

A General Introduction to Computer Assisted Language Learning
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Foundations of CALL

CALL is both exciting and frustrating as a field of research and practice. It is exciting because it is complex, dynamic and quickly changing—and it is frustrating for the same reasons. Technology adds dimensions to the already multifaceted domain of second language learning, requiring new knowledge and skills for those who wish to incorporate it into their professional practice or understand its impact on the language teacher and learner. Yet the technology changes so rapidly that CALL knowledge and skills must be constantly renewed to stay apace of the field. The amount of literature in the field is impressive: there are thousands of published articles, almost 500 of which were considered in preparing this series. We have many promising and innovative ideas but only the beginnings of definitive answers as to how to use computers most effectively to support language learning. Despite this uncertainty, as computers have become more a part of our everyday lives—and permeated other areas of education—the question is no longer whether to use computers but how. CALL researchers, developers, and practitioners have a critical role in helping the overall field of second language learning come to grips with this domain.

So what exactly does this exciting and frustrating field of CALL entail? Beatty (2003) offers the following characterization: “...a definition of CALL that accommodates its changing nature is *any process in which a learner uses a computer and, as a result, improves his or her language*” (Beatty, 2003: 7). This definition, though rather broad, is nevertheless a reasonable starting point when we consider the range of articles that show up at CALL conferences, in CALL journals, and in CALL books. It does, however, give rise to two additional questions: What do we mean by “computer”? And what do we mean by “improve”?

The first of these is an important question in defining the field because CALL as considered here does not include simply the canonical desktop and laptop devices we label computers. It also includes the networks connecting them, peripheral devices associated with them, and a number of other technological innovations such as PDAs (personal digital assistants), mp3 players, mobile phones, electronic whiteboards, and even DVD players which have a computer of sorts embedded in them (Levy & Hubbard, 2005).

The second question, what does it mean to improve, can be answered with respect to a number of different perspectives:

- learning efficiency: learners are able to pick up language knowledge or skills faster or with less effort;
- learning effectiveness: learners retain language knowledge or skills longer, make deeper associations, and/or learn more of what they need;
- access: learners can get materials or experience interactions that would otherwise be difficult or impossible to get or do;
- convenience: learners can study and practice with equal effectiveness across a wider range of times and places;
- motivation: learners enjoy the language learning process more and thus engage more fully;
- institutional efficiency: learners require less teacher time or fewer or less expensive resources.

Note that in some of these cases this does not lead to improving language directly in Beatty's sense, but rather to improving the learning conditions in some fashion. It is also worth pointing out that, just as with other "assistance", uses of CALL can in some cases impede progress. In other words, while improvement in one or more of the areas above may be the goal of a given CALL initiative, that outcome is not always achieved.

Practically speaking, we can further expand Beatty's already broad definition. CALL books and journals also include articles relating to the use of computers to improve teacher productivity and in teacher education, professional development, materials development, and language assessment. In terms of what appears in CALL publications and conference presentations, then the wider field of CALL encompasses any use of computer technology in the domain of language learning. It is this more extensive view of CALL that is assumed in the present work.

In the remainder of this introductory chapter, we will explore this wide ranging field following the same general path as the four volumes in this set. We will begin with a discussion of the foundations of the field, including conceptualizations of research, design, and evaluation. We will then touch on how CALL has been used to promote the development of language skills, discuss the important area of computer mediated communication (CMC), and conclude with a number of additional topics including online learning, computer-based language testing, teacher and learner training, and CALL based on natural language processing.

CALL Theory, Frameworks, and Conceptualizations

Throughout its history detractors of CALL, and indeed many of its supporters, have criticized the field as being overly "technology driven" at the expense of theory, research and pedagogy (e.g., Egbert & Hanson-Smith, 1999, 2007; Salaberry, 2001). Similarly, others have criticized the field for being too connected to general education rather than focusing on the unique qualities of language learning (Hubbard, 1987). In response to this a number of conceptualizations or frameworks have been proposed in an attempt to describe the elements of CALL adequately or to guide the field in what the individual

authors contend is a more coherent direction (Bax, 2003; Chapelle, 2001; Colpaert, 2004; Hubbard, 1996; Levy 1997; Phillips, 1985; Underwood, 1984; Warschauer & Healey, 1998 and many others). At the time of this writing, two of the more influential views are those of Chapelle (2001), who links the design and evaluation of CALL tasks to a set of principles derived primarily from the research base of the interactionist perspective of second language acquisition (SLA), and Bax (2003), who views “normalisation” as the defining direction for the field, a state where technology is fully integrated into language teaching and ceases to be special or unusual, much like the textbook, pen, and blackboard of the traditional classroom.

