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Emerging technologies and language learning: mining the past to transform the future

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Abstract: This paper is an expanded version of a keynote presentation for the 2022 ChinaCALL Conference on the theme of "emerging technologies". Today's emerging technologies—artificial intelligence, machine learning, conversational robots, virtual worlds, virtual reality, augmented reality, automated assessment, and so on—are full of promise and seem poised to revolutionize language teaching and learning over the next decade. However, rather than looking forward, I review lessons I have learned over a four-decade career in CALL, focusing on those lessons that have continuing relevance for accommodating these and future technologies as they emerge. In the first part, I present a simple model for technology-mediated language learning as a foundation for the remaining discussion. In the second, I review seven challenges that I worked on in CALL, starting in the 1980s. I describe how I came to be aware of the issues involved and how through a combination of reviewing research, collaborating with colleagues, and drawing on my own experience, I came to learn lessons of enduring value. The final part briefly explores the potential for converting these and other lessons learned into principles to guide current and future encounters with technologies for language teaching and learning.

Keywords: CALL; emerging technologies; evaluation; learner training; MALL; principles; reflective teaching; technology mediation model

1 Introduction

The goal of my keynote presentation from the ChinaCALL 2022 conference was to highlight a number of insights colleagues and I have had that continue to be relevant, despite the dramatic evolution of technology. Teachers today face all the challenges we have had for decades—and more. Researchers and practitioners continue to develop new methods, techniques, and theories to support language teaching.

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Teaching and learning contexts can be changed dramatically by forces external to education itself, as the COVID-19 crisis has shown us. And of course, we have digital technologies, technologies that have to be integrated now in one form or another in almost every teaching and learning setting. Because technologies constantly change, teachers have to constantly change, or they and their students will be left behind. The key, I believe, is to build those changes incrementally on knowledge and experience from interactions with prior technologies. Crucially, though, it is not the knowledge and experience alone that lead to success, but rather the critical thinking that accompanies their application to an emerging application or new environment.

To be true to the keynote presentation, I am writing from a personal perspective, telling the stories of lessons I have learned over four decades in CALL. As with the keynote itself, this will mean that there is an unusually heavy focus on my own work compared to a typical journal paper. This is because it is in essence a retrospective piece, but one where, as it looks back in time, supports the goal of providing a resource for work in the future.

In the next section below, I introduce a model for technology-mediated language learning. Its purpose is to capture the notion that interaction of any kind through technology is influenced by that technology. For language learning, what is influenced is both the acquisition of conscious or unconscious knowledge of language forms and functions and the operationalization of the conscious or automatic processes for using that knowledge. In the following section, I review seven of the more enduring lessons that my career in CALL has taught me. In the final section, I translate some of these lessons into *principles*, short and memorable statements that can guide teachers, researchers, and developers in their quest to use technology effectively, and especially to deal with emerging technologies as they appear. I believe that as the language teaching world continues to grow more and more complex and demanding, teachers will find that having their own set of principles to draw from will lead to a more fulfilling and less stressful career, allowing them to react confidently to the changes they will inevitably face.

2 Technology mediation model

Figure 1 presents an updated version of the technology mediation model that my colleague Mike Levy and I first proposed in a paper for *Computer Assisted Language Learning* (Levy & Hubbard, 2005). That piece, “Why Call CALL ‘CALL’”, argued for continuing to use *computer-assisted language learning*, or *CALL*, as the name of our field during a time when other acronyms were being promoted. Consequently, the circle in the center contained the “computer”. In this revised version, I replace “computer” in the original with the term “technology mediation system” to represent

