

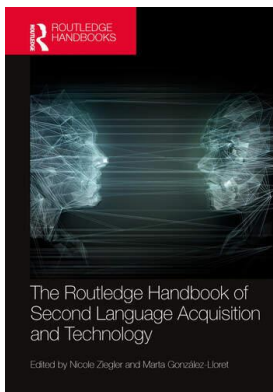
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Nicole Ziegler, Marta González-Lloret

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Glenn Stockwell

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HISTORICAL FOUNDATIONS OF TECHNOLOGY IN SLA

Glenn Stockwell

Introduction

Second language acquisition (SLA) is a field that has been heavily influenced by trends in theory and practice since it began to gain traction as an academic discipline in the 1960s, and there have been a number of attempts to follow the complex path that it has followed over this time. Ellis (2020), for example, describes SLA as having gone through several overlapping phases, initially exploring the order and sequence of acquisition, expanding into universal grammar, second language pragmatics, and input and interaction. This was followed by cognitive and social perspectives moving into the mainstream, and the more recent trends of complexity and multilingualism. These shifts have been attributed largely to developments in psychology and linguistics (see Larsen-Freeman, 2018), but it could also be argued that the field has been impacted by developments in technology as well. The purpose of this chapter is to examine how technology has evolved over the past half-century, and how this has impacted the shifts that we have seen in the teaching and learning of second languages. There are numerous ways in which the relationship between technology and second language acquisition could be addressed, and others have discussed this more from the point of view of specific theories or teaching approaches such as task-based language teaching (González-Lloret & Ortega, 2014), feedback and interaction (Ziegler & Mackey, 2017), sociocultural approaches (Lomicka & Lord, 2016; Vandergriff, 2016), motivation and identity (Ushioda, 2011), and ecological perspectives (Blin, 2016), to name a few. In this chapter, however, the main focus is on the way in which technology itself has had a direct influence on the approaches to teaching and learning a second language. It does this through following the evolution of technology over the past 50 years and exploring how this impacts not only current but also future practices.

It should be noted, however, that pinpointing an exact start of when technology began to be used in language teaching and learning is surprisingly difficult, and the precise origins have been “lost to history” (Dunkel, 1987, p. 250). An investigation of the emergence of related academic publications does, however, reveal that technology has been a part of language education for several decades, with research appearing in journals on language teaching and learning, as well as increased production of books and journals specializing in technology in SLA. Even from these early days, the originality and sophistication of the ideas with which teachers and researchers applied technology to their teaching and learning environments were clearly evident. The approaches used in the studies that were carried out at the time were broad and varied, as were the technologies that formed the foundations of this research.

What, precisely does “technology” mean in the context that it is used here with regards to second language acquisition? In many respects, nearly anything could be termed a “technology”

if the scope is not limited in some way. While the definition of technology has changed greatly over the past century, the image that most people would have is likely a computer, although the size and shape of so-called modern computers have also undergone a phenomenal change since Alan Turing described a “universal computing machine” (p. 241) in 1936, using paper tape as a means of inputting information which was then processed and the required output produced. Computing machines—or computers—have become smaller, faster, more versatile, and capable of storing immense amounts of information, yet their ultimate functions remain largely the same: processing information from input and making this information available to users as output. Input has evolved from paper tape into myriad methods such as disks (floppy, hard, USB flash memory, or cloud-based), keyboards and mice, trackpads, styluses, touch screens, or even audio or video input. When referring to technology in SLA, the focus is on “computers,” although even this has become a somewhat amorphous term that has come to include other devices such as mobile phones, tablets, and wearable technologies. Computers have evolved at a rate that has surpassed virtually any other technology in the history of humankind, and as a result have moved from specialized military uses of room-sized machines from the 1940s, through to corporate use of mainframes in the 1960s, then to individual uses of “personal computers” (i.e., PCs) which were small enough to fit on a single desk (see Tardieu et al., 2020, for a discussion). As technology advanced even further, computers became even more compact, until they reached a size small enough to be carried around, in the form of laptop computers or mobile phones. PCs, laptop computers, and portable phones have all increased significantly in sophistication, and devices small enough to fit in a pocket boast processing power thousands of times greater than that of machines of five decades earlier.

