Language Learning & Technology
ISSN 1094-3501
October 2021, Volume 25, Issue 3
pp. 6–26

EMERGING TECHNOLOGIES

Evolving technologies for language learning

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Abstract

This column traces the evolution of electronic resources for language learning over the past 25 years, focusing on the arrival and transformation of the "world wide web", the dramatic changes in mobile technologies, and the movement towards commercial and all-in-one solutions to online learning. In the choice and use of learning materials and approaches, I argue for the consideration of current research in second language acquisition (SLA), with particular importance being studies on sociocultural/pragmatic and multilingual practices, the application of usage-based and complex dynamic models of language learning, and the evidence of the viability of informal language learning. Those developments inform an ecological approach to computer-assisted language learning (CALL), which stresses the openness and unpredictability of the process through the organic interplay between learner and environment. The column concludes with a plea for a greater role for second language development as a vital contribution to the development of global citizenry.

Keywords: *CALL, SLA, Ecological Theories, Mobile Language Learning, Language Learning Materials*

Language(s) Learned in This Study: *English*

APA Citation: Godwin-Jones, R. (2021). Evolving technologies for language learning. *Language Learning & Technology*, *25*(3), 6–26. http://hdl.handle.net/10125/73443

Introduction

Five years ago, in the 20th anniversary issue of this journal, I provided a retrospective of the columns I had written on emerging technologies (Godwin-Jones, 2016c). Looking back at those columns provided a perspective on developments in computer assisted language learning (CALL) since 1997. This time around, I will focus more specifically on the evolution of technologies used in language learning, with my take on what tools and approaches have proven to be enduring and which have faded. Although my overview will be guided by evidence in terms of published research, this will not be a formal meta-analysis or systematic survey. There will be a good dose of subjectivity on display, shaped by my own experiences as a teacher, scholar, and member of the CALL community. That perspective is also determined by my long-term service at a public university in the United States, making it likely that there will be an evident North American slant. While my primary focus is on the evolution of technology over the last 25 years, I necessarily will be considering approaches as well to second language acquisition (SLA) that have played a role in technology adoption and utilization. I begin with a look at specific tools and environments for CALL–especially the web and mobile devices–then discuss more specifically the evolving interface between CALL and SLA. I conclude with a look at metaphors for characterizing CALL and at possible future directions.

CALL Tools and Environments

In the first issue of *LLT*, I wrote about streaming audio and video, innovations in 1997. The movement away from physical media has continued since then, with streaming audio services such as Spotify and streaming video companies like Netflix dominating the market. In the trash have gone CDs and DVDs.

The battle over digitizing standards and media formats seems quaint today, with once widely promoted standards such as HD-DVD now a footnote in Wikipedia. For that matter, some of the format winners, Blu-ray video, for example, have declined to near irrelevance. Media streaming will serve here as an example of several general trends evident in the evolution of technology tools in general and in CALL specifically over the last 25 years. I will focus principally on two blockbuster developments in that time period, the world wide web and mobile phones, but will discuss others along the way. The trends I highlight are: (a) the rise of networks and of multimodal communication, (b) the commercialization and commodification of the Internet, and (c) the movement away from hands-on CALL development.

Networks and Multimedia

The rise of streaming video in the latter 1990s, integrated into web pages (through plug-ins), heralded the arrival of networked multimedia. That has been accelerated in the last decade through mobile devices. The early web seemed to promise the situation we have today in mobile technology, with multiple tools and services integrated into a single platform. That was the promise of Java, embedded into webpages as applets. Performance problems, incompatibilities, and security concerns doomed Java as a client-side web technology (similarly with Flash), although Java still has a strong server-side presence. Other transformative promises of the web have fallen by the wayside as well. At one point, we were headed towards a 3-D web (Panichi et al., 2010). The dream of a "semantic web" (Berners-Lee et al., 2001) turned into a fantasy as well, the tagging and taxonomies necessary turned out to be incompatible with quick and dirty web authoring, which emerged as the de facto standard. The main culprit, however, as discussed below, was different: as tech companies gained ever more users and power, an orderly, organized web promised to provide fewer monetary gains.

In 1996, networks were wired, wireless alternatives were expensive, slow, and unreliable. Wi-Fi and fast, ubiquitous cellular service have enabled the mobile revolution we continue to experience. That connectivity to the world (and social media, email, chat, etc.) along with incredibly useful mobile app/services (maps, streaming media, news, etc.) have created a new, intimate, and indispensable relationship with technology through our phones (Eilola & Lilja, 2021). The smartphone ecosystem has accelerated and cemented the multimodality of the incipient web through easier playback, capture, and editing of audio and video. Apps today seamlessly and transparently combine text, sound, and images in a handheld device with more processing power than desktop computers of the 1990s. Those of us who recall the jerky, stamp-sized digital media of early QuickTime continue to marvel at where we are today. From a language learning perspective, smartphones have brought additional benefits: easy text entry in multiple script systems, ability to combine different languages in a single text, the anytime-anywhere access to authentic L2 materials, the availability of L2 support services (dictionaries, translators, flashcards, etc.) and more.

Of course, today, we see those language learning features of smartphones as a given and look to more innovative uses of the mobile space, such as augmented reality (AR; Godwin-Jones, 2016a). Two of the most downloaded articles in *LLT* over the last quarter century are columns on mobile apps (Godwin-Jones, 2011) and on smartphones (Godwin-Jones, 2017), testimony to the continued importance of the mobile space (see Guillén, 2021). The apps column, surprisingly to me, is in fact the number one downloaded *LLT* article, despite the fact that it advocates for a direction in app development contrary to subsequent mainline practice. I argued for web-based rather than proprietary apps, allowing for access on multiple operating systems (and on web browsers) and using open standards. Few apps today are hybrid in that way, although Ovide (2020) points to recent developments in mobile gaming that enable use on smartphone web browsers as a possible general trend. I have argued frequently in *LLT* columns for the use of technology standards, accessibility, interchangeable formats, and open resources. As Colpaert (2016) argues, using open formats is important in technology sustainability, a key consideration in a field in which there is a long history of projects and products suddenly disappearing.

Commercialization and Commodification

The early web for language learning was all about access to L2 materials (Godwin-Jones, 1996). No longer did language instructors need to be sure to leave room in their suitcases from trips abroad to include newspaper clippings, advertising supplements, restaurant menus, or printed train schedules. All that and more became available electronically. Moreover, those realia did not come artificially packaged and out of date in textbooks, but were culturally and linguistically authentic, written for local or national populations. In that way, they offered the additional benefit of insights into regional cultural differences. It took little time for language instructors to send their students online to conduct webquests (Godwin-Jones, 2004) or to gather knowledge (and local contacts) in preparation for study abroad (Godwin-Jones, 2016b).

It was not long before a different kind of resource became available online, principally on the web, which proved to be linguistically and culturally valuable. These were personal writing through blogs, travel diaries, reviews, recipes – the kind of individual contribution initially labeled as the read-and-write web and subsequently Web 2.0 (Godwin-Jones, 2003). As more people and more countries gained online access, individuals and class-based exchanges became possible, opening what has proven to be one of the most pedagogically effective uses of online access, namely virtual exchange or telecollaboration (Godwin-Jones, 2019d). Exchanges started out as email and chat, often using the tandem model. The Cultura project (Furstenberg et al., 2001) stands out as an outstanding model of telecollaboration, often still used as an inspiration and model (Chun, 2014). Today, lingua franca, often multilateral exchanges have proliferated through organizations such as Soliya or Erasmus+ pre-mobility (Dooly & O'Dowd, 2018). The wide use of virtual exchange has been enabled by access to free videoconferencing tools like Skype and Zoom, available on mobile devices. Those services have become invaluable in a world in which physical displacement and contact have eroded as a consequence of a global pandemic. Although sometimes outsourced to commercial services (using, for example, TalkAbroad or Conversifi), virtual exchange is one area in which open partnerships and initiatives among educators (through UNICollaboration or other services) have predominated. The new Journal of Virtual Exchange is testimony to the importance and wide use of this powerful learning activity.

While the web continues to be a tremendous boon to citizens, consumers, and educators, the original vision of what the web could offer the world has faded. That utopian view was of a universally available platform for free exchange of all voices and views and therefore an enabler of democracy and equality. A recent series in the *New York Times Magazine* explores the many ways the Internet has evolved in a different direction (So the Internet didn't turn out the way we hoped, 2019). One of the unfortunate developments ironically has been through the devices which have brought online access to more and more individuals, namely mobile phones. The popularity of apps has splintered online content and exchanges into proprietary silos, which tend to perpetuate echo chambers. That movement is clearly present through social media, with Facebook and Twitter as poster children. Smartphones have accelerated that tendency, as they build distance between individuals fixated on their screens and physically present others, as well as create walls between themselves and users of different apps. That has led to a situation described by Turkle (2011) as "alone together" and by others as "networked individualism" (Rainie & Wellman, 2019).