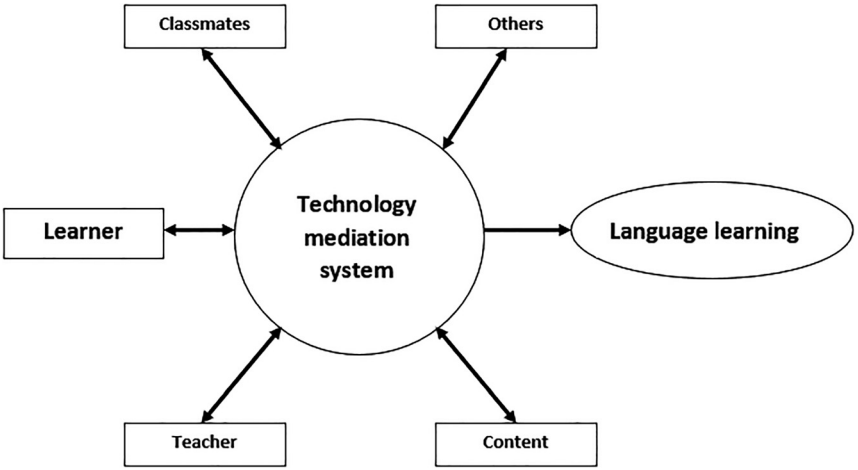

Figure 1: Technology-mediated language learning model (Hubbard, 2022).

an expansion of the concept (Hubbard, 2022). The technology mediation system includes the device – the computer in the form of a desktop, laptop, tablet, or smartphone – that is transmitting and receiving the information. It also includes the network, whether that network is wired, Wi-Fi, 3G, 4G, or 5G, as well as the software, the programming underlying everything from the World Wide Web to individual applications.

Essentially what Figure 1 says, going from left to right, is that we have a learner interacting with a variety of co-participants. These include classmates, the teacher, others outside of the class (peers, native speakers of the language, and so on), and content, content of all sorts, from applications like *Duolingo* designed specifically to support language learning (what Levy (1997) calls tutorial CALL) to authentic online texts or videos in the target language. And importantly, this is happening in the pursuit of language learning proficiency. This model is therefore not just for interacting in a language through technology, but for doing it with a conscious effort toward learning.

Let me offer an example. Consider a learner at an intermediate level. The learning goal, which could be set either by the learner or by the teacher, is to improve listening skill and to build vocabulary. The interaction in this case is going to be with content, for example, online target language video recordings. I am going to make this particular example independent of interactions with any others, including the teacher. So, if we go back to Figure 1, the learner interacts with the video content through the technology mediation system. And what is that technology mediation

system? Well, it can be quite different for different settings, but here we will assume that it is a laptop computer that is connected to the Internet through Wi-Fi. There is a web application as part of this that has a media player, and that media player has all the normal controls like a slider, a volume control, a pause/play button, and so on. In addition, it supports first language and second language captions, a link to transcripts, and a speed control, allowing the video to be slowed down for easier processing.

So how does the technology mediation system in this case potentially impact language learning? For instance, what happens if the learner turns on the target language captions? What happens if the learner turns on first language captions? What happens if the video is slowed down to 75% of normal speed? How does each of these interventions affect not only comprehension but ultimately language learning? Is it improving target language processing or getting in the way? We cannot yet fully understand how this mediation is affecting learning, but if we use a model like that in Figure 1 to guide our *thinking* about what is happening in this hypothetical listening activity, it will help us take steps toward understanding the degree to which a given technology may be supporting or undermining learning goals.

In the example I gave, the primary application was the media player embedded in a web page. In addition, there is a web browser that allows the learner to find and bring up the desired video. A copy of that video, somewhere in the cloud has been archived and indexed so that it can be found. And if this is going through Wi-Fi, there are variables in terms of bandwidth from the local router and the number of devices sharing that bandwidth. These elements and more are parts of the technology mediation system. Again, assuming the goal here is language learning, not just language use, all these elements can impact the ways in which the learner engages in the interaction and what of value they gain from that interaction. At this fairly high level of abstraction, I claim that this simple model is applicable across technologies, ranging from email to virtual reality. Similarly, it is compatible with a range of theories, certainly with cognitive theories of language learning and likely also with socio-cultural perspectives. Further, it is useful across all skills: the nature of the technology mediation will change depending on the skill, but whether it is reading, writing, listening, speaking, or interaction, the mediation is still going to exert an influence.

Beyond the technology mediation system itself, its *impact* is a function of the interactants (learner, teacher, peers, others, and content), the interactions, the activity or task, and the environments in which these all occur, all of which must ultimately be considered. Finally, it is worth noting that the technology does not automatically improve learning in this model – that is, it is not just a technology *enhancement* model. There are ways that the technology mediation system can

actually slow or get in the way of learning, even block learning, depending on how the technology's options are employed.