Although these CALL-centered frameworks have informed practice in some areas, notably courseware and task design and evaluation, most of the research and development of the field has been driven by external theories. Levy and Stockwell (2006), for example, characterize CALL practitioners and developers as mainly consumers of theory developed for other purposes. This is not universally seen as a problem. Egbert & Hanson-Smith claim that “...educators do not need a discrete theory of CALL to understand the role of technology in the classroom; a clear theory of SLA and its implications for the learning environment serves this goal” (Egbert & Hanson-Smith, 2007: 3). Whether or not theories emerging from a CALL perspective would be of value remains an open question, but to date little progress has been made in that direction.

Early CALL Projects

CALL emerged as a distinct field with the beginning of CALL-centered conferences and professional organizations that accompanied the spread of the personal computer in the early 1980s. No overview of the field would be complete without acknowledging at least some of the pioneering attempts that preceded this era. There were early efforts to teach specific foreign languages in the 1950s and 60s on mainframe computers (Beatty, 2003), but the first large-scale project was done with the PLATO system developed at the University of Illinois. This used a programmed instruction approach that provided students with practice material targeted to their presumed level along with feedback and remediation as needed. Levy (1997) notes that PLATO materials were developed for a number of languages, in particular French. The system was designed to maintain detailed records of value not only for the teachers and students but also for researchers.

Early work with what were then called “microcomputers,” such as the BBC computer, Apple II, and IBM PC, began to proliferate in the early 1980s. This new wave continued to include academic projects involving teams of designers, programmers and language teachers, but this era was also marked by the emergence of teacher-programmers, typically using the BASIC language to create activities for their own students. Meeting first as informal user groups at larger conferences, they were instrumental in founding organizations such as CALICO, the CALL interest section of TESOL, and EuroCALL.

At about the same time that microcomputers were spreading, the random-access laser videodisc brought a new dimension to language learning in the 1980s, the beginnings of multi-media education. Several large-scale projects, such as Montevideo, a simulation

for learning Spanish, were developed during this time (Gale, 1989). Among the most ambitious undertakings in the history of language teaching was MIT's Athena Language Learning Project, an attempt to bring together interactive videodisc and artificial intelligence (AI) applications to revolutionize language learning. Although the AI elements were not fully realized, the project did produce some intriguing materials, notably *A la rencontre de Philippe*, a participatory drama where students play a character trying to find an apartment in Paris (Murray, Morgenstern, & Furstenberg, 1989).

In addition to academic initiatives, there have been hundreds of commercial software projects, a few of which have managed to survive and thrive. Two of the more successful enterprises in business terms have been Auralog (founded in 1987) with its flagship *Tell Me More* series and Fairfield Language Technologies (founded in 1992), creator of *Rosetta Stone*.

CALL Research Trends and Issues

Although much of CALL has been driven by development and practice, research has also played an important role. Within the field, research has served to move CALL toward more promising directions but has also worked outside the field in giving CALL some credibility in the broader domains of applied linguistics and education.

Early CALL research often focused on attempting to demonstrate the superiority of using computers over traditional language teaching. As a number of researchers have noted, this comparative approach had limited value, often leading to a "no significant difference" outcome (see Dunkel (1991) and Pederson (1987) for reviews). Although some studies have continued to compare the CALL vs. no-technology options, most now are either non-comparative or compare one version of a CALL activity with another, for example using captions vs. transcripts with online video (Grgurović & Hegelheimer, 2007).