Needless to say, non-computer technologies have long featured in SLA research, with more analogue tools, such as audio tapes, commonly found as a part of language laboratories (e.g., Keating, 1963). However, it could be argued that computer-based technologies have had and continue to have unparalleled effects on formal and informal language learning, impacting the very way in which teaching and learning is conceptualized. It is against this background that language teaching and learning should be framed, with pedagogies inevitably being shaped by the technologies that are used. As technologies became more accessible, they moved slowly away from being specialized and isolated tools to tools that could become “normalized” as a part of everyday practice both inside and outside of the classroom (see Bax, 2003, for a discussion). Where once specialist knowledge was a prerequisite to using technology in educational settings, technologies are very much becoming a part of the regular classroom, used for teaching a wide range of language skills and areas. This is where a second primary definition needs to be made clear: what SLA through technology actually means. It has been common for discussions of technology in language teaching and learning to be somehow homogenous, as though the term “technology” could be understood as a constant that has a uniform impact on language acquisition (see Stockwell, forthcoming, for a discussion). Much as with any type of teaching resource—digital or otherwise—the effect on particular language skills and areas will depend on a great number of factors, including the learning goals, the proficiency of the learners, and the teaching approaches adopted by teachers using these resources. Teaching with technology can mean an almost unlimited number of possibilities of tools, targets, and teaching practices, each of which fit together in unique ways depending on the language learning context. The purpose of this chapter is to explore the historical foundations of the field of computer-assisted language learning (CALL), and how the field has been shaped by the process of development.

Historical Perspectives

It is easy to hold the misconception that research into technology in the early days since its introduction into language education was crude and unimaginative. While it is true that teachers were

limited by the available technologies, a look at the literature of the time reveals that many of the studies were immensely creative, and teachers took full advantage of the affordances of the available technologies. For example, a study that would seem appropriate today, even some 50 years since its publication in *The Modern Language Journal* in 1968, was by Adams et al., entitled “Conversation with a computer as a technique of language instruction.” This article provided a detailed overview of how technology could be used to support teaching German using a range of the latest tools, including computers, tape recorders, printers, and projectors. While there were other sporadic publications about technology in language teaching from around that time, one of the earliest academic journals to feature technology centrally in language teaching and learning is *System*, which published studies exploring the use of desktop computers for testing and feedback (Davies, 1973) and audio and video tapes for supporting learners of French (Charro & Blanco, 1973) in its first issue in May 1973. The *CALICO Journal* appeared some 10 years later with its first issue in 1983, and like the majority of the publications from that era, it consisted mainly of descriptions that went on for little more than a few pages. The brevity of the reports at the time likely attests to the difficulties in determining exactly *what* the focus of the research needed to be, with the studies attempting to describe learning in ways that had not been widely experienced before. There were also several books that were published in the early to mid-1980s, largely as a result of the spread of the microcomputer, which allowed for access to computers in classrooms or self-access centers. *ReCALL* released a pre-issue in 1989, with the first articles appearing in 1990 in a single issue; the same year in which *Computer Assisted Language Learning* published its inaugural issue. *Language Learning & Technology* joined the ranks of academic journals in this field in 1997, and since then there have been hundreds of books and at least 20 journals dedicated to the topic.