Let me give one brief personal example unrelated to language learning to support the previous point. I have a son who lives about an hour away, and when I went to visit him for the first time, I put his address into my smartphone's map application. I followed the directions and got to his house right on time, just as expected. And then I did that again, and again the next time I visited him, and again the time after that. At some point I realized that I had probably visited him a dozen times, but if I turned that map application off, I was not sure where to make some of the turns. I would probably have gotten lost. In contrast, in the twentieth century, I would have mapped it out once or maybe twice on paper, and remembered where I went.

So this is an example where the presence of the technology mediation system blocked rather than accelerated my navigational learning. A GPS map system is a kind of augmented reality. We have the road unfolding in front of us on a screen in real time, and it is telling us where we should make our turns, what the traffic is like, and so on. It is a fantastic technology to support the task of getting us to where we want to be, but it *does not* help us *learn* how to get there – unless we consciously use the information it provides for that purpose.

In one way or another, the goal of language learning is to connect target language forms to meaning in a way that can be recalled and reproduced as needed by the learner/user in a real-life situation. In my map example, I had no reliable memory of the connection to the actual road in front of me, or of what the signals were telling me in terms of where I was and where I might turn to get to my son's house. I was fully reliant on the technology and followed directions *blindly*.

This is important. How does a particular instance of technology mediate access, motivation, engagement, focus, and social interaction? These are key considerations in the language learning endeavor. And placing these in a teaching situation, the influence of the mediation depends on what the objective of a particular lesson is and on how aware of that objective and committed to it the learner is.

To summarize, Figure 1 captures the insight that teachers, researchers, and developers need to go beyond surface affordances and do what they can to take into account the potential impact of the elements of the *technology mediation system* on the learners as they engage in interactions. This is not a simple task, but I believe that time devoted to this endeavor will rarely be wasted.

3 Some lessons I learned

Having introduced the technology mediation framework as a foundation, in this section I describe a series of "lessons learned" over the past few decades. There is precedent for this in our field, going back at least to a paper by Davies (1997) containing seven lessons on how the future of CALL could be informed by its past. I originally titled this section "some lessons learned", but in fact, they are really lessons that *I* learned through a combination of reading relevant research, engaging in teaching with technology, and critically reflecting on what was working, what was not, and why. By sharing these lessons, I hope both to inform others and to move them to take into account the experiences they are having using technology for language teaching and what insights they can personally draw from those to influence future endeavors in this realm. The biggest mistake any of us can make is to "teach innocently" (Brookfield, 1995), assuming that the technology will automatically work as we expect it to with our students. In the remainder of this section, I review seven experiences from my career in CALL that led me first to insights and then on to generalizations, frameworks, and models that came to shape subsequent teaching and professional activities.

3.1 Evaluation: 1986–1988

Let me start with evaluation. Late in 1982, I took my first steps toward becoming a "teacher programmer", coding my first set of computer exercises for students in my ESL reading class at Ohio University. There was limited software available for language learning, and what existed was often both expensive and methodologically primitive. So my early work in CALL centered on coming up with ideas for software, programming it myself on Apple II computers, using it with my students, and then presenting what I thought were my successes at regional and national TESOL conferences. As a part of being a software developer, I became aware of how I was looking critically at other people's software and of how other people were looking at mine. At that time, the frameworks to support such evaluation were typically checklists that were either heavily biased toward one method at the expense of others or, even more commonly, were just technology focused without considering language learning elements.

I joined a professional organization in the early 1980s called CALICO (Computer-Assisted Language Instruction Consortium). The organization's *CALICO Journal* published reviews of commercial CALL software. Their review checklist at the time only had the word *language* used once in it, and that was for what language the