The early web promise of an enlightened citizenry through universal access to information online has withered as well in the face of ever more instantly shareable online misinformation, resulting in widespread belief in conspiracy theories and outright lies. Unfortunately, the barriers to reliable information from mainstream media have grown through the rise of paywalls. At the same time, intrusive online advertising has made many websites and media almost unusable. That is the case, for example, for YouTube, a resource that otherwise offers many opportunities for language learning (Terantino, 2011). There is a significant further downside to the openness of the web, especially evident in social media, namely the proliferation of hate speech and harassment. Companies whose existence depends on advertising revenue (Facebook, Google) have been reluctant to risk losing users (and money) through closer monitoring of content. This has led to the need for extreme caution in online access in educational

settings. Large language models, such as GPT-3 (Godwin-Jones, 2021), built on crawling the Internet indiscriminately and collecting massive sets of data, inevitably contain biased, false, and harmful speech (see Bender et al., 2021). Much of the negative language is aimed at black and brown populations and at women. Jee (2021) suggests that a feminist orientation to the Internet would benefit not only women, but everyone. That might take the form of new social media platforms, such as the recently released Herd, which is much more customizable than Facebook, allowing, for example, for adjustments to feed parameters and supplying additional privacy options. Berners-Lee, the originator of the web, has recently begun an initiative through an open-source software project, Solid, to counter online hegemony and personal tracking (Lohr, 2021). Another approach might be the application of non-Western frameworks to the ethics of data use and collection. Williams et al. (2020) advocate for the integration of Confucian life ethics for language models used in robotics. Ethical issues in data collection and use have come to the fore in recent years among the general public, commercial technology firms, and AI developers (see D'Ignazio & Klein, 2020). Privacy and ethics concerns are critical in CALL as well and need to be a major topic in teacher education (Hubbard, 2017).

From Do It Yourself to Do It For Me

The movement towards the commercialization of online spaces occurred at a time when ever more people have the opportunity to be not just consumers, but producers of content. In fact, this has created new pathways to wealth through online "influencers" and YouTube stars. In contrast to content creation in the early web, today few technical skills are needed to post content online. There is no need to learn the scripting language of the web, HTML, just as there is no need for dedicated desktop applications for audio or video recording/editing. Everything can be done easily on a phone. This has led to an overflow of online content, so that separating the wheat from the chaff has become increasingly more difficult and time-consuming. This represents a big shift in what today constitutes digital literacy. The emphasis has moved from how to use online tools and services, to how to find and consume trustworthy and personally appropriate content. That may involve the ability to find an individually effective way to organize and retrieve information on one's phone and in the cloud, as demonstrated in the migrant learner of Finnish profiled in Eilola and Lilja (2021), who finds unique but effective ways to record and quickly retrieve notes on vocabulary encountered in the wild.

A parallel shift has occurred for language teachers. By the 1990's we were already far removed from the earliest days of CALL. In the 1970s and 1980s, it was expected that one be proficient at programming. The landmark CALL book by Higgins and Johns (1984) consisted largely of a set of subroutines in BASIC. The web originally was similar. To post content you not only needed to learn HTML, but also how to transfer files to a server using FTP, and possibly even how to set up and run a web server of your own. To add interactivity to your web page you would have needed to learn Perl or Java to create server-side scripts. Browser-based interactivity through JavaScript arrived in 1995 and required as well a basic knowledge of programming concepts. While of course it is still possible to create one's own webpages, the process has become more involved, largely because the contemporary web of HTML5 offers so much more in terms of user interface, element positioning, and interactivity (Godwin-Jones, 2014). As a result, web code has become much more complex, with web creators using widely distributed scripting libraries such as JQuery, combined with data formatted in JSON (JavaScript Object Notation). At the same time, form-based pages with text entry options have yielded to easier (and more flexible) contributions to websites and social media. That includes easy ways to embed images or videos.

For instructors using the web in classroom settings, another development has removed the need to know how to create webpages, namely the rise of learning management systems (LMS) such as Blackboard, Canvas, or Moodle. Such services are now widely used, especially at the tertiary level, and allow instructors to create shells for their classes which handle efficiently posting assignments, collecting and grading homework, maintaining a gradebook, setting up discussion forums or journals, and sharing content. The benefits of using an LMS are sometimes seen as offset by the limitations inherent in their use, leading professors to assume that the sum total of what is possible to do online is represented by that

proprietary system. Critics point as well to the fact that content created by both instructors and students is trapped within the system and that achieving a comfort level in using an LMS is hardly a useful skill for life and work after graduation (Godwin-Jones, 2012). For language instructors, another widely adopted option provides a resource for learning materials not needed to be created locally, namely publisher sites that most often accompany commercial textbooks. While these electronic workbooks are widely used, the design and functionality has been criticized, shown to be one of the main reasons students dislike hybrid language classes (Anderson, 2018; Lomicka & Lord, 2019). In fact, most publisher sites revert to a behaviorist model of language learning, with mechanical practice and little emphasis on meaningful communicative tasks (Sharma, 2017).

The wide use of commercial materials may be one of the principal reasons that open educational resources (OER) has not lived up to the promise many of us saw in that movement, although recent evidence suggests perhaps new impetus arising for open resources (Blyth & Thoms, 2021; Comas-Quinn et al., 2019), as well as for student-generated resources (Narwood, 2021). The Boise State Pathways Repository for OER provides a useful model for locally developed but nationally distributed open learning materials. Bañados (2006) and Garza (2016) provide models for hybrid and online learning that go beyond the LMS and publisher sites, integrating a wide variety of open tools and services that are designed to complement each other. Combining learning resources, as determined by contextual appropriateness, departs from an all-in-one content strategy, moving towards the concept of "atomized CALL," as outlined in Gimeno-Sanz (2016). To counter the possibility that selected tools or services will become unavailable or obsolete by the time they are ready to be deployed, Sykes and González-Lloret (2020) argue for possible partnerships with commercial developers. An alternative is to seek out open, sustainable resources or to develop pedagogical materials with colleagues and/or students (Mathieu et al., 2019). Partnerships with nonprofits or government-funded initiatives is another route. That has long been possible within the EU, although many projects remain prototypes rather than ongoing tools or services. In the US, federally funded national language centers offer avenues for funding and expertise. That is the model, in fact, that has allowed *LLT* to exist for 25 years. Given the wave of newly online or hybrid L2 courses arising out of the pandemic, we can hope that new approaches can supply alternative models for online learning integrating open resources (Godwin-Jones, 2020a). As discussed below, new models ideally will be based on lessons learned from recent research in SLA.

CALL Development from an SLA Perspective

Electronic workbooks from publishers and online language learning services, such as Duolingo or Babble, generally use an approach to SLA aligned to a cognitive model of language, with a traditional division into separate skills and a separation of lexis, syntax, and morphology (Guillén et al., 2018). Language is presented as a discrete set of knowledge to be learned, with right or wrong choices and with the end goal of native-like fluency and correctness. While contextual language use through interactions with peers or tutors is often an available feature in commercial language services, it is not the core of the approach, and sometimes is available only through a premium upgrade. I will argue here that, despite the popularity of commercial publishers and online language learning products and services, CALL approaches that are more oriented towards developments in SLA theory and research findings point in quite different directions. Those include: (a) the centrality of socio-cultural learning in SLA, (b) a model of language based on usage-based theories, (c) the evidence of the effectiveness in the use of leisure-oriented informal language learning resources, and (d) the reality of widespread multilingualism.

Socio-Cultural Learning

It has been increasingly recognized in SLA theory that more than cognitive processes are involved in learning a second language (L2; Atkinson, 2014; Ellis & Larsen-Freeman, 2006). Human language is a social phenomenon and socialization plays a major role in learning our first language; this too is true in subsequent languages (Lantolf & Pavlenko, 1995). We learn language by using it (Larsen-Freeman, 2015). In CALL, social learning has underpinned the rise of computer-mediated communication (CMC),

the use of email exchanges, text chat, and discussion forums to provide opportunities for real use of language by learners (Thorne, 2008). Today, virtual exchange, most often involving videoconferencing, has become an important addition to instructed SLA. While they do not duplicate the process of in-person communication (Kern, 2014), video exchanges do represent embodied communication, allowing for affect displays, gestures, and physical surroundings to be part of the messaging. Recent research in SLA has highlighted the reality of embodied and distributed cognition (Guerrettaz et al., 2021; Thorne et al., 2021).

A major benefit of having learners engage in online exchanges is the potential for gaining insight into the importance of language pragmatics, the use of language in culturally and contextually appropriate ways (Culpeper et al., 2018). Learners gain experience in culturally determined practices, such as turn-taking, topic switching, politeness conventions, and forms of address; in linguistic phenomena like intonation and register; and in meta-linguistic factors such as backchanneling or asking for help/clarification. These are areas rarely included in classroom instruction or covered in textbooks. They are slippery concepts in contrast to grammar and vocabulary learning. As there are no hard and fast rules, but rather patterns of usage established by convention, pragmatic language is best learned in actual language use. Explicit instruction can be helpful (Sykes & Cohen, 2018). Communication breakdowns resulting from faulty pragmatic transfer or pragmatic ignorance may be embarrassing, but can represent "rich points" (Agar, 1994), likely to be a memorable learning experiences through emotional resonance (Helm, 2013). The development of self-awareness through encounters with disorienting dilemmas (linguistic or cultural) can be a transformative learning experience (see Leaver, 2021).

