

# 4

## Exploring Theory in Computer-Assisted Language Learning

Glenn Stockwell  
Waseda University  
[gstock@waseda.jp](mailto:gstock@waseda.jp)

**Abstract:** The field of computer-assisted language learning (CALL) is, by the very nature of its dependence on technology, one that is in a constant state of change. As a result of this change, it may be argued that theory, research, and even practice in the field struggle to keep pace with these technological developments. Given the centrality of technology in CALL, any discussions of theory, research or practice must take into the consideration the impact that technology has, not only on the learning process, but also on the reasons for and the focus of research undertaken in the field, and the range of factors which may contribute to how and why technology is employed in a given context. Although each has featured in the CALL literature over the past several years, the complex interrelation between them remains largely unexplored. This paper examines the elements of what theories of CALL must include, and provides some examples of theories that are from outside the mainstream language learning literature that may be of relevance to teachers and researchers in CALL. The paper concludes with a brief discussion of the complexities of theory in CALL, and how a rethink of the position of theories that draw more heavily on the technological aspect of the field may help lead to a deeper understanding of the role that technology plays in the language learning process.

### Introduction

Although there was some sporadic use of technology in language teaching environments prior to this time, if we look at how long the major journals and books in the field have been around, we could say that CALL as a discipline has been around for more than a quarter of a century. The *ReCALL* journal is now into its 25th year, *Computer Assisted Language Learning* journal into its 26th, and the *CALICO Journal* into its 30th, and it has been nearly 20 years since Higgins and John's (1984) seminal work was published. Needless to say, the development of an interdisciplinary field such as CALL has not been without difficulties, and many researchers over the years have stopped to take a look at what has been done and the future directions of the field (e.g., Warschauer, 1996; Bax, 2003).

As A. N. Whitehead (1911, p. 233) very famously noted, "It is a well-founded historical generalization that the last thing to be discovered in any science is what the science is really about." It would not be too much of an exaggeration to say that this is also applicable to the field of CALL. We may say that it is widely agreed that CALL refers to the use of technology to facilitate the language learning process, but exactly how technology

can be applied to achieve this has gone through several stages of thought. One factor that has made it particularly difficult in CALL when compared with other fields is that one of the major players, technology, keeps changing at a phenomenal rate, and the effects of this change reach not only to the classroom, but rather into virtually all aspects of our daily lives. Technologies have become more accessible, smaller and more portable, and exponentially more powerful. At the same time, there has also been a significant change in the educational environment itself, with a shift in focus from the teacher to the students, from centralized to distributed. In the midst of this ongoing change, the field of CALL has pushed steadily onwards, and this has been evident in the myriad of ways that technology has found itself into a wide range of language teaching and learning contexts, the scope and scale of the research conducted, and the theories that have been applied to explain the various phenomenon that have emerged.

The purpose of this paper is to take a look at theory, research and practice in the field of CALL, considering how they interrelate and how they have developed. It will aim to examine how CALL research has been conducted, and provide some suggestions for how research and practice in the field may be carried out to

be of maximum benefit to language teachers who wish to implement technology smoothly and effectively into their individual language learning contexts.

### **Interdependency of theory, research and practice**

As alluded to above, the essence of CALL is to determine how technology may play a role in the teaching and learning of a second language. How exactly technology may be used to achieve this will depend very heavily on what technologies are used, as this will necessarily have an effect on when, where and how the technology can be applied to the language learning context. Technologies that are fixed, such as desktop computers, will mean that their usage is limited to a time and place that they are available, which may entail setting aside a certain amount of time on a regular basis in a computer laboratory. Technologies that are portable, such as MP3 players, mobile phones, tablet computers or laptops, have meant that there is a far greater amount of freedom with regard to time and place, but their usage is still very much dependent upon what the technology is capable of doing (e.g., mobile phones are easy to carry around, but there are limitations in screen size and text input) and, of course, the types of tasks or activities that students are required to use them for. Thus, practice in CALL—the collective term we might use for how technologies are used to teach languages—is highly dependent on the technologies, but at the same time, one might question whether the technology itself is the primary factor which determines the language learning uses that it is put to. Underlying the use of the technology are the language learning goals that the teacher (or learner) has in mind, and it should be kept in mind that technology itself cannot contribute to learning a language. Healy (1999) puts this very accurately with her metaphor that, “...technology alone does not create language learning any more than dropping a learner into the middle of a large library does” (p. 136).