software was in: French, English, German, etc. That checklist was clearly focused on the technology itself rather than on how it might support language learning. In my first CALICO Conference talk in 1986, I questioned the value of that checklist and proposed a supplemental framework based on the language teaching approach the software seemed to embody. My work was heavily influenced by a framework for describing and comparing methods that had been developed by Richards and Rodgers (1982). Following their lead, rather than prescribing what the language teaching approach should be, I tried to be more agnostic and provide for a variety of approaches at that time – behaviorist, explicit learning, communicative, and strategy based. I produced a set of checklists showing the characteristics of each as they related to the software under review, published in Hubbard (1987). In the following year, I built on the core concept of embodying language teaching approach considerations in evaluation and created a more comprehensive "methodological framework" that appeared in Hubbard (1988). This framework synthesized the Richards and Rodgers (1982) framework with one from Phillips (1985) for CALL and expanded on that synthesis. Using this new framework, an evaluator began by producing an *operational description* of the software to ensure an understanding of how the software worked before attempting to judge it. With that description in mind, the evaluator would then check for *teacher fit* – how well the software reflected a language teaching approach compatible with that of the teacher. It would also check for *learner fit* – how well the software's content and operation were compatible with the students' level, learning objectives, interests, and motivations. In later work, I expanded the evaluation framework to include development and implementation using much of the same machinery to integrate the three components (Hubbard, 1996).

Importantly, the methodological framework involved open-ended questions rather than being a checklist, although one could generate a checklist from it for a given teacher fit and learner fit. In the years following its publication, the framework became the foundation for the reviewing template used by the *CALICO Journal,* and the teacher fit and learner fit components remain in the journal's review framework at the time of this writing (see the *CALICO Journal* learning technology review guidelines at https://journal.equinoxpub.com/Calico/libraryFiles/downloadPublic/481). The framework has withstood the test of time because it did not prescriptively reference any particular technology, theory, or teaching method, all of which have changed significantly in the past 35 years.

3.2 Computer games for language learning: 1991

Games and the related concept of gamification for language learning have become a significant part of our field in the last decade (Flores, 2015), but some of us were already experimenting with it in the mid-1980s. Some created games dedicated to language learning. For example, I designed, programmed, and piloted with my students a reading game to teach skimming and scanning strategies. Others looked to off-the-shelf computer games to be used for language learning purposes, especially those in public domain (Stevens, 1985). We recognized then as now that we want students to be engaged in their learning activities and that games could help achieve that goal. However, despite the desire to use software with games or game-like qualities to support learning, when I was looking at computer programs that were being presented as language learning games, I observed that many seemed to have one or both of the following problems:

(1) Although they used language, it was not clear that they were helping students learn it;
(2) Although some promoted language learning, it was unclear that learners considered them games – that is, they lacked the fun and engagement factor and seemed to be just an embellished form of drills or quizzes.

Now importantly, this was just an observation – I was not in a position to do research on the topic at that time. However, I was inspired by the work of Baltra (1984, 1990) among others on using adventure games collaboratively, with two or more English language learners sharing a single computer screen and discussing actions and strategies in English as well as inputting English into the game itself. Thus, I was convinced that it was possible to employ computer games effectively if their design and use were examined critically.

I was given the opportunity to share my observations in a short (3.5 page) article (Hubbard, 1991). There, besides noting observations (1) and (2) above, I suggested criteria for evaluating game-oriented software for its capacity to support language learning as well as for its ability to motivate and engage learners so that they would accept it and enjoy it as a game. That article was not cited much for years until interest in digital games for language learning returned. According to Google Scholar, one-fourth of the citations for this 1991 paper have come in the past four years. Perhaps interested colleagues rediscovered it because it still had these two main points. If we are going to be creating or using games for language learning, make sure first that they actually promote language learning and that our students are likely to accept them as games that they want to engage in.

3.3 Meaning technologies: 2001

Throughout the 1990s, alongside my teaching and administrative duties, I worked as a developer creating software for my own students and with a Silicon Valley company making EFL CD-ROMs. At the turn of the century, I began to shift my interest away from design and programming toward integrating web-based content and technologies, in particular those that supported comprehension as a necessary initial step to language learning. At that time, I was regularly teaching one and sometimes two classes each quarter focused on listening comprehension. Stanford, my home university, is on a quarter system: we have three 10-week terms a year, plus an optional summer, so I was getting a lot of opportunities to try out relevant technology in listening classes. Students were already using English captions, native-language captions, and electronic dictionaries to aid their listening comprehension, what Cárdenas-Claros and Gruba (2009) categorize as "help options". I knew these could be used to help, and I encouraged their use sometimes, but it also seemed that they could impede learning. Students could simply take shortcuts to finish a task, but also innocently use them thinking that they would help learning. As Vandergrift later observed, "Captions, annotations, and computer programs to slow down speech may be useful for developing word recognition skills and learning vocabulary; however, their value in teaching students how to listen is questionable. Given that written support is usually not available in authentic, real-time listening, students need to learn to rely only on the acoustic signal and relevant contextual factors to develop listening strategies" (Vandergrift, 2004, p. 9). So, for example, if learners always rely on captions to support comprehension, then they may not develop their listening skill adequately, just as I did not improve my navigation skill when using a GPS.