The field has moved ahead dramatically since its early beginnings for three main reasons. First, technologies have developed in their functionalities at a phenomenal rate. Powerful processors in small, portable machines with constant Internet access, built-in high-quality cameras, microphones, GPS systems, and the ability to play multimedia have now been the norm for the better part of a decade. These functionalities have enabled teachers to design a range of resources, tasks, and activities that give learners access to and the ability to interact with the target language in ways simply not possible without such technologies. Second, the technologies themselves have become far less expensive, making them affordable for teachers and learners who can have their own devices rather than relying on institutions to purchase devices that are typically limited to classroom use. This has offered learners the freedom to use devices at times that suit their individual needs, allowing language learning to occur as a part of their own daily routines rather than fitting in to the times and places stipulated by class schedules or opening hours of self-access centers. Finally, the focus of research itself has shifted over time as well, with the initial focus on “proving” that technology is worth the time, money, and effort required to implement it slowly giving way to research that explores how the technology can be used as a viable teaching and learning tool itself.

Critical Issues and Topics

Describing the critical issues associated with technology in language teaching and learning from a historical perspective is not an easy undertaking, given the massive shifts in the research and practice that has taken place over the past several decades. Both have been shaped by the changes in technology itself, but they have also been impacted by the view of technology as an increasingly normalized aspect of the learning environment. This section takes a chronological perspective on the changes in the teaching, learning, and technological environment, and explores how these have contributed to the evolution of the field over the past several decades. It should be pointed out that although the development of CALL is described below in blocks of the five decades from the early 1970s through to 2020, the emergence of new agendas of research and practice does not mean that

they completely replace what preceded them, and many of the applications of technology from these beginnings of CALL were used for decades—and some are even still being used today—albeit adjusted to the developments in technology which have taken place.

A good deal of the research from the late 1970s focused on the potential individualized nature of teaching through technology, frequently using the PLATO system (Ariew, 1979; Clutterbuck, 1979; Last, 1979). PLATO was an impressive system designed for teaching that boasted good quality graphics and a touch screen, but with a price tag equivalent to US\$30,000 today, the costs were prohibitive for most individuals and even many educational institutions. From the early 1980s, technology found its way into both classrooms and the private studies of academics who were willing to explore its potential as a tool in language teaching and learning in the form of personal computers. In these early days, when there was still a high degree of hype, unrealistic expectations, skepticism, and even fear about technology as a viable teaching resource, a primary focus was on the comparison of technology with non-technological means (e.g., Clarke, 1986). This was not unreasonable considering the costs involved with technology at the time, where the IBM Personal Computer 5150 retailed for today's equivalent of around US\$4,500 and the Apple Macintosh for around US\$6,000 (Comen, 2018), but comparisons were at best tenuous at times, with rather different learning contexts being compared to one another. At the same time, there was a lingering perception that computers should be limited to the mathematics and science domains, with strong resistance to their use in the humanities and social sciences (Davies & Steel, 1982). This was exacerbated by a pervasive skepticism toward computers in language education, with the consensus of the time summed up with comments like “computers can ... teach computer language, not a living language” and “... CAI is a waste of time, energy, and money that should be used to buy library books” (Olsen, 1980, p. 342). Technology was not widely seen as a serious supplement to existing methods of teaching, and a fear of the unknown was a large impediment to progress in the field in these early years.

Despite this opposition, the inevitable nature of the spread of technology in education was summed up by Dunkel (1987), who argued,

While many teachers still judge computers as worthless gadgets, the spectre of today's educational technology will neither be waved away with a flourish of a textbook nor brushed away with comments about expensive gadgetry [and] computers will be appearing in increasing numbers on the instructional scene.

p. 253

Needless to say, many teachers recognized the value of technology for language teaching and learning as being more than superficial responses to repetitive drills, which was representative of a good deal of the courseware available at the time (Higgins, 1987). Thus, a rich body of literature that systematically explored how technology could be applied to language teaching and learning grew out of this recognition and interest. Notable examples include discussions of how SLA theory could be related to CALL (Doughty, 1987), of learner characteristics as a predictor of engagement with technology (Chapelle & Jamieson, 1986), of design and implementation of CALL (Ng & Oliver, 1987), and of evaluation of CALL software (Hubbard, 1988). This period was an extremely important one for the development of the field, as it marked the time when serious discussions of technology as not just a novelty in education, but a potentially powerful tool that could shape the teaching and learning process, took place. A strong focus on the technology itself certainly persisted during this period, but this is in some ways understandable given the “newness” of computers in broader society. The downside was, however, that the novelty effects of using these new technologies also contributed to an inflated perception of their effects, particularly with regard to motivational aspects, and some of the research of the time did continue to present overly optimistic accounts of the positive effects that technology had on language acquisition.