Although mostly neglected in commercial language learning services, the importance of pragmatics has become much more recognized today than it was 25 years ago. There is substantial evidence of its more frequent appearance in L2 instruction, both in the classroom (Taguchi, 2015) and as an independent online resource (Yeh & Swinehart, 2020). Still, SLA research continues to focus predominantly on language complexity, accuracy, and fluency (CAF), rather than on adequacy and appropriateness (González-Lloret, 2019). CALL research has dealt with pragmatics mostly in the context of CMC and telecollaboration (González-Lloret, 2019). Promising new directions in pragmatics and CALL are studies examining conventions and practices in different online communities (Yeh & Swinehart, 2020, on Reddit), on specific tool use (Sykes, 2019, on hashtags), or on recreational activities (Sykes & Dubreil, 2019, on gaming). Of particular usefulness are online resources for help in the difficult task of assessing pragmatics learning (Sykes et al., in press).

The Usage-Based Language Model

The increased recognition of the importance of pragmatics in SLA parallels a movement away from a model of language built on rules to one based on patterns. A usage-based perspective highlights the importance of word groupings, chunks of language conventionally used together (Ellis, 2017). Those groupings combine lexis and grammar and can range from collocations to frequent syntactical structures. This model of language has been supported by studies in corpus linguistics and by the practice of conversation analysis (CA; Seedhouse, 2005). González-Lloret (2015) provides a useful overview of the use of CA in CALL. Multimodal CA, integrating transcripts with images from video recordings, has become an effective means to analyze exchanges, demonstrating the important role played by physical surroundings, objects, and body language/gesture/gaze (Eilola & Lilja, 2021; Thorne et al., 2021).

Patterns of language are learned through frequency and saliency. Language learning from this perspective is a statistical process (Ellis, 2017), based on exposure to patterns in context. As with pragmatics, explicit instruction has shown to be helpful (Ellis, 2008). Data-informed approaches to SLA leverage the large collections of actual language usage available in corpora to point to patterns prominent in a given language. Studies have shown how corpus-based instruction can be helpful in students learning constructions that are important, but quite different in nature from students' native language (Boulton & Cobb, 2017). An inductive approach to data-based learning involves students being given a set of data (sample sentences) drawn from a corpus and tasked with analyzing and finding regularities and commonalities in order to uncover and learn patterns. For many learners this active, discovery-based

learning can be quite effective (Flowerdew, 2015). Similar insights into specific use of constructions as well as into metalinguistic knowledge of how language works can be gained through CA, a technique mostly associated with research, but which is useful in instructional settings as well (see McConachy, 2017).

I first wrote about corpora in *LLT* 20 years ago (Godwin-Jones, 2001) and have since written repeatedly on data-informed language learning. It has been argued that corpus use has gone mainstream (Boulton & Cobb, 2017). That may be the case among researchers in applied linguistics, but I am skeptical to what extent hands-on corpus access is widely used in instruction (see also Chambers, 2019). On the other hand, corpora have positively influenced textbook authoring, dictionary compilation, and other language tools/services. Although data collection and analysis play a central role in CALL, a recent issue of *LLT* on big data generated fewer submissions than usual and only two accepted papers (Reinders & Lan, 2021), perhaps a sign that the topic is not seen today as being as promising in its usefulness as I and others (Kessler, 2018) have thought. The explanation could be related as well to the technical requirements of dealing with big data and artificial intelligence (Godwin-Jones, 2021). It reflects perhaps as well a decline in research activity in iCALL (i.e. intelligent L2 tutors), as that direction necessarily involves both sophisticated data collection/analysis and natural language processing (Lu, 2018; see, however, Chinkina and Meurers, 2017, for an example of innovative AI-based iCALL). Advanced techniques in learning analysis have shown that the use of AI tools in data analysis is worthwhile. That is demonstrated, for example, in the use of clustering techniques to identify salient patterns in small groups, as seen in Lee et al. (2019) or Peng et al. (2020). Similarly, AI-based tools for social network analysis are being used to uncover usage and learning patterns (Butler & Liu, 2019), with visualization tools being helpful in illustrating trends and models (Youngs et al., 2018). Such approaches can provide informative results that move beyond whole group results or averages to reveal important variations in outcomes.

Although a usage-based understanding of language, with its emphasis on the importance of examining words in context, is today widely accepted in applied linguistics, its impact on practices and products for learning grammar and vocabulary has been minimal. Commercial language learning services and publisher sites emphasize discrete grammar knowledge, separate from vocabulary. Dedicated vocabulary learning, although today improved through tools like Memrise that feature sophisticated spacing algorithms and crowdsourcing of mnemonic devices, continues to focus on individual words, rather than on phrasal integration or collocations (Godwin-Jones, 2018).

Informal Language Learning

In recent years, a number of studies have highlighted an approach to SLA which draws on usage-based theory, namely the use of leisure-oriented informal language learning resources online. Much of that research has focused on learners of English, for whom there are particularly rich resources available online (Kusyk, 2017; Sockett, 2014; Sundqvist & Sylvén, 2016). This phenomenon has been made possible through the growing availability in many countries of streaming audio and video services that provide free or low-cost access to popular music, television series, or movies. Particularly effective is video programming which features characters in repeating roles and in similar situations from one episode to the next. Those include situation comedies, soap operas, or blockbuster movie franchises. Incidental language learning comes through both the entertainment value – leading to frequent viewing – and the exposure to characters' idiolects and recurring language patterns. This has its theoretical basis in usage-based linguistics.

It is not only media consumption that has been studied as a source of SLA, but social media and participation in affinity groups as well. These are activities in which L2 learner users engage for enjoyment or socialization, but which have a potential byproduct of SLA. Fanfiction has come to the fore in recent years as an activity that can represent a powerful combination of agentic action, identity exploration, extensive L2 writing, and community building/mentoring (Sauro, 2017). Studies of the role of Facebook in language learning have shown as well the complex intertwining of identity construction, socialization, and creative language use on that platform (Baker & Sangiamchit, 2019). That has been

shown to be the case in online gaming as well (Scholz & Schulze, 2017). In fact, gaming — in its many different iterations — is one of the success stories in CALL in recent years, even if not a universally appealing activity (Chun, 2019). The combination of entertainment/competition (emotional investment), identity exploration (through avatars), group interactions, and pragmatic language use make multiplayer online games an ideal vehicle for second language learning (Reinhardt, 2019). Widely popular gaming platforms such as Fortnite, Roblox, or Minecraft have evolved beyond simply gaming, becoming more akin to social networks. Indeed, some are foreseeing a metaverse (a universally shared, always on virtual space, as in Stevenson's *Snow Crash*, 1982) built around a platform such as Fortnite (Park, 2020).

On the other hand, the recreational use of immersive technology platforms, which seemed to hold such promise for language learning, have faded, with the rise and fall of Second Life (see Hubbard, 2019). On the other hand, more recent products such as ImmerseMe or Mondly offer interesting immersive opportunities for language learning (Fryer et al., 2020). Makransky and Petersen (2021) offer a promising theoretical framework for integrating immersive VR into educational practice. As is the case with Second Life, other once promising technologies and consumer products have morphed into different forms. Electronic whiteboards, for example, have been replaced with handheld tablets, Microsoft Kinect by personal robots. Smartphones have disposed of a whole range of consumer products, including cameras (still and video), personal digital assistants (Newton, Palm), GPS devices, dedicated music players (iPods), and voice recorders. Meanwhile, new consumer devices (smart glasses, home speakers, car consoles) seem poised to offer new avenues for informal language learning (Godwin-Jones, 2019a).

Translanguaging

A characteristic increasingly recognized as salient in online language use, such as in social media or multiplayer gaming, is its multilingual nature (Ortega, 2017, 2019). Researchers have demonstrated, for example, how many Facebook exchanges involve multiple languages (Kulavuz-Onal & Vásquez, 2018). This reflects current understanding of L2 development: that a learner's L1 does not simply go away while the L2 is practiced, but rather is constantly in the background, influencing L2 use (Blommaert & Rampton , 2015). The intertwining of languages cognitively and socially has been characterized with the term *translanguaging* (García & Li, 2014). The reality of that phenomenon–perhaps more evident today than ever before, especially in online environments–calls into question the historical approach to instructed SLA of striving to create a monolingual native speaker equivalent in the learner. Instead, learners can be thought of as developing a set of "mobile symbiotic resources" (Blommaert , 2010, p. 43), with an awareness of how they are used appropriately in different contexts. Mixing languages can be natural and accepted in some situations but not in others. Multilingual awareness and meta-linguistic knowledge are recognized today as important goals in instructed SLA (Ortega, 2019). That movement translates into classroom practice in terms of the use of the target language only as well as in a recognition of the value of translation activities (Kramsch, 2020).

