These projects point at developing a different set of competence, skills, and mindsets that are increasingly viewed as important for communicating online in the 21st century (Guth & Helm, 2010). While implementing these types of activities in K-12 foreign language contexts is increasingly popular, research into this implementation is just beginning (Dooley & O'Dowd, 2012), with the majority of studies documented within post-secondary contexts (see O'Dowd & Ware, 2009, for a review).

Two studies at the secondary level have recently been reported, both of which discussed both the positive potential as well as the challenges posed by the secondary setting. First, Evans (2011) reported on a five-year telecollaborative project, Tik Talk, that engaged francophone and anglophone speakers from around the world in bulletin board-
based interactions and sought to explore what cross-cultural interaction with target language speakers could afford language learners. An analysis of the interactions between the learners of French and English revealed that spontaneous peer scaffolding was a common occurrence, as was cross-cultural interaction in which the “possibilities of common ground [were] explored” (p. 113), often through complex topics that were fully embraced by students. Moreover, Evans points out that the program attuned student learners to the importance of close reading and to differences in genre and register through a comparison between what was used in online spaces and what was used in class. While limitations to the work were present—such as the reduced role of the instructor, the closed nature of the groups, and the extensive nature of the network—the study contributes another piece to the expanding body of work suggesting the powerful benefits of online interactive writing for language learners, highlighting specifically the possibility of engaging in challenging topics, of deepening understanding of language structure and usage, and of peer collaboration in language learning.

Next, Ware and Kessler (2013) recently reported on a mixed methods study that examined how middle school students in the US developed online communication skills through an online exchange with Spanish students. They found that participating students demonstrated significantly higher levels of interactional discourse than non-participating peers on a researcher-developed discourse questionnaire. Moreover, qualitative analyses suggested the potential of this type of interactive writing for enhancing student understanding of the language choices available to them in the context of global online communication. These types of initial studies suggest the potential of telecollaborative interactive writing for promoting a different kind of online communication skill arguably introduced by an increasingly networked, interactive world outside the classroom. In sum, then, interactive writing in online spaces, whether with local or global interlocutors, has been shown to afford language learners the opportunity to hone not only their understanding and application of the writing process but also their understanding and application of cross-cultural interaction.

**DISCUSSION: LEVERS OF CHANGE AND FUTURE DIRECTIONS**

In this review, we have carved out two main categories for synthesizing current research on language learning and technology within K-12 settings. We have argued that studies conducted within a learning outcomes perspective help educators determine which technologies can best meet particular learning goals more effectively and efficiently. Choosing among different technologies to find the most well-suited pedagogical option for meeting particular learning goals for targeted learner populations allows educators to amplify the pace and possibilities of familiar learning paths. In contrast, research examining the learning opportunities made available through technologies asks how the educational culture itself might be shifting due to the affordances offered by social networking sites, multimodal and multi-vocal authoring, and international interactive communication. In these sites, learners are increasingly able to merge out-of-school language environments with in-school learning and to participate in a variety of meaningful communicative environments that rely on flexible and creative approaches to language learning and use.

In looking toward future research, we anticipate that K-12 educators and researchers, from both the learning outcomes and opportunities frames, will increasingly seek opportunities to collaborate, particularly in two key areas: assessment and professional development. The first of these, assessment, offers a key lever of change in elementary and secondary contexts. Assessment data that provide information on large numbers of students help persuade stakeholders to support the kinds of financial, infrastructural, and pedagogical changes needed when institutionalizing the integration of language learning technologies at a large scale. We are therefore likely to see increasing use of technologies that promote specific learning outcomes, such as standalone modules that allow learners to practice integrated language skills, particularly for the growing population of English language learners in US schools.
However, as we have discussed within the learning opportunities frame, understanding the promise of particular tools is difficult to track without also mapping out newer domains of language learning and use that are afforded by newer technologies. Therefore, strong evaluative efforts that include a variety of research methodologies across both the qualitative and quantitative spectrum are needed. CALL researchers have already begun to develop creative research designs that draw on social network analyses (Zheng & Warschauer, 2012), correlational analyses (Lawrence, Warschauer, Zheng, & Mullins, 2013), and mixed methods research (Ware & Rivas, 2012).

The second area likely to receive attention in the near future is professional development. We have documented a gap in how resources are allocated to help language teachers adopt new technologies, adapt to new instructional contexts, and assess new types of student learning. Despite this limited investment in funding for, or access to, systematic professional development in K-12 settings, however, CALL researchers have documented encouraging accounts of educators who have nonetheless committed substantial efforts to integrate technology into their language classrooms. Such studies have tracked the importance of coupling training with a positive school culture (Hawkes, 2011) and a supportive department culture (Fisher, 2011) in order to generate enthusiasm for change, willingness to attempt new pedagogical approaches, and maintenance of technology integration over time.

Beyond these structural and pedagogical supports involved in professional development, research is also needed to identify how educators’ underlying theoretical perspectives of language learning are intertwined with—and might also possibly be changed by—technology use. Over a decade ago, for example, Warschauer (1999) illustrated how beliefs about language are intimately connected to instructors’ on-the-ground practices in the classroom by examining case studies of instructors who used technology in their writing instruction. Similar results were found in a recent study by Kozlova and Zundel (2013), who documented five focal teachers using new multimodal technologies in their online language learning platforms. In these studies, how each instructor made use of the multimodal features reflected their underlying theoretical perspectives on learning and teaching languages. Future research on professional development will contribute more factors that influence instructors’ use of various technologies in K-12 settings.

We close with an appeal to CALL researchers to continue building conceptual models that support creative research designs in ways that strengthen the growing knowledge base within our various specialized areas. We believe that the two perspectives presented here, of learning outcomes and learning opportunities, help frame current research and future developments in the unique context of K-12 learning. As we strive to keep pace with the new pedagogical possibilities opened by both current and ever-newer technologies, we anticipate that the spirit of creative inquiry will continue to draw researchers together to further our collective understanding of technology and language learning.

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