It was not until the 1990s that CALL evolved from a predominantly text-based experience to one that came to include interactive video and audio, a domain that was previously limited to laser disc technologies (Stevens et al., 1986). Hypermedia was slowly becoming a standard for linking text to these multiple media, allowing learners to proceed through resources in a non-linear manner, but it also formed the foundation for navigating through pages on the newly available World Wide Web (better known as “hypertext”). Multimedia gave learners access to contextualized dialogues in the target language that they could interact with as a result of hyperlinks to vocabulary, grammar, questions, and/or other supplementary information. Courseware that included multimedia was the focus of a number of studies during this time, which explored both the pedagogical and attitudinal factors associated with its use (Brett, 1996; Murray & Barnes, 1998). At the same time, the World Wide Web—or now, more commonly, the Internet—also added completely new dimensions to the language learning environment. For example, before the Internet, news in the target language was usually selected by the teacher and then provided to learners, and interactions with speakers of the target language were difficult to set up and carry out, often requiring a good deal of arrangement and negotiation by the teacher with local communities. After the emergence of the Internet, learners could not only seek out updated information from the target language community of their own volition, but they could also search for culturally relevant points about people, places, and events, and interact directly with people in the target language community to discuss information that they had obtained (Osuna & Meskill, 1998; Zhao, 1996). Widespread access to the Internet led to various forms of networking and telecollaboration, and studies exploring the use of computer-mediated communication (CMC) flourished, including synchronous text chat (Kitao & Kitao, 1999), email (Aitsiselmi, 1999), and MOOs (text-based virtual worlds) (Donaldson & Kötter, 1999). The novelty of having learners able to interact with speakers of the language that they were studying was an enormous attraction to many teachers, who strove to set up environments where learners could engage in this communication to gain exposure to language models and discuss the target culture. In one sense, this was also an extremely important era for CALL, in that it contributed to a movement away from the view that technology was only relevant to learning fixed syntactic or lexical patterns, and rather, technology was able to promote authentic interaction.

CMC remained a popular topic into the 2000s, although the technologies expanded beyond the text-based tools, which were the norm previously, through to audio-graphic forms of CMC, which allowed for audioconferencing or videoconferencing (Wang, 2004). Research often focused on the features of the interactions, such as seeking out examples of negotiation of meaning (Kitade, 2000). This period saw a widening interest in the social aspects of learning, and with this, the ways in which technology could contribute to the social dimension of language learning also became more popular. Of these, the issue of social presence in CALL (Yamada & Akahori, 2007) and, later, identity in online communities through social networking sites (Harrison & Thomas, 2009) were significant trends in later research, and have remained so even until the time of writing. It is difficult to include all of the technological advances that took place in the first decade of the new millennium that had an impact on second language acquisition, but there are three that are of particular importance. The first of these is mobile technologies, which were emerging in the late 1990s, but quickly gained in popularity throughout this time period. Research looked at various mobile tools, most notably podcasting (Ducate & Lomicka, 2009; Rosell-Aguilar, 2007) and mobile phones (Kiernan & Aizawa, 2004; Stockwell, 2008) including their SMS function (Kennedy & Levy, 2008). Smart phones also started to attract interest when they appeared in 2007 (Godwin-Jones, 2008), and to a certain degree, they have taken on the collective roles of many of the mobile technologies that were used before them. The second is learning management systems (LMS), which came into being before the turn of the century, but proprietary tools like Blackboard and WebCT (Siekmann, 2001) and freely available alternatives like Moodle (Brandl, 2005), picked up speed as a means of providing content to learners and tracking how learners engaged with this content. Finally, virtual worlds also progressed from text-based MOOs through to three-dimensional graphic environments

that can enable learners to virtually “experience” authentic environments as a form of rehearsal (Toyoda & Harrison, 2002). This has also been linked to computerized games and simulations where learners interact with the environment and with others in an attempt to achieve predetermined goals (see Peterson, 2010). These various developments have both influenced and been influenced by the social perspectives of learning that emerged in SLA research in part reinforced by Kramsch’s (2002) seminal work on language socialization, a view of learning which has continued to receive widespread ongoing support.