Exposure to L2 communities online provides a rich demonstration of translanguaging. It also is increasingly evident that there is the potential in such activities for significant intercultural learning and enhanced global awareness. That has led to greater emphasis being placed in SLA on leading students towards more awareness and experience with cross-cultural communication, so as to develop "critical intercultural awareness" (Byram, 1997, p. 19). SLA researchers in recent years have raised the idea that language learning has a socio-political significance and that therefore language learning should be viewed as an instrument for advocating social justice and developing in students a sense of global citizenship (Lenkaitis & Loranc-Paszylk, 2019) or "critical cosmopolitanism" (Jackson, 2018). That has been the case in CALL as well (Anwaruddin, 2019; Hellmich, 2019). Studies such as Kukulska-Hulme et al. (2015) and Eilola and Lilja (2021) demonstrate how smartphone use among communities of learners can become a resource for joint social action.

Multilingualism has been slow to gain a foothold in CALL (Buendgens -Kosten, 2020; Ortega, 2017). Few CALL projects or products support plurilingual skill development. In addition to incorporating multiple languages in interfaces and content, desirable as well is the possible integration of language

variants, such as demonstrated in Papin (2018), which discusses an immersive learning tool featuring variations on continental French. The perspective on languages in CALL tends to be even more restricted, in that the overwhelming focus has been on English language instruction (Sauro, 2016). At the same time, the ubiquity of English language instruction has led to many more opportunities for exchanges among English learners. Research in this area has provided interesting insights into English as a lingua franca (Baker & Sangiamchit, 2019) and English use in international contact zones (Canagarajah, 2014). Findings from research in these areas can be informative for CALL research (Godwin-Jones, 2020b), given that the Internet today provides a multilingual contact zone as never experienced before (Thorne et al., 2015).

CALL Metaphors and Future Directions

In a recent monograph in the *Modern Language Journal*, Levine (2020) outlines a "human ecological approach to language pedagogy" (p. 9) in which he presents SLA as a transformative process, both for the individual and potentially for society as a whole. He argues for facilitating learner agency through choice, fostering the capability for critical examination, and highlighting the crucial role of the narrative imagination. Basing his pedagogical model on sociocultural theory and complex dynamic systems theory, Levine argues that given the complexity, multilingualism, and politically volatile world of the 21st century, a new language pedagogy is needed that takes into consideration both issues of social justice and the multiplicity of opportunities for SLA today beyond the classroom. Repeatedly in the monograph, Levine uses the same metaphor for emphasizing the variability of language learning trajectories, the impact of initial conditions for SLA, and the crucial role of the learning environments encountered, namely that of a surfer riding ocean waves:

> The complex system that is the surfer, the board, the wave (itself an entity in a complex ecological system), and other elements and processes less relevant to our illustration, come into being the moment the surfer steps onto the board to ride the wave. For those exciting seconds (exciting for the surfer as the only sentient agent in this particular system, or perhaps for us as spectators), all the entities that make up the system are interconnected and in fact interdependent. The nature of the ride will depend on factors such as the skill of the surfer, the shape of the wave at any given instant, the wind, and so forth (p. 22).

Levine (2020) goes on to explain how that dynamic of the surfer corresponds to a classroom language learner:

> While one certainly can draw metaphorical parallels between a surfer riding a wave and a language learner learning a new language, the point here is indeed that the nature of dynamic, interconnectedness in a language classroom is akin to that of the surfer riding the wave. The initial conditions of the system are crucial, that is, the sorts of knowledge, abilities, and traits of each individual, the dynamics of the classroom community, the experience, knowledge, and skills of the teacher, features of the physical and social context, and so forth, all impact the developmental and language-use paths individuals follow in whatever period of time the system exists (p. 23).

Interestingly, that metaphor of the surfer is what I used as well in a recent *LLT* column on learner autonomy (Godwin-Jones, 2019c). I argued that the complex ecological system of the ocean surfer–with its interdependent dynamic of body and environment–parallels the contemporary language learner, especially through reliance on online informal language learning:

> Successful outcomes are not assured and are dependent on both the individual's background, initiative, and competence, as well as on local conditions. The surfer's trajectory, like that of the language learner, is susceptible to the kind of initial conditions at hand (of the individual and of the environment), both of which are subject to constant change. Second language (L2) development is a dynamic process, often nonlinear and episodic, making static or linear metaphors of mastery or programmatic progression invalid (Godwin-Jones, 2019c, p. 9).

Language learning trajectories depend on an ever-changing array of affordances that derive from interactions of learner agency with the resources available at a given time and space. As Levine comments, "To stretch the surfer metaphor just a bit more, from a pedagogical perspective, it is not about trying to predict a particular outcome but rather smoothing the way for the learner " (p. 24). That in a nutshell is our task as language educators and CALL practitioners, to help steer the learner, living "at the edge of chaos" (Finch, 2010, p. 423), to find the pathways over time likely to be most beneficial. That translates into rejecting a one-size-fits-all pedagogy and focusing on individual trajectories, in line with increasing calls in SLA theory for a person-centered approach (Benson, 2017; Larsen-Freeman, 2018). One of the most noticeable trends in CALL research reflects this direction, namely the proliferation of qualitative studies which examine individual learners or small groups (Chun, 2019). Analysis of learners' language diaries or learning histories can be revelatory (Benson & Nunan, 2005).

Reinhardt (2020) has written recently that CALL from its earliest days has used metaphors to characterize how computers can be helpful in language learning. Those include the frequently encountered images of the computer as "tool" or as "tutor":

> Though the first CALL programs were tutors, mobile language apps like DuoLingo incorporate activities that reflect this metaphor still today. As a result, many users still think of technology as an L2 teacher, rather than as a tool used by the learner or teacher constructively. In contrast to a tutor, a computer that is understood as a tool is not the sole source of knowledge, but rather it serves as a means to develop or access knowledge, aligning with cognitive-constructivist understandings of language and learner-centered approaches to instruction (p. 235)

Reinhardt points out that through the rise of social and collaborative learning in conjunction with the contemporary web, a “new metaphor of technology as community or ecology emerged, a derivative of the tool metaphor but going a step further and recognizing the socially networked and interconnected nature of the use of tools” (p. 235). Reinhardt asserts that the tool metaphor does not adequately describe the reciprocal relationship of user and environment in social media, namely that the user contributes to an online environment (blog, forum, fansite, for example) and in the process changes that environment.

This aligns with recent assessments of the relationship between learner and the environment. Levine (2020) calls for new views on context, not viewing it as background, but as a vital, fully participating, and dynamic actor in the learning process. This echoes the “material turn” in language education (Guerrettaz et al., 2021, p. 4) as demonstrated in studies by Canagarajah (2018) and Pennycook (2018). Sociomaterialism, as discussed in Guerrettaz et al. (2021), has a particular appeal for CALL research, as it proposes to break down barriers between learning materials and the social world. Exploring the complex relationship between humans and objects is becoming recognized in CALL research as an important area of study, as seen in studies associated with the “maker” movement (Dubreil & Lord, 2020). The view of materials as “emergent assemblages” (Guerrettaz et al., 2021, p. 11), whose use and usefulness may vary widely depending on user conditions, helps to illuminate the complexity and variability in SLA today. Researchers have invented new terminology to characterize the intertwined relationship of individual, language learning, and environment, such as *mindbodyworld* (Atkinson, 2014), *structured unpredictability* (Little & Thorne, 2017), or *rewilding* (Thorne et al., 2021). These formulations strive to integrate scientific studies examining organisms in their environments, such as the concept of *Umwelt* in biosemiotics (Von Uexküll, 1909) or that of *organism-environment system* from psychology (Järvilehto, 2009). Such concepts postulate an expanded, dynamic, and distributed sense of cognition and agency, shared between the individual and the environment.

Recognizing the limitations in the view of CALL materials as tools, Reinhardt (2020) proposes a new set of metaphors:

> I propose an additional set of metaphors that construe social media apps, sites, and services not only as tutor, tool, or communities, but as windows, mirrors, doorways, and playgrounds. These metaphors capture user action, perception, and reflection, which are key to understanding them as part of ecologies of language learning and use (p. 236).

I believe these metaphors are helpful in pointing out how online media today makes two-way communication and actions possible (windows, doors), but also can lead to self-reflection and self-knowledge (mirrors), as well as allowing for entertainment and gaming (playgrounds). I would add an additional metaphor which I believe is helpful in envisioning the dynamic relationship of the learner, instructed SLA, and informal online resources, namely the *porous classroom* (Breen, 1999). The emphasis in this metaphor is on opening up instruction to what lies beyond classroom walls, such as local communities and constituencies, as well as further afield through technology, remote resources and communities (Godwin-Jones, 2020a). A similar image is that of the *invisible classroom*, associated with the concept of transformative language learning and teaching which stresses the use of local resources, learner autonomy, and open learning materials (Leaver, 2021).