Machine translation was becoming a particular concern at the turn of the century. Among other options, a web-based program called Babelfish had become particularly popular (Davies, 1997), and while it was crude by today's standards, it looked like it could be easily misused. Indeed, some scholars suggested it might lead to dramatic changes in language teaching and learning.

As a teacher, I saw the need to try and strike a balance between the extremes of banning or restricting these *meaning technologies* or letting them be used freely. In Hubbard (2001), I introduced these concerns and suggested techniques for a classroom teacher to model ways to reinforce the form-meaning relationships so that these technologies became tools for comprehension in the service of language acquisition. For example, I noted that captions could be used during the first part of a video segment to establish a foundation for comprehension and then turned off for a more authentic listening experience (see Markham and Peter (2003), for research supporting this technique).

The recent release of the AI program ChatGPT is once again bringing us serious concerns about technology negatively impacting learning. In this case, we are dealing with a *production* technology, one that could, for example, write an exam essay for a student directly in English (Susnjak, 2022). ChatGPT's translation abilities are also being explored, including by a group at Tencent AI Labs (Jiao et al., 2023). At the time of this writing, it remains to be seen how this will impact teaching and learning, but it is clear that teachers will need to become keenly aware of the growing capabilities of this sort of application and find ways to work with students to use it to support rather than subvert language learning.

3.4 Learner training: 2004

The concept of *learner training* is not new to language teaching, but its specific application to CALL was not well established in the early decades of the field. In the 1990s, I knew about learning strategy training, for example, because it was already an established area in second language reading and to a lesser extent in listening. However, there was little in the way of literature on it in CALL.

It was a particular class experience that raised my awareness of the need for learner training in technology use. In the mid-1990s, I had developed some listening software for the Macintosh computer, and I assigned it regularly to my students for homework. The main activity type was a picture identification exercise where students would see three somewhat similar but different graphics, listen to a description, and then click on the graphic that fit what was said (or "none of these" as a fourth option). They worked on these exercises independently each week in the language lab, and I gave them short forms to fill out about how useful they found it, how easy or difficult it was, how long they used it, and what their score was (Hubbard, 1995). My goal was to have them listen carefully to each prompt multiple times, trying to understand as much as possible before answering. I anticipated that this would improve their processing of connected speech and would take about 30 min. However, on reading their reports and talking with them in biweekly individual meetings, I discovered that several reported completing the 10–12 item assignment in just 5 min because they listened to the items once, answered the prompt, and sometimes even got one hundred percent right.

The students and I discussed this disconnect between my expectations and theirs in class and in the individual meetings. After explaining the objective of the activity, I demonstrated how to make the items more challenging by first hiding the graphics until after they had heard the prompt. I also showed them how they could use the material for dictation after they had gotten the correct answer. That was the start of learner training for my listening classes, leading the students beyond just operating

the software and on to understanding how it could best help them to improve their processing, including how they could adapt the level of challenge to their individual proficiency levels.

In addition to my instruction and modeling, I gave students class time to talk to each other in small groups about how they were using this and other software independently. Eventually, I formalized what I was doing into a framework for learner training based on five principles (Hubbard, 2004). Up to that point, the majority of learner training I had read about in CALL was focused on technical areas – how to use a particular piece of software, what all the controls did, and so on. Beyond this technical training, the primary point of my framework was to recognize that the students needed *pedagogical* training because they were taking on part of the role of the teacher when working by themselves. They not only needed to know how to operate the software but also when to use certain control options and why. This extended well beyond the software I had developed and eventually became the central part of an advanced listening course I taught, where students would do weekly independent listening projects using audio and video materials they found on the web (for the class notes from 2020, see https://web.stanford.edu/~efs/693b/). I revisited the topic in Hubbard (2013), which was aimed at making the case for why learner training should become a core element of CALL research and practice.