Practice in CALL is exceedingly complex, and is constantly affected by the context in which it occurs, be this at an individual level, an institutional level, or a societal level (see Stockwell, 2012a, for a discussion). The way in which learners use technologies in their everyday lives will, for example, have an effect on how they apply these technologies to other usages as well (Levy & Stockwell, 2006). Similarly, if there are institutional preferences for using technologies, such as an institution-wide learning management system (e.g., *Blackboard*, *Moodle*, etc.), this will also likely have some influence on not only what technologies are used, but also what they are used for. At a societal level, some technologies are more readily available than others. Tablet computers are quite popular amongst students in Australia (Fujimoto, 2012), but ownership by students in Japan still seems to be very much in the minority

(Stockwell, 2010). As a result, requiring learners to use their tablets to complete tasks in Australia might be considered as a possibility, but in Japan it would mean that only a very small number of learners would be able to do this. In this way, the context will always have an effect on the ways that technologies could and should be used to achieve language learning goals.

How, then, does this relate to research? The terms research and practice appear frequently together in the titles of books and journals in a range of fields, and CALL is no exception to this. There is clearly an interrelationship between the two, and one could not be carried out effectively without at least some minimal reference to the other (Hinkel, 2005). The nature of the relationship depends very much on the focus of what is being undertaken, however, with research often being the point of departure for what happens in practice, and practice being the point of departure for what ends up being researched. For example, if a developer of CALL software has a desire to see whether some tool that they have developed is effective for learners to acquire vocabulary, it is likely that the teaching environment will be shaped to make such a study possible. Should an experimental or quasi-experimental type of approach be undertaken, then it is likely that learners will be—at times rather arbitrarily—divided into two separate groups, where one uses the technology and the other does not. Given the ethical concerns of having one group of students potentially advantaged by the use or non-use of a technology, the researcher may decide to use a matrix approach, where the two different groups are given access to the technology at different times during the course. While in this case both groups of learners have had access to the same technology, the timing in which this access occurs is necessarily going to have some kind of effect, be it on the content which is taught, or in the way that it relates to other material which has been taught. In this way, it becomes clear that research has clearly shaped what happens in practice.

In CALL contexts, the starting point for research may also be the technology itself, where a teacher may have an interest in a new technology, and be interested in its applicability to a learning situation. In this case, the technology itself has shaped not only what has happened in practice, but research is likely to be undertaken at the same time, meaning that it has also shaped what is researched. In this way, it becomes evident that the relationship between practice, research and technology is a mutually dependent one, where it would be rather difficult for one element to exist without some effect on the other two.

What about the role of theory? Before embarking on the discussion, it helps to have a view of what we mean when we refer to theory. Mitchell, Myles and Marsden

describe theory as, "...a more or less abstract set of claims about the entities which are significant within the phenomenon under study, the relationships which exist between them, and the processes which bring about change" (2013, p. 2). Whether the theory that is applied is formalized or just an informal perspective on a given situation, we would assume that teachers applying theory would maintain some perspective of how learning will occur.

The role of theory is always going to be present in any discussion of research or practice, and, for that matter, technology. This perspective will obviously directly shape what happens in the classroom, but at the same time, it can also have an impact on research. It is likely to affect not only on what data are collected, but also how these data are viewed and interpreted. An interactionist may look at the turn-taking that takes place between learners interacting via Skype or some other audiconferencing tool, while a socioculturalist, with the same data set may look at instances of scaffolding. In this case, it is possible to think of theory as a means of bringing some elements to the foreground or the background (Levy & Stockwell, 2006). A researcher who is looking to investigate turn-taking may adopt a different data collection method from a researcher who is interested in scaffolding. To this end, as Mackey and Gass (2012, p. 1) argue, "...research methods are dependent upon the theories that they are designed to investigate." Indeed, the theory which is applied can bring about a completely different view of the same situation, shading it in the unique characteristics inherent in the theory.