Contributions and Research

I have elected to refer to the next decade, from 2010, as the “current contributions” as indeed much of what has happened over these past 10 years has actively shaped what is happening in educational environments today. Notably, smartphone sales surged phenomenally, exceeding computer sales early in the decade, although there were increases in both (Taylor, 2012). Smartphones and tablets became more commonplace, and teachers began exploiting their language teaching and learning environments (Chen, 2013; Kondo et al., 2012). Prices of computers and mobile devices continued to drop, and inexpensive options become available for less than US\$400, putting technologies into the reach of students across various socioeconomic bands, and this has contributed to a shift from institution-initiated technology usage to a learner-initiated one.

This does not, of course, mean that learners are capable of using these technologies for educational purposes without sufficient training and support (Romeo & Hubbard, 2010), nor that all learners will have equal access to technology (Ortega, 2017, 2019). Mobile technologies, have, however, put learning resources in constant reach of learners’ hands, and not surprisingly, this has been reflected in the research where mobile learning is appearing in the literature in progressively innovative and thoughtful ways (Burston, 2015). Typically using mobile devices, augmented reality, in which digital images are superimposed over actual scenes viewed through the camera of the device, is another field which has seen significant progress (Godwin-Jones, 2016). Multimedia can be added to still textbooks or even inanimate objects to provide additional information to assist in comprehending or learning from them.

Finally, MOOCs have added a new dimension to online learning, where virtually unlimited numbers of learners can have free access to courses that are primarily facilitated by technology but with a support structure in place for learners from teachers and/or peers, and their application to language learning has also been a recent area of discussion (Jitpaisarnwattana et al., 2019).

As we move into the next decade, technologies are continuing to develop rapidly, although the developments may not be as visible as they were compared with some 10 to 20 years ago when concepts such as mobile phones, laptop computers, and social networking were still in their infancy. The engines that are in operation behind these technologies continue to progress, and we are seeing a greater degree of stability, lower costs, and higher numbers of active users as a result of these advances. As technology does become more widespread with more and more teachers and learners feeling comfortable with using it as a part of their personal, educational, and professional lives, the need to look beyond the technology to the way in which it can be used stands out as a primary objective for the field.

An encouraging trend in the field over the past decade has been a greater inclusion of theory. Theory has been a part of CALL for decades, but the complexity of the field means that theory needs to take into consideration multiple perspectives, ranging from the design of artefacts, the learning environment, and the research itself (Levy & Stockwell, 2006). While criticism has been directed toward CALL for the high percentage of studies that did not explicitly describe the theories used (Hubbard, 2008), the last several years have seen reference to a widening range of theories in published papers, although the majority of these have been borrowed from other fields such as SLA, instructional design, or human-computer interaction principles (Hubbard & Levy,

2016). The list of theories that could be described here is too long to explain in depth, so just three of the potential theoretical domains that might be applied to second language acquisition are briefly mentioned here. First, social theories have come to be a more central part of CALL research (Stockwell, forthcoming), and models which attempt to see how the technology can play a role in bringing social learning experiences to learners (Henry et al., 2018; Tran, 2018). Second, the ways in which technology can help the learning process such as easing the cognitive burden on learners (Yu et al., 2019) and providing contents tailored to learners through learner profiling (Henry & Thorsen, 2019; Park & Hiver, 2017) are also areas that are being explored, and have the potential to enhance the learning process. Finally, there has been a widening acceptance of the fact that the interplay of factors in the language learning process are difficult to predict, and seminal work by Larsen-Freeman and Cameron (2008) on complexity theory and dynamic systems have also had an impact on views of technology (Godwin-Jones, 2018). While this remains a comparatively unexplored area at this point, there is room for further work to determine how learners behave within the larger context of the learners' daily lives rather than viewing them as learners detached from any real-life interactions.