3.5 Principles of mobile assisted language learning (MALL): 2013

By 2012, mobile language learning had been growing for quite some time (Burston, 2013). With the advent and rapid spread of the smartphone, a "computer" much more powerful than the typical laptop or desktop of a decade before, mobile learning had become significantly more popular. In 2013 I was invited to write a paper by the International Research Foundation (TIRF) on a topic related to MALL. At that time, I had not done a lot of work with MALL because my students typically continued to use laptop computers for most of their academic work. However, I did have the sense that MALL was being overhyped—too much attention was being given to the potential of the technology compared to its demonstrated value for language learning. In addition, conference presentations and published papers describing MALL uses often (though not universally) focused on its positive features and ignored any challenges. Although I was not ready to write a paper in this area on my own, I had a colleague, Glenn Stockwell, who had done a lot of good work in MALL and who had been given the same invitation independently. Like me, he was not eager to write a paper on his own, so we decided to collaborate.

We communicated through email and regular meetings on Skype. A key point that emerged from our discussions was that input for designing and implementing MALL tasks ideally involved drawing on research from three areas: MALL itself, CALL, and mobile learning in areas other than language. We produced a paper that proposed and defended 10 emerging principles for MALL, each supported by research from one of the three contributing fields (Stockwell & Hubbard, 2013).

Let me give three examples. One principle was to limit multitasking and environmental distractions. It is often convenient for learners to use a mobile device for language practice while doing something else or in a noisy environment, but the resulting learning can be degraded. Another principle was to be aware of the learners' "cultures of use" (Thorne, 2003, p. 38). Thorne's work came from CALL, but it is clearly relevant for any technology implementation, including MALL. He discussed what happened when French and American students were put together in a virtual exchange and told to use email to communicate with their overseas partners. In one case, the two ended up using a synchronous chat program instead of email, because at the time, that was their culture of use for social interaction. As a result, they ended up spending much more time communicating than other student pairs who interacted through email. The final example principle was to provide students with relevant learner training, guidance on how to use the mobile device, application, and environment effectively both to complete the task and to support language learning objectives.

3.6 Teaching reflectively with technology: 2013–2017

Reflective teaching has always been important for language classrooms, especially in the early stages of a teacher's career (Richards & Lockhart, 1994). However, based on what I witnessed at conferences and even noticed in published work, reflection in using technology for language teaching is often not in evidence. There is a tendency to observe and report on only the positive aspects of technology use.

In 2013, I decided to explore this issue along with a colleague of mine from Cyprus, Sophie Ioannou-Georgiou. She and I had worked together on the team developing the TESOL Technology Standards Framework (TESOL, 2008) and a few years later were part of an exchange between IATEFL and TESOL. In this exchange, funded by the British Council, a member from the TESOL CALL interest section was sponsored to attend the IATEFL Conference in the UK, and a member from the Learning Technologies special interest group of IATEFL was sent to the TESOL conference in the US. As part of the exchange, we embarked on a collaborative project between the two groups in the form of a book. Having recently witnessed

numerous CALL-oriented conference talks where applications of technologies were presented uncritically (sometimes even without actually using the applications with students), we decided to push the idea of teaching reflectively with technology as the central theme for the book.

As teachers and teacher trainers, we both knew that whenever we brought in a new technology, it worked better for some students, less well for others, and maybe not at all for some. We felt that when teachers reported only positive results, without addressing the challenges they had faced, that this was a disservice to the teachers in the audience. We were also concerned that teachers reporting on their technology use seemed unaware of others who had gone before them.

We sent out a call for papers to the two groups we were representing and specified that we were not interested in a typical research paper; rather, contributors had to demonstrate reflective teaching practice as follows:

(1) Represent practical uses of recent and emerging technologies or innovative applications of more established ones.
(2) Include an explicit rationale for incorporating the technology tied to language learning goals and objectives, supported with references.
(3) Incorporate thoughtful reflections based on observation and/or collected data regarding what worked, what did not, and why, connected where possible to relevant literature (a minimum of five references was required).