The image of a porous classroom and Levine's concept of a *human ecological* approach to SLA point to the dynamism and unpredictability of modern SLA. I argue that this should inform CALL research today (Godwin-Jones, 2019b). From a CALL research perspective, another useful metaphor for understanding the process of SLA, brought over from science, is chaos theory, emphasizing the complexity of the emergent nature of learning trajectories (Larsen-Freeman, 1997). In that sense, CALL, I believe, has transitioned away from being accurately described using comparisons with engineering. We are certainly able to look back at successful language learning and try to understand the processes, but being able to predict reliably based on needs analyses and rational design will carry our understanding of such a dynamic and individualized process only so far. From that perspective, unexpected outcomes are not failures, but should be expected, seen as natural results of complex interactions among humans and non-humans. According to Guerrettaz et al. (2021), that situation should inform teacher education, with "training that emphasizes recognition and responsiveness over controlled planning" (p. 17). An understanding of the ecological nature of language learning (Chun, 2016)–the crucial role that the learning environment plays in dynamic interaction with individual learners–can help teachers expect diverse student learning outcomes and cope with the reality that instruction does not universally or automatically result in learning. For researchers in applied linguistics, ecological frameworks, such as complex dynamic systems, sociomaterialism, or actor-network theory (Latour, 2005), help move us beyond problematic theories such as the accumulation metaphor for learning grammar, the assumed linearity of SLA, and the division between implicit and explicit learning (Chapelle, 2009; Larsen-Freeman, 2015). In CALL, the application of these frameworks points to the ecological invalidity of a determinist orientation to cause and effect studies, particularly those based exclusively on results from pre- and post-testing (Godwin-Jones, 2019b).

The last decades have demonstrated how variable the pathways to learning have become. Future developments are likely to make that even more the case. Mobile devices will continue to be constant companions and are likely to be joined by wearable devices. The emerging Internet of Things will be present as well in homes and cars, enabled through fast 5G networks. We have already seen the widespread use of virtual assistants (Apple's Siri, Google Assistant, Amazon's Alexa) in smart speakers, automobile dashboards, and earbuds (Dizon, 2020). The services supplied by these virtual assistants, powered by advances in artificial intelligence and the collection of huge datasets, will continue to expand and improve (Godwin-Jones, 2021). Improvements in natural language processing through neural networks have made big strides, as evident in the dramatic improvement in the quality of Google Translate (Johnson et al., 2017). Automatic speech recognition and voice synthesis, as seen in Google Duplex, come close to being able to replicate human to human conversations (González-Lloret, 2019).

Periodically, VR appears to be on the verge of going mainstream, but has been hampered by the cost of the hardware, mixed user experiences, and the difficulty in customizing applications to specific environments (Blyth, 2018). AR, on the other hand, seems likely to take off in the near future, with the launch of smart glasses by companies like Apple and Google (Parmaxi & Demetriou, 2020). They are likely to be paired with mobile phone apps and to offer not just tourist-level language help and translation, but exciting opportunities for in-place language learning. The future is already evident in AR apps such as *Mentira* (Holden & Sykes, 2012) or *Chrono-Ops* (Thorne, 2013) which integrate collaborative learning, gamification, and both virtual and local human resources. *Mentira* is exemplary in that it targets pragmatic language use in Spanish, with users linguistically successful in encounters not due to grammatical correctness, but rather through contextual appropriateness. A recent study using *Chrono-Ops* demonstrates how the dynamic relationship of human and non-human actors can carry over to language learning in the wild (Thorne et al., 2021). A water fountain becomes a focal point for *noticing* (Schmidt, 2012), both from a linguistic and from a sociomaterialist perspective, with "[the] physicality of the water fountain – its visibility, size, and the sound of the flowing water in the fountain — prompted the noticing of the fountain by a participant, and subsequently the fountain became a resource to list and discuss as part of completing the task" (Thorne et al., 2021, p. 111). Another striking example of this phenomenon of assemblage (of resources) and entanglement (of people and objects) is the role that a tree plays in an Ojibwe lesson, taught in the woods (Engman & Hermes, 2021).

While AR represents the high end on the technology scale, there has been growing recognition in recent years within the CALL community that we need to keep in mind communities of learners who do not have access to the latest and greatest technology resources (Joshi et al., 2019). Those include underserved populations in developing nations, as well as disenfranchised groups in the developed world (rural and urban poor, communities of color). We should be aware that the much-ballyhooed rise of informal language learning through leisure time, extensive film/TV viewing is not available to wide swaths of the world due to lack of funds, time, or space. While autonomous, self-directed English language learning is often viewed as an avenue of socio-economic advancement, that opportunity in reality is denied to those who lack basic necessities such as reliable power, affordable Internet, or sufficient time, space, and leisure to binge watch episodes of *Friends*.

More attention is being paid to the language needs of migrants and refugee populations (Charitonos & Kukulska-Hulme, 2017). Their language learning situation is quite different from that of university students in the West completing a language requirement or learning for leisure and travel. Studies continue to explore how under-resourced communities can use resources available on inexpensive phones such as chat or the popular WhatsApp for language learning (Kartal, 2019). One of the language learning activities that is low resource but creative in its potential is interactive fiction. This text-based activity has been around since the pre-multimedia days but has seen increased interest recently (Pereira, 2018), often in the context of fanfiction (Cornillie et al., 2021). Twine, an open-source tool for telling interactive stories, has become quite popular (Buendgens -Kosten, 2021).

Conclusion

In the United States, language learning in schools and universities is on the decline. There is a growing emphasis on practical job skills and preparing students for life after graduation. That has led to increased enrollment in STEM fields and away from the liberal arts. At the same time there is a growing recognition that despite widespread concerns over globalization, held responsible for the growth of socio-economic inequality, and the rise of nationalist politics, global interconnectivity is here to stay. Global crises, from pandemics to global warming to mass migrations can only be solved globally. If that is the case, language learning should be widely promoted, being, as it is, at the core of international understanding. The CALL community can play an important role in enabling and encouraging more language learning. Twenty years ago, a colleague from down the road from me, Rachel Saury, at the University of Virginia, wrote a piece in *Change* entitled "A day in the life of Thomas Baggett: Technology and the making of an international

intellectual community in the year 2020" (2001). It is in many ways a remarkably foresighted vision of language learning and technology. She envisions a student at UVA double majoring in Francophone African studies and public policy. He is learning both French and an indigenous west African language in a hybrid learning environment, with extensive use of video conferencing, collaborative writing software, jointly annotated websites, and recorded digital video lectures. On the other hand, Saury (2001) did not anticipate the mobile revolution: Thomas has to go to the language lab to complete some assignments.

What I find most impressive about the article is the role she lays out for how technology can be leveraged in the future to facilitate international cooperation and cultural understanding:

> Given the realities and challenges of a growing international community, what would happen if we concentrated the emerging benefits of technology on creating future peacemakers? Would further violence be prevented? Would the health and welfare of more people be improved? Would the importance of human rights, and of reaching for and maintaining equality among human beings, become more commonly accepted? (p. 23)

Saury visualizes an "international intellectual community", largely built on advanced technologies, but the goals of which go well beyond language learning:

> To me, four things define international intellectual community both as a field of inquiry and as an object of study for our students. First, it entails a keen sense of interconnectedness with all beings worldwide, fostered and supported by the knowledge of multiple languages, cultures, and/or cultural practices. Second, it requires the ability to make cross-cultural connections as a matter of regular practice, both in person and electronically. Third, it implies an imperative to choose a profession through which a positive impact can be made on human suffering and/or the health of the environment on a global scale. Fourth and last, it demands development of critical thinking skills grounded in the liberal arts (p. 23).

Saury's comments at the end are even more true today than when written 20 years ago: "We are truly rich in hardware and software. But how willing are we to take on the global responsibility that our riches afford us? How rich are we in practice and in vision?" (p. 23). Technology in and of itself, no matter how powerful the advances, cannot solve the world's problems, but if we find ways to harness its help in language learning, cultural understanding, and interconnections, that can be a boon to both individuals and society as a whole.

References

Agar, M. (1994). *Language shock*. Quill.

Anderson, H. M. (2018). *Blended basic language courses: Design, pedagogy, and implementation*. Routledge.

Anwaruddin, S. M. (2019). Teaching language, promoting social justice: A dialogic approach to using social media. *CALICO Journal*, *36*(1), 1–18.

Atkinson, D. (2014). Language learning in mindbodyworld: A sociocognitive approach to second language acquisition. *Language Teaching*, *47*(4), 467– 483

Baker, W., & Sangiamchit, C. (2019). Transcultural communication: Language, communication and culture through English as a lingua franca in a social network community. *Language and Intercultural Communication*, *19*(6), 471–487.

Bañados, E. (2006). A blended-learning pedagogical model for teaching and learning EFL successfully through an online interactive multimedia environment. *CALICO Journal*, *23*(3), 533–550.

Bender, E. M., Gebru, T., McMillan-Major, A., & Shmitchell, S. (2021). On the dangers of stochastic parrots: Can language models be too big? 🦜. In *Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency* (pp. 610–623). Association for Computing Machinery.

Benson, P. (2017). Language learning beyond the classroom: Access all areas. *Studies in Self-Access Learning Journal*, *8*(2), 135–146.

Benson, P. & Nunan, D. (Eds.) (2005). *Learners' stories: Difference and diversity in language learning*. Cambridge University Press.

Berners-Lee, T., Hendler, J., & Lassila, O. (2001). The semantic web. *Scientific American*, *284*(5), 34–43.

Blommaert, J. (2010). *The sociolinguistics of globalization*. Cambridge University Press.