The same may be said of the choice of technology and how it is used. A strong advocate of drills may see the technology of choice—be it a desktop computer, mobile phone or tablet computer—as a tool in which to achieve this, providing answers to questions generated from some kind of a database. The types of activities that they design will likely fit this view, and as such the technology and the software that is used will need to make this possible. In contrast, a person who advocates natural communication between learners may believe that social networking service (SNS) sites provide exactly the environment that they would like to use with their learners, allowing them to communicate with each other through *Facebook* or some other tool. In this case, the choice of technology has become something completely different from the advocate of drills, and the manner in which the technology is used would be affected by this view. In this way, it becomes very clear that the impact of the theory that is applied to a given situation is likely to have a very wide-reaching impact on all aspects of how CALL is conceptualized and conducted. Theory is discussed in more depth in the following section.

As the discussion above has alluded to, theory has always had a place in CALL. It may seem somewhat odd to point out, then, that at times its position has been rather tenuous. CALL practitioners for the most part recognize the importance of theory, and several theories have been cited in the CALL literature over the past three decades. How could this position be considered as being "tenuous" then? A reality is that there has been a not-insignificant body of research in CALL that does not cite any theoretical framework at all, particularly in the early years. Even when it is not cited, there going to be, as described above, a view of how languages are learned in the background behind how technology has been implemented in the language learning context. In many cases, however, it has remained somewhat tacit, and it is only in the past decade or so that theory has featured more prominently in CALL research. It is certainly possible to argue that it has been this lack of reference to theory that has been at the base of some criticisms directed towards the field of CALL, which is seen very much as an extension of second language acquisition (see Chapelle, 2005; 2007; Egbert & Petrie, 2005).

There have in fact been very few serious attempts at looking at theory in CALL. While it has received passing reference in many publications, these are generally limited to a particular study or environment. Two of the more notable analyses of theory and CALL have been carried out by Levy and Stockwell (2006) and Hubbard (2008). Levy and Stockwell (2006) suggest that theory can be used for different purposes in CALL, including theory for design, theory for teaching, and theory for research. It is conceivable that practitioners in CALL apply multiple theories at the same time, depending on their needs in a given teaching and learning situation. This means that it is important to be aware of the purpose of theory and to ensure that conflicts in theories are avoided.

In Hubbard's (2008) research, he examined theories cited in the *CALICO Journal* from 1983 through to 2007, finding that theories that pertained to second language acquisition or linguistic theory made up 38 of the 90 articles that mentioned a theory, and a further 27 being based on educational, pedagogical or learning theory. Of some concern in his study, however, was that a large number of theories were mentioned only once, indicating that while there is an attempt to look beyond the mainstream theories, very few of these have been given serious consideration beyond a cursory mention. It is probably not that surprising that CALL should have reference to second language acquisition (SLA) theory. The acronym that forms the word CALL entails two primary components – "computer" and "language learning." Without underplaying the importance of

the “assisted” part of the equation either, it becomes obvious that these two parts will certainly affect the way that CALL is conducted, and of course the theories that underlie CALL research and practice. The argument for the use of SLA theories is in many ways a convincing one, and there have been those who suggest that CALL is, in essence, an extension of mainstream second language teaching and learning. One would argue, however, that this view is one that underplays the role of technology in the language learning process. Is it possible to simply view the technology in the same way as any other language learning tool, such as a textbook, a cassette, or even pen and paper? While it is indeed possible that technology may take on the role of at least one of these tools, we could argue that its role goes beyond them, and into a wider scope within our daily lives. Technology has become ingrained in many of the things we do on a daily basis, and where once we may have memorized telephone numbers, addresses, important dates and other events in our lives, much of this is now being left to the range of devices that we choose to own.