Recommendations for Practice

As Garrett (2009) points out, it is virtually impossible for a single person in a single article to do justice to all of the developments in the field, and there are many other important research themes pertaining to SLA and technology that have not been included in this brief overview due to space limitations. In saying this, however, the description provided here does make it possible to see the sheer scope of the technologies that have appeared, and how they have directly impacted research and practice in the language learning environment. The technologies have come, some have gone, some have evolved, and some have stayed, but there are still numerous interrelated recommendations for practice, which may be made based on these five decades of research and practice.

First, in many regards, technology is the most visible aspect of the learning environment, and as such it is the factor that teachers tend to focus their attention on when they are exploring how to solve a problem in their educational context. There are dangers in selecting technologies without having a clear idea of what affordances the technology brings to the environment, and even how these may shape the context (see Chun et al., 2016). Research that examines the overall complexity of the learning environment, as well as the seen and unseen effects that technology may have on second language learning, development, and performance, is essential to facilitating more widespread integration of learning into learners' daily lives. Closely related to this is the importance of making learning with technology a part of the everyday life of the learner (Benson et al., 2018; Lai et al., 2018). In this way, learners can easily bring the technology into their own spontaneous interactions, giving them greater opportunities for language input and output.

Second, to really get an understanding of how learners use the technology both as a part of their academic and private lives, there is a strong need to move away from simply exploring learners' (and teachers') perceptions of technology. Decades of research have shown that learners are both simultaneously interested in and skeptical of technology in their learning due to a lack of confidence in how to use it effectively for learning purposes (see Romeo & Hubbard, 2010). Given the potential impact of training with technology, research is needed to explore how this training can be provided (Stockwell, 2019), and how to assist learners in extrapolating this to learning that takes place outside of formalized educational contexts. Finally, it is also essential that teachers have sufficient training so that they are able to provide the support that learners need. The understanding of the importance of teacher education has gained traction in the past 10 to 15 years, with research that specifically addresses this need appearing periodically in the literature (Hubbard & Levy, 2006; Son & Windeatt, 2017; Stickler et al., 2020). Only with an integrated approach to using technology

that explores each of these aspects will it be possible to maximize the potential that it can bring to the teaching and learning context, and dispel the myths and skepticism regarding what technology can and cannot achieve.

Future Directions

Looking back at the history of technology in SLA can in some ways provide some insights into the directions that the field may progress in the future. We may see these directions in terms of pedagogies, learners, and research directions. First, as we have been able to see, pedagogy has been strongly shaped by developments in technology, and the spread of more affordable devices with multimedia and Internet capabilities has created opportunities for not only linguistic development, but also for social and even creative experiences. Technology has shifted from being a tool that was put into learners' hands by the teacher to something that learners constantly access of their own volition, in a complex interplay of individual, social, educational, and instrumental uses, and pedagogies are continuing to evolve in a way that reflects these shifts. The focus of CALL on requiring learners to supply the correct response to questions on grammar or vocabulary has moved toward how learners may express themselves as individuals in the target language. It is expected that pedagogies in the future will continue to follow this trend, and technologies will be used to help create a learning experience where social interactions and self-expression take on a central role in the development of second language proficiency.