Blommaert, J., & Rampton, B. (2016). Language and superdiversity. In K. Arnaut., J. Blommaert, B. Rampton, & M. Spotti (Eds.), *Language and superdiversity* (pp. 21–48). Routledge.

Blyth, C. (2018). Immersive technologies and language learning. *Foreign Language Annals*, *51*(1), 225–232.

Blyth, C., & Thoms, J. J. (2021). *Open education and second language learning and teaching*. Multilingual Matters.

Boulton, A., & Cobb, T. (2017). Corpus use in language learning: A meta-analysis. *Language Learning*, *67*(2), 348–393.

Breen, M. P. (1999). Teaching language in the postmodern classroom. In R. Ribé (Ed.), *Developing learner autonomy in foreign language learning* (pp. 47–64). University of Barcelona Press.

Byram, M. (1997). *Teaching and assessing intercultural communicative competence*. Multilingual Matters.

Buendgens-Kosten, J. (2020). The monolingual problem of computer-assisted language learning. *ReCALL*, *32*(3), 307–322.

Buendgens-Kosten, J. (2021). Digital storytelling: Multimodal meaning making. In T. Beaven & F. Rosell-Aguilar (Eds), *Innovative language pedagogy report* (pp. 103–108). Research-publishing.net. https://doi.org/10.14705/rpnet.2021.50.1243

Butler, Y. G., & Liu, Y. (2019). The role of peers in young learners' English learning: A longitudinal case study in China. In M. Sato, & S. Loewen (Eds.), *Evidence–based second language pedagogy: A collection of instructed second language acquisition studies* (pp. 145–167). Routledge.

Canagarajah, S. (2014). Theorizing a competence for translingual practice at the contact zone. In S. May (Ed.), *The multilingual turn: Implications for SLA, TESOL and bilingual education* (pp. 78–102). Routledge.

Canagarajah, S. (2018). Materializing 'competence': Perspectives from interactional STEM scholars. *Modern Language Journal*, *102*, 268–291.

Chambers, A. (2019). Towards the corpus revolution? Bridging the research–practice gap. *Language Teaching*, *52*(4), 460–475.

Chapelle, C. A. (2009). The relationship between second language acquisition theory and computer-assisted language learning. *Modern Language Journal*, *93*, 741–753.

Charitonos, K. & Kukulska-Hulme, A. (2017). Community-based interventions for language learning among refugees and migrants. In R. Talhouk, V. Vlachokyriakos, K. Aal, A. Weibert, S. Ahmed, K. Fisher, & V. Wulf (Eds.), Refugees & HCI workshop: The role of HCI in responding to the refugee crisis, communities & technologies (pp. 26–30). Association for Computing Machinery. http://oro.open.ac.uk/49677/4/ACM_HCI%20Refugees_Charitonos%2BKukulska-Hulme.pdf

Chinkina, M., & Meurers, D. (2017). Question generation for language learning: From ensuring texts are read to supporting learning. In *Proceedings of the 12th workshop on innovative use of NLP for building educational applications* (pp. 334–344). Association for Computational Linguistics. http://aclweb.org/anthology/W17-5038.pdf

Chun, D. M. (Ed.). (2014). *Cultura-inspired intercultural exchanges: Focus on Asian and Pacific languages*. University of Hawai'i, National Foreign Language Resource Center.

Chun, D. M. (2016). The role of technology in SLA research. *Language Learning & Technology*, *20*(2), 98–115. https://scholarspace.manoa.hawaii.edu/bitstream/10125/44463/20_02_chun.pdf

Chun, D. M. (2019). Current and future directions in TELL. *Journal of Educational Technology & Society*, *22*(2), 14–25.

Colpaert, J. (2016). Big content in an educational engineering approach. *Journal of Technology and Chinese Language Teaching*, *7*(1), 1–14.

Comas-Quinn, A., Beaven, A., & Sawhill, B. (Eds.). (2019). *New case studies of openness in and beyond the language classroom*. Research-publishing.net. https://research-publishing.net/book?10.14705/rpnet.2019.37.9782490057511

Cornillie, F., Buendgens-Kosten, J., Sauro, S., & Van der Veken, J. (2021). "There's always an option": Collaborative writing of multilingual interactive fanfiction in a foreign language class. *CALICO Journal*, *38*(1), 17–42.

Culpeper, J., Mackey, A., & Taguchi, N. (2018). *Second language pragmatics: From theory to research*. Routledge.

D'Ignazio, C., & Klein, L. F. (2020). *Data feminism*. MIT Press.

Dizon, G. (2020). Evaluating intelligent personal assistants for L2 listening and speaking development. *Language Learning & Technology*, *24*(1), 16–26. https://doi.org/10125/44705

Dooly M., & O'Dowd, R. (2018). Telecollaboration in the foreign language classroom: A review of its origins and its application to language teaching practice. In M. Dooly, & R. O'Dowd (Eds.), *In this together: Teachers' experiences with transnational, telecollaborative language learning projects* (pp. 11–34). Peter Lang.

Dubreil, S., & Lord, G. (2020). Make it so: Leveraging maker culture in CALL. *CALICO Journal*, *38*(1), i–xii.

Eilola, L. E., & Lilja, N. S. (2021). The smartphone as a personal cognitive artifact supporting participation in interaction. *The Modern Language Journal*, *105*(1), 294–316.

Ellis, N. C. (2008). Usage-based and form-focused SLA: The implicit and explicit learning of constructions. In A. Tyler , Y. Kim, & M. Takada (Eds.), *Language in the context of use: Discourse and cognitive approaches to language* (pp. 93–120). De Gruyter Mouton.

Ellis, N. C. (2017). Cognition, corpora, and computing: Triangulating research in usage-based language learning. *Language Learning*, *67*(S1), 40–65.

Ellis, N., & Larsen-Freeman, D. (2006). Language emergence: Implications for applied linguistics—Introduction to the special issue. *Applied Linguistics*, *27*(4), 558–589

Engman, M. M., & Hermes, M. (2021). Land as interlocutor: A study of Ojibwe learner language in interaction on and with naturally occurring 'materials.' *Modern Language Journal*, *105*(1), 86–105.

Finch, A. (2010). Critical incidents and language learning: Sensitivity to initial conditions. *System*, *38*(3), 422–431.

Flowerdew, L. (2015). Data-driven learning and language learning theories. In A. Leńko-Szymańska & A. Boulton (Eds.), *Multiple affordances of language corpora for data-driven learning* (pp. 15–36). John Benjamins.

Fryer, L. K., Coniam, D., Carpenter, R., & Lăpușneanu, D. (2020). Bots for language learning now: Current and future directions. *Language Learning & Technology*, *24*(2), 8–22. http://hdl.handle.net/10125/44719

Furstenberg, G., Levet, S., English, K., & Maillet, K. (2001). Giving a virtual voice to the silent language of culture: The Cultura project. *Language Learning & Technology*, *5*(1), 55–102. https://scholarspace.manoa.hawaii.edu/bitstream/10125/25113/05_01_furstenberg.pdf

Garzía, O., & Li, W. (2014). *Translanguaging: Language, bilingualism and education*. Palgrave Macmillan.

Garza, T. J. (2016). Raise the Flag(ship)! Creating hybrid language programs on the flagship model. In D. Murphy, & K. Evans-Romaine (Eds.), *Exploring the US Language Flagship program: Professional competence in a second language by graduation* (pp. 224–243). Multilingual Matters.

Gimeno-Sanz, A. (2016). Moving a step further from "integrative CALL". What's to come? *Computer Assisted Language Learning*, *29*(6), 1102–1115.

Godwin-Jones, R. (1996). Creating language learning materials for the World Wide Web. In Warschauer, M. (Ed.), *Telecollaboration in foreign language learning* (pp. 69–82). National Foreign Language Resource Center, University of Hawai'i at Mānoa.

Godwin-Jones, R. (2001). Tools and trends in corpora use for teaching and learning. *Language Learning & Technology*, *5*(3), 7–12. https://scholarspace.manoa.hawaii.edu/bitstream/10125/44559/05_03_emerging.pdf

Godwin-Jones, R. (2003). Blogs and wikis: Environments for online collaboration. *Language Learning & Technology*, *7*(2), 12–16. https://scholarspace.manoa.hawaii.edu/bitstream/10125/25195/07_02_emerging.pdf

Godwin-Jones, R. (2004). Language in action: From webquests to virtual realities. *Language Learning & Technology*, *8*(3), 9–14. https://scholarspace.manoa.hawaii.edu/bitstream/10125/25246/08_03_emerging.pdf

Godwin-Jones, R. (2011). Mobile apps for language learning. *Language Learning & Technology*, *15*(2), 2–11. https://scholarspace.manoa.hawaii.edu/bitstream/10125/44244/15_02_emerging.pdf

Godwin-Jones, R. (2012). Challenging hegemonies in online learning. *Language Learning & Technology*, *16*(2), 4–13. https://scholarspace.manoa.hawaii.edu/bitstream/10125/44279/16_02_emerging.pdf

Godwin-Jones, R. (2014). Towards transparent computing: Content authoring using open standards. *Language Learning & Technology*, *18*(1), 1–10. https://scholarspace.manoa.hawaii.edu/bitstream/10125/44346/18_01_emerging.pdf

Godwin-Jones, R. (2016a). Augmented reality and language learning: From annotated vocabulary to place-based mobile games. *Language Learning & Technology*, *20*(3), 9–19. https://scholarspace.manoa.hawaii.edu/bitstream/10125/44475/20_03_emerging.pdf

Godwin-Jones, R. (2016b). Integrating Technology into Study Abroad. *Language Learning & Technology*, *20*(1), 1–20. http://www.lltjournal.org/item/2925

Godwin-Jones, R. (2016c). Looking back and ahead: 20 years of technologies for language learning. *Language Learning & Technology*, *20*(2), 5–12. https://scholarspace.manoa.hawaii.edu/bitstream/10125/44457/1/20_02_emerging.pdf

Godwin-Jones, R. (2017). Smartphones and language learning. *Language Learning & Technology*, *21*(2), 2–11. https://scholarspace.manoa.hawaii.edu/bitstream/10125/44607/1/21_02_emerging.pdf

Godwin-Jones, R. (2018). Contextualized vocabulary learning. *Language Learning & Technology*, *22*(3), 1–19. https://doi.org/10125/44651

Godwin-Jones, R. (2019a). In a world of SMART technology, why learn another language? *Educational Technology and Society*, *22*(2), 4–13.