To this end, it is possible to argue that, particularly in this current day and age (although this was evident to a degree in the past as well), that technology has taken on more than the facilitator role as might have been assigned to it in the past, much as a textbook was. In our everyday lives, we often choose not to remember details – who needs to when they can easily be looked up in our electronic address books or calendars, or, depending on what it is we wish to find out, simply searched for on the Internet. It is possible to take pictures of signs, menus or other scenes and then forward these on to others, rather than taking the time and effort to describe them. In language learning contexts as well, where we use the technology to take on certain roles that might once have been within the domain of the learners themselves. This of course would relate to the process through which languages are learnt. Based on this idea, it becomes apparent that any theory of CALL needs to look at the process of learning the language, and at the same time the effect the technology has on this process. This would largely need to consider how the learner interacts with the technology, and the impact that the technology has during the SLA process. The concept itself is not an entirely new one, as Levy (1997, p. 184) pointed out, the technology when used as a tool (as opposed to tutor) serves to “augment learner capacities,” meaning that in many ways, it amplifies and enhances the capacities the learner has, or in some cases, making up for those capacities the learner may lack.

While there are several theories that relate to how humans interact with technologies, two theories that appear to be immediately applicable to the way in which technology may be used in language learning are distributed cognition and situated learning. These

are by far the only theories that may be applicable, but for illustrative purposes, a brief overview of these two theories and how they may be used in language learning context is provided here.

### ***Distributed cognition***

The concept of distributed cognition was first conceived by Hutchins (1995a) as a means of examining the real-world flow of representations in cooperative work settings. Since then, the concept has been expanded to include the way in which cognition occurs as a process that combines both internal and external memory and processing functions. Hutchins’s view emphasized the external nature of human cognition, and he argued that, “...a complete theory of individual human memory would not be sufficient to understand that which we wish to understand because so much of the memory function takes place outside the individual” (1995b, p. 286). That is to say, in many of the activities that take place in our daily lives, a large proportion of them occur as a combination of processes that take place within individuals and the tools that are used to facilitate these activities. While distributed cognition can also refer to sharing of information between individuals during processing (see Cole & Engström, 1993), the discussion here has been limited to the role that technology can play in sharing the cognitive load.

In a CALL context, the application of distributed cognition is immediately obvious. For instance, if we look at the process of learning vocabulary, it is evident that there are several ways in which the learning process may be somewhat different than learning through non-technological means. One example might be that rather than relying on the human memory to keep track of lists of vocabulary, the learner can have these stored in a place where they are easily accessible and then use them for self-study as they see fit. This particular use is perhaps not very different from what may be done using pen and paper methods, but there are some aspects where the affordances of the technology can be put into play. Learners may be able to input the vocabulary that they wish to learn into software that can automatically create questions for them, be they in context or using other tools. Links to dictionaries that provide the pronunciation of the word, or examples from corpora of actual use can be accessed very easily. Even the reading process itself can be affected by the technology, where pre-installed technology can remove the need to look up unknown vocabulary at all, rather allowing words to be automatically highlighted when touched or clicked on, with a list of information about the word being made available. In this way, the load on the learner is necessarily different from what it would be without the use of technology.

In the first example given here regarding the vocabulary

lists, the process of writing itself may have some differences. In the case of ideographic languages such as Japanese, using a keyboard/keypad removes the need to actually handwrite the character, with the device bringing up the suggested character from a list. This puts the focus on recognition rather than on production, requiring different skills than physical handwriting. Using a system that can automatically create questions for learners can often mean that the range of questions used can be more varied than might be the case with books or self-written lists, while the automatic showing of word meanings reduces the need to access sources such as a dictionary that are external to the activity itself. This may have the effect of decreasing the amount of time spent on looking up new words, but of course at the same time there is the danger of not giving due attention to new words as the meaning is available without cognitive load (see Nation, 2001, for a discussion). Thus, while the effects of the technologies may be viewed as either positive or negative, depending on what is being used for what purpose, suffice to say that there is indeed an effect, and this effect is something that needs to be taken into consideration when looking holistically at the language learning process.

### **Situated action**

The underlying idea behind situated action is that people will behave differently depending on the situation and the options available (Suchman, 2006). If one were to imagine a large room with a single green button on the wall, labeled, "Push the green button." In such a situation, there may be people who happily push the button, and others who feel would be reluctant to do so. The reason for this difference is that many people are unlikely to take risks if they do not know what the outcomes of a particular are. Even when faced with the same circumstances, people will decide on rather different outcomes, depending not only on what the outcome is, but also on what the perceived outcome might be. Those who envisage that the green button might link to a door opening would likely be far less hesitant in pushing the button when compared to those who might imagine something terrible would happen like an explosion. The strength of the perceived outcome is not to be underestimated, as it can have play a role in determining actions and behaviors that occur.