In our introductory chapter, we motivate the need for reflective teaching with technology as follows.

One way of understanding the notion of teaching reflectively is by looking at what it *isn't*. Brookfield (1995) famously contrasts it with *teaching innocently*. Teaching innocently occurs when the teachers assume that they understand what they are doing and the effect it is having on their students. Teaching innocently, they do not challenge the assumptions underlying their teaching actions… The failure to teach reflectively, then, is not necessarily based on laziness or time limitations or even arrogance. Rather, we would argue, it is a case of not knowing what we don't know and then letting the exploration stop there (Hubbard & Ioannou-Georgiou, 2017, pp. 12–13).

We collected 21 case studies divided almost equally between the two organizations. We succeeded in getting the authors collectively to demonstrate a range of ways for teaching reflectively with technology in a variety of ESL and EFL contexts. In doing so, we hope to have provided a model for others to follow. The book was eventually published in 2017 by IATEFL(see https://web.stanford.edu/~efs/tert/ for more information).

3.7 Drawing on the past: 2018–2019

I started moving more formally in the direction of drawing on the past to help inform the future in a 2018 GLoCALL/ChinaCALL keynote presentation in Suzhou, "Five keys from the past to the future of CALL", published the following year in Hubbard (2019). These represented points I had made in various publications over the years and in the CALL courses I had taught, but this was the first time I had organized them in this manner. Reviewing these five keys was an important step for me in generating the ideas for the current paper.

(1) When a new technology appears and is considered for CALL, there is a tendency to greatly overestimate its impact and to be dazzled by its apparent potential. Gartner, a company that provides executives with relevant insights for their businesses, refers to this tendency as the "hype" part of their hype cycle (Linden & Fenn, 2003). Within CALL, Murray and Barnes (1998) called it the "wow factor". During this early period of adoption, a lot of time and effort is often spent on speculation, attitudinal research (e.g., do students like it?), and rushed development before the affordances and constraints are sufficiently understood. A key lesson from this is to approach new technologies critically rather than with blind enthusiasm and to be guided by the often-repeated adage that it is not the technology alone that is important, but rather how it is used. "Using technology in delivering a lesson or instructional unit will not make bad pedagogy good" (Golonka et al., 2014).

(2) As depicted in Figure 1 and discussed in above, the mediational properties and impact of technology need to be understood as they relate to language learning potential.

(3) Good research is important for CALL, but it must be interpreted carefully, not just simply adopted—or dismissed—uncritically. Those working in CALL need to understand not only the importance of research results, but also their limitations. Many studies involve either the opinions of teachers or the opinions of students at a particular point in time, which may not be particularly useful five or ten years later. There are other studies that may maintain their relevance for decades. For example, I suspect Thorne's (2003) generalization on the importance of understanding learners' "cultures of use" for technologies in language learning tasks is as relevant today as it was when published, even though the technologies have changed.

(4) Fifteen years ago, I published a paper in the CALICO Journal on the future of language teacher education (Hubbard, 2008). In it, I noted that teacher candidates we were working with at that time needed to be prepared for a professional career of 40 years or more, one involving constant technological change.

Thus, teachers need to be trained not just on how to use current technology. They also need to know how to think about technology, approach it critically, and expand their operational and pedagogical skills with it through a program of lifelong professional development.

(5) Learners similarly need training. It is a mistake to assume that just because they are comfortable with technology for social interaction that they can effectively utilize it in pursuit of their language learning objectives.

4 Guiding principles for technology mediated language teaching and learning

In this last section, I discuss how we can use insights gathered from the past to develop principles for integrating both established and emerging technologies into language teaching. Like teaching reflectively, letting principles guide one's teaching is not a new idea (Richards, 1996). Teachers may have background in theory and research and certainly in methodology. However, according to Richards, they develop personal principles, or maxims, that inform their approach to teaching. These principles—brief, memorable generalizations informed by theory, research, practice, and experience—guide teachers' instructional decisions and actions. Principles can be broad or narrow, and importantly, they are useful not just for teachers, but also for developers and researchers.

Here are some examples of broad principles that can be drawn from the preceding sections.