Godwin-Jones, R. (2019b). Re-orienting computer-assisted language learning through the lens of complexity theory. In F. Meunier, J. Van de Vyver, L. Bradley, & S. Thouësny (Eds.), *CALL and complexity – short papers from EUROCALL 2019* (pp. 1–6). Research-publishing.net. https://doi.org/10.14705/rpnet.2019.38.1001

Godwin-Jones, R. (2019c). Riding the digital wilds: Learner autonomy and informal language learning. *Language Learning & Technology*, *23*(1), 8–25. https://scholarspace.manoa.hawaii.edu/bitstream/10125/44667/23_01_10125-44667.pdf

Godwin-Jones, R. (2019d). Telecollaboration as an approach to developing intercultural communication competence. *Language Learning & Technology*, *23*(3), 8–28. http://hdl.handle.net/10125/44691

Godwin-Jones, R. (2020a). Building the porous classroom: An expanded model for blended language learning. *Language Learning & Technology*, *24*(3), 1–18. https://scholarspace.manoa.hawaii.edu/bitstream/10125/44731/24_03_10125-44731.pdf

Godwin-Jones, R. (2020b). Towards Transculturality: English as a lingua franca in intercultural communication and in online language learning. *Languages and International Studies*, *23*, 1–34

Godwin-Jones, R. (2021). Big data and language learning: Opportunities and challenges. *Language Learning & Technology*, *25*(1), 4–19. http://hdl.handle.net/10125/44747

González-Lloret, M. (2015). Conversation analysis in computer-assisted language learning. *CALICO Journal*, *32*(3), 569–594.

González-Lloret, M. (2019). Technology and L2 pragmatics learning. *Annual Review of Applied Linguistics*, *39*, 113–127.

Guerrettaz, A. M., Engman, M. M., & Matsumoto, Y. (2021). Empirically defining language learning and teaching materials in use through sociomaterial perspectives. *Modern Language Journal*, *105*(1), 3–20.

Guillén, G. (2021). 37 years of CALL [Tableau Slides]. Tableau. https://public.tableau.com/profile/gaguillen#!/vizhome/40yrCALL/37YearsofCALL

Guillén, G., Sawin, T., & Springer, S. (2018). The lingo of language learning startups: Congruency between claims, affordances, and SLA theory. In S. Lin, & J. Li (Eds.), *Assessment across online language education* (pp. 198-218). Equinox Publishing.

Hellmich, E. A. (2019). A critical look at the bigger picture: Macro-level discourses of language and technology in the United States. *CALICO Journal*, *36*(1), 39–58.

Helm, F. (2013). A dialogic model for telecollaboration. *Bellaterra Journal of Teaching & Learning Language & Literature*, *6*(2), 28–48.

Higgins, J., & Johns, T. (1984). *Computers in language learning*. Addison-Wesley Longman.

Holden, C., & Sykes, J. (2012). Mentira: Prototyping language-based locative gameplay. In S. Dikkers, J. Martin, & B. Coulter (Eds.), *Mobile media learning: Amazing uses of mobile devices for learning* (pp. 111–130). ETC Press.

Hubbard, P. (2017). Foundations of computer-assisted language learning. In J.-B. Son, & S. Windeatt (Eds.), *Language teacher education and technology: Approaches and practices* (pp. 153–167). Bloomsbury Publishing.

Hubbard, P. (2019). Five keys from the past to the future of CALL. *International Journal of Computer-Assisted Language Learning and Teaching (IJCALLT)*, *9*(3), 1–13.

Jackson, J. (2018). *Online intercultural education and study abroad: Theory into practice*. Routledge.

Järvilehto, T. (2009). The theory of the organism-environment system as a basis of experimental work in psychology. *Ecological Psychology*, *21*(2), 112–120.

Jee, C. (2021, April 19), Why a more feminist internet would be better for everyone. *MIT Technology Review*. https://www.technologyreview.com/2021/04/01/1020478/feminist-internet-culture-activist-harassment-herd-signal/

Johnson, M., Schuster, M., Le, Q. V., Krikun, M., Wu, Y., Chen, Z., Thorat, N., Viégas, F., Wattenberg, M., Corrado, G., Hughes, M., & Dean, J. (2017). Google's multilingual neural machine translation system: Enabling zero-shot translation. *Transactions of the Association for Computational Linguistics*, *5*, 339–351.

Joshi, P., Barnes, C., Santy, S., Khanuja, S., Shah, S., Srinivasan, A., Bhattamishra, S., Sitaram, S., Choudhur, M., & Bali, K. (2019). Unsung challenges of building and deploying language technologies for low resource language communities. *arXiv preprint arXiv:1912.03457*. https://arxiv.org/pdf/1912.03457.pdf

Kartal, G. (2019). What's up with WhatsApp? A critical analysis of mobile instant messaging research in language learning. *International Journal of Contemporary Educational Research*, *6*(2), 352–365.

Kern, R. (2014). Technology as Pharmakon: The promise and perils of the internet for foreign language education. *The Modern Language Journal*, *98*(1), 340–357.

Kessler, G. (2018). Technology and the future of language teaching. *Foreign Language Annals*, *51*(1), 205–218.

Kramsch, C. (2020). Translating experience in language teaching research and practice. *Applied Linguistics*, *41*(1), 30–51.

Kukulska-Hulme, A., Gaved, M., Paletta, L., Scanlon, E., Jones, A., & Brasher, A. (2015). Mobile incidental learning to support the inclusion of recent immigrants. *Ubiquitous Learning: An International Journal*, *7*(2), 9–21.

Kulavuz-Onal, D., & Vásquez, C. (2018). "Thanks, shokran, gracias": Translingual practices in a Facebook group. *Language Learning & Technology*, *22*(1), 240–255. http://hdl.handle.net/10125/44589

Kusyk, M. (2017). The development of complexity, accuracy, and fluency in L2 written production through informal participation in online activities. *CALICO Journal*, *34*(1), 75–96.

Lantolf, J. P., & Pavlenko, A. (1995). Sociocultural theory and second language acquisition. *Annual Review of Applied Linguistics*, *15*, 108–124.

Larsen-Freeman, D. (1997). Chaos/complexity science and second language acquisition. *Applied Linguistics*, *18*(2), 141–165.

Larsen-Freeman, D. (2015). Saying what we mean: Making the case for second language acquisition to become second language development. *Language Teaching*, *48*(4), 491–505.

Larsen-Freeman, D. (2018). Looking ahead: Future directions in, and future research into, second language acquisition. *Foreign Language Annals*, *51*(1), 55–72.

Latour, B. (2005). *Reassembling the social: An introduction to actor-network-theory*. Oxford University Press.

Leaver, B. L. (2021). Transformative language learning: The next paradigm shift and its historical context. In B. L. Leaver, D. E. Davidson, & C. Campbell (Eds.), *Transformative language learning and teaching* (pp. 13–22). Cambridge University Press.

Lee, H., Warschauer, M., & Lee, J. H. (2019). Advancing CALL research via data-mining techniques: Unearthing hidden groups of learners in a corpus-based L2 vocabulary learning experiment. *ReCALL*, *31*(2), 135–149.

Lenkaitis, C. A., & Loranc-Paszylk, B. (2019). Facilitating global citizenship development in lingua franca virtual exchanges. *Language Teaching Research*, *23*, 1–18.

Levine, G. (2020). A human ecological language pedagogy. *Modern Language Journal, 104*(S1), 1–130.

Little, D., & Thorne, S. (2017). From learner autonomy to rewilding: A discussion. In M. Cappellini, T. Lewis, & A. Rivens Mompean (Eds.), *Learner autonomy and Web 2.0.* (pp. 12–35). Equinox.