The application of this theory to CALL design is also evident. Learners need to be aware of what the outcomes of actions that they are required to undertake will be so that they can make informed decisions about what actions to perform. For example, in the design of CALL applications, if learners do not know the functions of buttons or other features within the application, there is the chance that they will not be used in the way that is intended by the designers of the program. Options

need to be clear and logical, and leave as small amount of doubt as possible for the learner so that they feel comfortable about navigating around the environment in the application.

The two theories described here are meant to be illustrative rather than exhaustive, but they do serve as an example of the field of CALL may benefit from the different insights that human-computer interaction (HCI) provides. While of course SLA theory should maintain a central role in the view of technology in second language learning, it is somewhat naïve to underplay the role that technology plays in the learning process. As Levy (2000) argues, "...technology always makes a difference; the technology is never transparent or inconsequential" (p. 190). This suggest that a knowledge of both theories that apply to learning as well as theories that apply to how humans interact with technology are essential in better accounting for the complex relationship between technology and language learning that make up the field of CALL.

### **Complexities of theory in CALL**

While the discussion provided here into CALL theory is somewhat simplistic, it is intended to suggest that there is potentially far more to CALL than can be simply explained by theories of SLA that do not involve technology. This will very definitely depend, however, on the role that technology plays. When the computer assumes a more tutor role (see Levy, 1997, for a discussion), then the interplay between the learner and the computer will be completely different from what it would be when the computer is used as a tool. As a tutor, in addition to the cognitive aspects, we may also see psychological ones (and perhaps even social ones), with the computer taking on the "presence" of a teacher (see Hubbard & Bradin-Siskin, 2004). The simulated role of the teacher may include that of provider of various activities, feedback, and assistance, all of which may be perceived by learners in different ways.

As described earlier, the cognitive load of the learner may also be strongly affected by the technology, not only in what it can facilitate (as was seen in the discussion on distributed cognition) and in that it might make it possible for people who are geographically separated to communicate, but also in potentially more negative aspects. For example, as was discussed earlier, some learners become less inclined to learn certain elements as the technology has the potential to take over this task for them, but this may simply be a direction that we as humans are going in, and one that language teachers will need to adjust to in the future. Alternatively, when using tools such as videoconferencing, the high quality of sound and video give the impression that communication is as smooth as what takes place in face-to-face environments, but often there are minor glitches and pauses in these that can cause a different

meaning being transmitted or understood than what was originally intended.

Thus, technology will, as I have pointed out throughout this paper, make some difference, and there is a need to researchers in CALL to consider the entire range of complexities. This might mean that time will need to be spent on discussion of theories that go beyond the mainstream, and explore other areas of thought. When we look at what is happening in the field at present, as Hubbard's (2008) study suggested, many researchers in CALL appear to be dabbling in theories, without concerted attempts at investigating how they may or may not be applicable to the field. Such an outcome can only be achieved through following up on previous research, which may include walking down some tentative tracks that daring researchers in CALL have left behind, in an attempt to see if they lead anywhere that will be of value to the field.

## Conclusion

The range of issues which could have been raised in a paper such as this are far too broad to be covered in sufficient detail, so this paper has aimed to provoke thought regarding the considerations that must be kept in mind regarding theory, research and practice in CALL. At the risk of oversimplifying the complexities, the paper has provided a basic overview of how there is a necessary relationship that exists between these three elements, and how these are further complicated by the introduction of technology.

As technologies change, the ways in which humans interact with the technologies and with each other are destined to change. Those who implement CALL are encouraged to keep a firm eye on the developments in SLA, but to not do so at the expense of the research which looks at the ever-changing relationship between humans and the technologies that have become almost ubiquitous in our daily lives.