Second, the learners themselves will likely view technology as a natural part of education, including language education. The COVID-19 pandemic thrust both teachers and learners into situations where the educational experience could not take place without technology, and as such, the potential for technology to support teaching and learning has become obvious to even the most skeptical critics. The psychological barriers toward using technology have lowered, meaning that learners have had the opportunity to see how they may use it for a range of different ways as teachers struggled to enhance the learning experience for them. All parties involved in the educational experience, including teachers, learners, and administrators, gained valuable experience from this situation, making them better equipped to deal with using technology in a meaningful way in education in the future. In particular, learners are holding higher expectations of the learning experience. This does not mean that they are technically savvier than the teachers who are providing the courses for them, but they are likely to be more sensitive to shortcomings in the ways in which technologies are being employed. They may expect to have their voices heard with regards to the design of the tools used in their learning, and as such, successfully designing technology for learners will depend on exploring the role that the learners themselves can play in this process.

Finally, research itself will necessarily evolve as a result of these paradigm shifts. While exploring the potential of new technologies as they emerge has been a consistent theme in CALL (Stockwell, 2012), the need to do this from the perspective that a technology is somehow better than what came before it has slowly given way to research that explores the pedagogies that make the most of the affordances of new technologies in facilitating language learning opportunities. As mobile and wearable technologies become integrated more and more into learners' daily lives, the social dimensions of learning through technology, along with the ability of technology to provide contextual support for learners, will likely be a more commonly researched topic as time progresses. Furthermore, the potential of AI has long been a topic of interest in CALL, but the results have rarely lived up to the expectations held regarding its potential. While many teachers still show concern that they will be replaced by technology, as has started to happen in many other areas of society, research has slowly gravitated toward less confrontational uses such as automatic translation and learner analytics. This has resulted in new fields of research emerging about how to make the most of these uses, which will likely be central themes over the next several years as progress is made. While the exact directions in which research will lead the field in the ensuing

years remain difficult to predict, at the very least it is expected that technology will be in less of a peripheral role than it has been in the past, and how it features as part of the daily lives of the users in both the short and long term will likely feature heavily in the research in the future.

Further Reading

Bax, S. (2003). CALL—Past, present and future. *System*, 31(1), 13–28. [https://doi.org/10.1016/S0346-251X\(02\)00071-4](https://doi.org/10.1016/S0346-251X(02)00071-4)

This article is significant because of its controversial perspective that technology will become so “normalized” in education that it will no longer be necessary to think about using it. Bax argued that technology will become seamlessly integrated into language learning environments and therefore invisible. He also warned about the dangers of having too much expectation for new technologies, indicating that pedagogy is still the key to successful technology use.

Garrett, N. (2009). Computer-assisted language learning trends and issues revisited: Integrating innovation. *Modern Language Journal*, 93(s1), 719–740. <https://doi.org/10.1111/j.1540-4781.2009.00969.x>

Although written over a decade ago, this article pinpoints some of the problems facing integration of technology into language teaching and learning that continue to be relevant today. Garrett describes how technologies evolved exponentially in the 20 years before her first commentary on the place of technology in language education, and at the same time, teachers and learners have also evolved with these changes.

Han, Y. (2020). Connecting the past to the future of computer-assisted language learning: Theory, practice, and research. *Issues and Trends in Learning Technologies* 8(1). https://doi.org/10.2458/azu_ilt_v8i1_han

This article describes an interesting perspective on the changes which have occurred in the three pillars of the CALL—research, theory, and practice—as the field has developed over the past 50 years. Han gives a brief overview of how each of these have changed, and then proceeds to link this to what she sees as the future directions that the field may go in, specifically with regards immersive technologies, MALL, and ICALL, and considers the complexity of modern language learning environments.

Motteram, G. (2017). Language learning and technology: A thirty-year journey. In J.-B. Son & S. Windeatt (Eds.), *Language teacher education and technology: Approaches and practices* (pp. 63–76). London: Bloomsbury. This is a rare piece in that it describes a course that has been held over a 30-year period and describes the ways in which the course evolved and the impact that changing technologies were integrated into the course. The selection of technologies used in the course was shaped by the goals of the course, but at the same time the technologies affected the delivery, assessment, and to a certain degree the outcomes of the course.

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