Lohr, S. (2021, January 10). He created the web. Now he's out to remake the digital world. *The New York Times*. https://www.nytimes.com/2021/01/10/technology/tim-berners-lee-privacy-internet.html

Lomicka, L., & Lord, G. (2019). Reframing technology's role in language teaching: A retrospective report. *Annual Review of Applied Linguistics*, *39*, 8–23.

Lu, X. (2018). Natural language processing and intelligent computer-assisted language learning (ICALL). In J. I. Liontas (Ed.), *The TESOL encyclopedia of English language teaching* (pp. 1–6). Wiley-Blackwell.

Makransky, G., & Petersen, G. B. (2021). The cognitive affective model of immersive learning (CAMIL): a theoretical research-based model of learning in immersive virtual reality. *Educational Psychology Review*. https://doi.org/10.1007/s10648-020-09586-2

Mathieu, L., Murphy-Judy, K., Godwin-Jones, R., Middlebrooks, L., & Boykova, N. (2019). Learning in the open: Integrating language and culture through student curation, virtual exchange, and open educational resources. In A. Beaven, A. Comas-Quinn & B. Sawhill (Eds.), *New case studies of openness in and beyond the language classroom* (pp. 1–18). Researchpublishing.net. https://doi.org/10.14705/rpnet.2019.37.967

McConachy, T. (2017). *Developing intercultural perspectives on language use*. Channel View Publications.

Narwood, N. (2021). Coda: An expanding research agenda for the use of instructional materials. *The Modern Language Journal*, *105*(S1), 175–184.

Ortega, L. (2017). New CALL-SLA research interfaces for the 21st century: Towards equitable multilingualism. *CALICO Journal*, *34*(3), 283–316.

Ortega, L. (2019). SLA and the study of equitable multilingualism. *The Modern Language Journal*, *103*(S1), 23–38.

Ovide, S. (2020, November 24). Imagine a world without apps. *The New York Times*. https://www.nytimes.com/2020/11/24/technology/smartphones-apps.html

Panichi, L., Detschmann, M., & Molka-Danielsen, J. (2010). Virtual worlds for foreign language learning and intercultural exchange: Is it for real? In S. Guth & F. Helm (Eds.), *Telecollaboration 2.0: Language learning, literacies and intercultural learning in the 21st Century* (pp. 165–198). Peter Lang.

Papin, K. (2018) Can 360 virtual reality tasks impact L2 willingness to communicate? In P. Taalas, J. Jalkanen, L. Bradley, & S. Thouësny (Eds.), *Future-proof CALL: Language learning as exploration and encounters: Short papers from EUROCALL 2018* (pp. 243–248). Research-publishing.net. https://doi.org/10.14705/rpnet.2018.26.844

Park, G. (2020, April 17). Silicon Valley is racing to build the next version of the Internet. Fortnite might get there first. *The Washington Post*. https://www.washingtonpost.com/video-games/2020/04/17/fortnite-metaverse-new-internet/

Parmaxi, A., & Demetriou, A. A. (2020). Augmented reality in language learning: A state-of-the-art review of 2014–2019. *Journal of Computer Assisted Learning*, *36*(6), 861–875.

Peng, H., Jager, S., Thorne, S. L., & Lowie, W. (2020). A holistic person-centered approach to mobile-assisted language learning. In W. Lowie, M. Michel, M. Keijzer, & R. Steinkrauss (Eds.), *Usage-based dynamics in second language development* (pp. 87–106). Multilingual Matters.

Pennycook, A. (2018). *Posthumanist applied linguistics*. Routledge.

Pereira, J. (2018). Video game meets literature: Language learning with interactive fiction. *e-TEALS: An E-journal of Teacher Education and Applied Language Studies*, *4*(1), 1–18.

Rainie, L., & Wellman, B. (2019). The internet in daily life: The turn to networked individualism. In M. Graham, & W. H. Dutton (Eds.), *Society and the Internet* (pp. 27–42). Oxford University Press.

Reinders, H., & Lan, Y. J. (2021). Big data in language education and research. *Language Learning & Technology*, *25*(1), 1–3. http://hdl.handle.net/10125/44746

Reinhardt, J. (2019). *Gameful second and foreign language teaching and learning: Theory, research, and practice*. Palgrave Macmillan.

Reinhardt, J. (2020). Metaphors for social media-enhanced foreign language teaching and learning. *Foreign Language Annals*, *53*(2), 234–242.

Sauro, S. (2016) Does CALL have an English problem? *Language Learning & Technology*, *20*(3), 1–8. https://doi.org/10125/44474

Sauro, S. (2017). Online fan practices and CALL. *CALICO Journal*, *34*(2), 131–146.

Saury, R. E. (2001). A day in the life of Thomas Baggett: Technology and the making of an international intellectual community in the year 2020. *Change: The Magazine of Higher Learning*, *33*(1), 18–23.

Schmidt, R. (2012). Attention, awareness, and individual differences in language learning. In W. M. Chan, K. N. Chin, S. Bhatt, & I. Walker (Eds.), *Perspectives on individual characteristics and foreign language education* (pp. 27–50). De Gruyter Mouton.

Scholz, K., & Schulze, M. (2017). Digital-gaming trajectories and second language development. *Language Learning & Technology*, *21*(1), 99–119. http://hdl.handle.net/10125/44597

Seedhouse, P. (2005). Conversation analysis and language learning. *Language Teaching*, *38*(4), 165–187.

Sharma, P. (2017). Blended learning design and practice. In M. Carrier, R. M. Damerow, & K. M. Bailey (Eds.), *Digital language learning and teaching: Research, theory, and practice* (pp. 167–178). Routledge.

So the Internet Didn't Turn Out the Way We Hoped. Now What...(2019, Nov. 13). *The New York Times Magazine*. https://www.nytimes.com/interactive/2019/11/14/magazine/internet-future-dream.html

Sockett, G. (2014). *The online informal learning of English*. Springer.

Stevenson, N. (1992). *Snow crash*. Bantam Books.

Sundqvist, P., & Sylvén, L. K. (2016). *Extramural English in teaching and learning*. Palgrave Macmillan.

Sykes, J. M. (2019). Emergent digital discourses: What can we learn from hashtags and digital games to expand learners' second language repertoire? *Annual Review of Applied Linguistics*, *39*, 128–145.

Sykes, J., & Cohen, A. D. (2018). Strategies and interlanguage pragmatics: Explicit and comprehensive. *Studies in Second Language Learning and Teaching*, *8*(2), 381–402.

Sykes, J., & Dubreil, S. (2019). Pragmatics learning in digital games and virtual environments. In N. Taguchi (Ed.), *Routledge handbook of second language acquisition and pragmatics* (pp. 387–399). Routledge

Sykes, J., & González-Lloret, M. (2020). Exploring the interface of interlanguage (L2) pragmatics and digital spaces. *CALICO Journal*, *37*(1), i–xv.

Sykes, J., Malone, M., Forrest, L., & Sağdıç, A. (in press). Comprehensive framework for assessing intercultural pragmatic competence: Knowledge, analysis, subjectivity, and awareness. In O. Kang & A. Kermad (Eds.), *Transdisciplinary innovations for communicative success.* The Encyclopedia of Educational Innovations. Springer.

Taguchi, N. (2015). Instructed pragmatics at a glance: Where instructional studies were, are, and should be going. *Language Teaching*, *48*(1), 1–50.

Terantino, J. M. (2011). YouTube for foreign languages: You have to see this video. *Language Learning & Technology*, *15*(1), 10–16. https://scholarspace.manoa.hawaii.edu/bitstream/10125/44231/1/15_01_emerging.pdf

Thorne, S. L. (2008). Computer-mediated communication. In N. Van Duesen-Scholl & N. Hornberger (Eds.), *Encyclopedia of language and education*: *Vol. 4. Second and foreign language education* (2nd Ed., pp. 325–336). Springer.

Thorne, S. L. (2013). Language learning, ecological validity, and innovation under conditions of superdiversity. *Bellaterra Journal of Teaching & Learning Language & Literature*, *6*(2), 1–27.

Thorne, S. L., Sauro, S., & Smith, B. (2015). Technologies, identities, and expressive activity. *Annual Review of Applied Linguistics*, *35*, 215–233.

Thorne, S. L., Hellermann, J., & Jakonen, T. (2021). Rewilding language education: Emergent assemblages and entangled actions. *The Modern Language Journal*, *105*(S1), 106–125.

Turkle, S. (2011). *Alone together: Why we expect more from technology and less from each other*. Basic Books.

Von Uexküll, J. (1909). *Umwelt und innenwelt der tiere*. Springer.

Williams, T., Zhu, Q., Wen, R., & de Visser, E. J. (2020, March). The Confucian matador: Three defenses against the mechanical bull. In T. Belpaeme & J. Young (Eds.), *Companion of the 2020 ACM/IEEE International Conference on Human-Robot Interaction* (pp. 25–33). HRI.

Yeh, E., & Swinehart, N. (2020). Social media literacy in L2 environments: Navigating anonymous user-generated content. *Computer Assisted Language Learning*, *37*(1), 66–84.

Youngs, B. L., Prakash, A., & Nugent, R. (2018). Statistically-driven visualizations of student interactions with a French online course video. *Computer Assisted Language Learning*, *31*(3), 206–225.