## References

1. Bax, S. (2003). CALL—past, present and future. *System*, 31, 13-28.
2. Blake, R. (2000). Computer-mediated communication: A window on L2 Spanish interlanguage. *Language Learning & Technology*, 4(1), 120-136.
3. Chapelle, C. (2005). Interactionist SLA theory in CALL research. In J. Egbert & G. M. Petrie (Eds), *CALL research perspectives* (pp. 53-64). Mahwah, NJ: Lawrence Erlbaum Associates.
4. Chapelle, C. (2007). Technology and second language acquisition. *Annual Review of Applied Linguistics*, 27, 98-114.
5. Cole, M., & Engstrom, Y. (1993). A cultural-historical approach to distributed cognition. In G. Salamon (Ed.), *Distributed cognitions: Psychological and educational considerations* (pp. 1-46). Cambridge: Cambridge University Press.
6. Egbert, J., & Petrie, G. (2005). (Eds). *CALL research perspectives*. Mahwah, NJ: Lawrence Erlbaum Associates.
7. Garrett, N. (1998). Where do research and practice meet? Developing a discipline. *ReCALL*, 10(1), 74-101.
8. Healey, D. (1999). Classroom practice: Communicative skill-building tasks in CALL environments. In J. Egbert & E. Hanson-Smith (Eds.), *CALL environments: Research, practice and critical issues* (pp. 116-136). Alexandria, VA: TESOL.
9. Higgins, J. & Johns, T. (1984). *Computers in language learning*. London: Collins.
10. Hinkel, E. (2005). Introduction. In E. Hinkel (Ed.), *Handbook of research in second language teaching and learning* (pp. 3-6). Mahwah, NJ: Lawrence Erlbaum Associates.
11. Hubbard, P. (2005). A review of subject characteristics in CALL research. *Computer Assisted Language Learning*, 18(5), 351-368.
12. Hubbard, P. (2008). Twenty-five years of theory in the CALICO Journal. *CALICO Journal*, 25(3), 387-399.
13. Hubbard, P., & Bradin-Siskin, C. (2004). Another look at tutorial CALL. *ReCALL*, 16(2), 448-461.
14. Hutchins, E. (1995a). *Cognition in the wild*. Cambridge, MA: MIT Press.
15. Hutchins, E. (1995b). How a cockpit remembers its speeds. *Cognitive Science*, 19, 265-288.
16. Levy, M. (1997). *Computer-assisted language learning: Context and conceptualization*. Oxford: Oxford University Press.
17. Levy, M. (2000). Scope, goals and methods in CALL research: Questions of coherence and autonomy. *ReCALL*, 12(2), 170-195.
18. Levy, M., & Stockwell, G. (2006). *CALL dimensions: Options and issues in computer assisted language learning*. Mahwah, NJ: Lawrence Erlbaum Associates.
19. Mackey, A., & Gass, S. (2012). Introduction. In A. Mackey & S. Gass (Eds), *Research methods in second language acquisition: A practical guide* (pp. 1-4). Chichester: Wiley-Blackwell.
20. Mitchell, R., Myles, F., & Marsden, E. (2013). *Second language learning theories* (3rd ed.). Abingdon: Routledge.
21. Stockwell, G. (2007). A review of technology choice for teaching language skills in the CALL literature. *ReCALL*, 19(2), 105-120.
22. Stockwell, G. (2010). Using mobile phones for vocabulary activities: Examining the effect of the platform. *Language Learning & Technology*, 14 (2), 95-110.
23. Stockwell, G. (2012a). Conclusion. In G. Stockwell (Ed.), *Computer-assisted language learning: Diversity in research & practice* (pp. 164-173). Cambridge: Cambridge University Press.
24. Stockwell, G. (2012b). Diversity in research and practice. In G. Stockwell (Ed.), *Computer-assisted language learning: Diversity in research & practice* (pp. 147-163). Cambridge: Cambridge University Press.
25. Suchman, L. (2006). *Human-machine reconfigurations: Plans and situated actions* (2nd ed.). Cambridge: Cambridge University Press.
26. Warschauer, M. (1996). Computer-assisted language learning: An introduction. In S. Fotos (Ed.), *Multimedia language teaching* (pp. 3-20). Tokyo: Logos.
27. Whitehead, A.N. (1911). *An introduction to mathematics*. New York: Henry Holt and Company.