Like other areas of second language learning, there are a variety of approaches used by CALL researchers. Although quantitative studies probably dominated in the early literature, qualitative and mixed-method studies are now common, especially in the area of computer-mediated communication (CMC). An edited volume by Egbert & Petrie (2005) does a credible job of covering the more dominant research approaches along with some less common ones, presenting criticisms and offering suggestions for improving the overall quality of CALL research.

The absence of established norms for CALL research may be seen as a weakness of the field, limiting its ability to come up with established findings. However, the wide range of areas covered by CALL and the fact that it draws on so many distinct theories and disciplines (Egbert & Petrie, 2005; Hubbard, 2008; Levy, 1997), make it difficult to determine what such norms would be. Levy & Stockwell (2006) illustrate this quite clearly in their chapter on research by contrasting two articles in computer mediated communication that look at a similar phenomenon but through very different lenses, one

interactionist (Fernandez-Garcia & Martinez-Arbelaiz, 2002) and the other socio-cultural (Darhower, 2002).

CALL Design and Evaluation

Although many CALL projects have been designed organically, or with respect to general instructional design principles, attempts have been made by a number of scholars to characterize the unique qualities of CALL. Perhaps the most elaborate design framework to date is that of Colpaert (2004), which creatively blends engineering principles and pedagogical approaches and is specifically oriented toward the creation of language courseware. Another important work in this area is Levy (2002), who categorized the uses of the term *design* in a corpus of 93 CALL articles from 1999, including not only design of artifacts (e.g., software), online courses, and materials, but “design as a principled approach to CALL, including approaches to the design of CALL tasks” (Levy, 2002: 60).

Closely tied to design is evaluation. Levy and Stockwell (2006) recognize three general approaches here: checklists, methodological frameworks, and applications of SLA principles. Checklists, especially those used by teachers and others to determine whether or not to use a given program in their classes, have been and remain the most common approach to the evaluation of both software and tasks. While they have limitations, used appropriately they can be a valuable tool in the software selection process (Susser 2001). Methodological frameworks attempt to describe the key elements involved in making selection decisions in a more descriptive fashion than checklists, aiding users in what to look for and how to look for it while maintaining an agnostic view of what specifically constitutes good language teaching in a given setting (Hubbard, 1996). The SLA-based approach to evaluation is best exemplified by the work of Chapelle (2001), who identifies six research-based criteria for the evaluation of CALL tasks that can be used for both judgmental and empirical evaluation.

CALL and Language Skills.

In the contemporary classroom language skills are often integrated. However, just as much of the research on second language learning and teaching has built on separating the skills as individual objects of interest, so too has CALL development. In this section, we look at some of the options in using computers to help students develop oral skills, literacy, and underlying language knowledge.

Listening, Speaking and Pronunciation

The addition of sound to computers in the 1980s brought listening away from the linear tape and allowed the blending of onscreen graphics and text, leading to multimedia environments. Digitized speech and video offer greater control for the listener, and the addition of technologies for supporting meaning, such as L1 and L2 captions, glosses,

and explanatory notes, can improve both immediate comprehension and acquisition (Borrás & Lafayette, 1994). Thanks to the World Wide Web, today learners of almost any language can find a wealth of authentic audio and video to listen to for both language and culture. There are also dedicated listening exercises for many languages, many of them free, though their pedagogical quality varies considerably. Because of this, listening is a growth area for CALL, a way for learners to connect directly with the local culture of the language they are studying. In the context of online listening, Robin (2007) remarks, "...in the immediate future — the next five to ten years — the frontier in language learning and technology will not be found in what program does what better, but rather which students use off-the-shelf technology to best facilitate their own learning in their own learning style" (Robin, 2007: 109). Several authors have offered theoretically grounded models for computer-based listening, such as Hoven (1999). Plass & Jones (2005) propose a multimedia-based model of second language acquisition

Until recently, speaking practice in a CALL setting has largely been of two types: pairs or groups of students speaking to one another as they sit in front of a computer engaged in a task, or individual students using the computer to record their voice, often in the context of pre-determined dialogues. Automatic speech recognition (ASR) has allowed for a few limited spoken dialogue systems (such as SubaruShii for beginning Japanese (Bernstein, Najmi & Ehsani, 1999)) and some commercial programs such as Auralog's *Tell Me More* allow learners to select which lines to speak in a branching dialogue. However, these applications are far from the types of experiences found in normal face-to-face interactions. More natural speaking practice is now possible using asynchronous means such as online audio discussion boards (e.g., Wimba) and podcasting. Skype and other VOIP (Voice Over Internet Protocol) applications allow audio and video connecting computer to computer at little or no cost. There is also evidence from some studies that even working with text-based chat interactions can improve speaking proficiency (Payne & Whitney, 2002).