(1) Consider the mediational properties of the technology you want to use and how they relate to the learning goals (See Figure 1).

(2) Be sure to understand how an application or technology-based task works before judging its value. When you do judge it, consider it from the perspective of how it fits both you and your students.

(3) Avoid hype—be especially skeptical of unsupported claims about emerging technologies.

(4) Seek out relevant research and practice literature but read it critically.

(5) Teach reflectively with technology. Plan thoughtfully, monitor what is happening with your students while they are using technology, and especially reflect afterwards. Encourage your students to do the same to improve their use of that technology for future learning.

(6) Take time and make the effort to train your students to use technology more effectively for language learning.

These broad principles can be followed by more actionable narrow principles. Taking the last one, learner training, in Hubbard (2004) I proposed five pedagogically oriented principles based on theory, research, and reflective teaching that guided what I did with students

(1) Experience CALL yourself: Experiment with a technology or task from the learner's perspective before assigning it.
(2) Give learners some teacher training. Provide them with the relevant knowledge and skills necessary to work effectively on their own.
(3) Use a cyclical approach. Make training in effective technology use ongoing, not just based on a single training session.
(4) Use collaborative debriefings. Get learners to discuss their successes and failures with the technology in pairs or small groups.
(5) Teach general exploitation strategies. Show learners ways to make materials and tasks easier if they are too hard and harder if they are too easy. Have them focus on the connection between their actions and improving language proficiency.

I conclude this section by discussing a recent paper (Canals & Mor, 2023) showing what some others are doing with this concept of principles. The goal of their paper, which is about technology-enhanced task-based language teaching (TETBLT), is to produce a *singular pedagogy*, that is a set of principles that will guide exemplary teaching. In this study, the authors relied on a panel of 22 experts to produce an initial 16 TETBLT principles. They were then modified, based on a second round, because while all of them were relevant, some were overly challenging to implement, and (not surprisingly) there were some cases where the experts disagreed with one another. The team ultimately decided on a set of eight principles that they thought were useful and practical. One example straight from TBLT Itself is "learn by doing". Another principle references input characteristics, how it is important to have "a variety of rich and authentic inputs enabled and amplified by technology" (Canals & Mor, 2023, p. 12). Beyond providing a useful set of principles for TETBLT, their paper has value in the methodology employed in deriving principles through the discussion and interpretation of contributions from an expert panel.

5 Conclusion

I began here with a simple model of technology-mediated language learning. I then offered examples of lessons I learned during my 40 years in CALL that have guided my English teaching and teacher education work. Due to space limitations, there are some other significant areas I did not touch on that influenced my views and

implementation of CALL concepts. These include lessons I learned from the following:

- co-editing the first book devoted to teacher education in CALL (Hubbard & Levy, 2006), leading to a broader and deeper understanding of what others were doing in this domain;
- serving on the writing team for the TESOL Technology Standards Framework (TESOL, 2008), collaborating with colleagues to set targets for English language teachers in foundational and expert knowledge and skill in CALL;
- editing *Computer-Assisted Language Learning: Critical Concepts in Linguistics* (Hubbard, 2009), drawing on the wisdom and experience of 19 colleagues to generate a four-volume anthology of 74 influential papers from the history of CALL: https://web.stanford.edu/~efs/callcc/;
- developing a framework for theory types in CALL (Hubbard & Levy, 2016), recognizing in particular the value of theory adaptation and coherent combinations of theories—theory ensembles—to accommodate the intersection of SLA, technology, and other disciplines.

Finally, I showed how such lessons can be the basis for guiding principles for integrating technology in language teaching. I gave examples of principles that have helped me and showed how others are working to develop principles relevant to technology-mediated teaching.

In our rapidly changing world, the prospect of keeping up with technological and related pedagogical progress can easily be overwhelming. I have demonstrated here that it is possible to mine the past for lessons to help with the uncertainties of emerging technologies. I used examples from my own professional journey, but other such lessons are readily available in the CALL literature. Additionally, I have suggested that we can derive useful principles from lessons learned through integrating knowledge and experience in technology-mediated language learning to provide guidance for navigating the future. Over time these principles should be critically examined, revised, and added to as more knowledge and experience is gained.

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