In the area of pronunciation, there are three major types of applications. The simplest is the digital version of the tape recorder, where learners use the computer to listen to native speakers models, and then record and compare their own voices in an attempt to match that model. A second area that can be combined with recording is speech visualization. Here too, learners attempt to match a model, but instead of just hearing it, they view a graphic representation of it: the complex wave form, the spectrogram showing bands of stronger and weaker resonance at different frequencies, or an extracted wavy line representing the pitch contour. Although the value of matching wave forms and spectrograms is questionable due to their complexity, practice with pitch contours has been shown in several studies to be effective in raising awareness and performance in intonation (Chun 2002) and tone in tonal languages. The third application is using ASR (automatic speech recognition) to judge roughly how close a learner's speech is to a norm for native speakers. Feedback to the learner can be presented in the form of a meter or numerical score, although in addition to problems with judgmental accuracy (native speakers may be tagged as non-native for instance) there are clear limitations to the value of such feedback since it does not tell the learner where the breakdown is occurring or what to do to improve. A few recent applications such as Carnegie Speech

(www.carnegiespeech.com) have been able to pinpoint specific phonemes within a word or phrase that need work and offer targeted explanations and exercises for improvement.

Reading and Writing

Reading activities have existed on computer since the early days of the field, but until the 1990s brought crisp black on white monitors into widespread use, there were concerns about the efficiency and transferability of skills for reading on screen. Early on, it was recognized that computer programs could assist reading development in at least three ways: by controlling what the readers saw and how long they saw it in order to promote reading strategies and automaticity, by providing comprehension and other exercises, and by presenting glosses and other comprehension aids. More recently, the web has made accessible an enormous amount of printed material in both commonly taught and many less commonly taught languages. Online dictionaries have reduced the need for laborious glossing. Chun (2006) provides a review of CALL reading research linked to 10 implications for reading instruction from Grabe (2004) that have emerged from text-based reading research. By far the largest number of studies have been those concerned with just one of these implications: emphasize the learning of vocabulary. Despite the apparent potential of CALL in the area of second language reading, Chun (2006) has noted a number of areas in which little development has ensued. These include the final four of the 10 implications: “promote extensive reading; build reading fluency and rate; develop intrinsic motivation for reading; and contribute to a coherent curriculum for student learning” (Chun, 2006: 86). Clearly, there is room for additional work here as more and more reading shifts naturally from paper to digital form, especially since reading itself is changing due to the increasingly common embedding of hypertext links and multimedia.

Beyond practice in keyboarding as students moved from paper and pen to the computer for composition, early work on writing in CALL focused in two areas: developing word processing skills in learners and the use of text-based and later graphic organizers to support the writing process. Although research in word processing was once common in CALL, it is no longer: Pennington (2004) notes that this is because 1) research in word processing showed positive effects in terms of writer attitudes, text length, text quality and quantity and in some cases quality of revisions and 2) word processing is now used by virtually everyone for composing--it has become normalized in the sense of Bax (2003). Spell checkers and to a lesser extent grammar checkers were brought in as they matured to aid in the development of accuracy in second language writing. A few dedicated CALL programs were developed that included aspects of vocabulary, grammar, and composition to create an integrated composing and editing environment, such as *Systeme-D* for French (Noblitt, Sola & Pet, 1987). Applications have been developed to promote collaborative writing and the Web: most recently the free online suite of Google Docs (<http://docs.google.com>) has been co-opted by language instructors for this purpose. Recognizing that authentic writing requires an audience, language instructors use a variety of computer-based options for publishing student work. Initially, this was done using word processing and dedicated publishing software to create and format print publications. In the 1990s, student-produced web pages became an option, and recently

blogs and wikis have opened up additional opportunities for students, particularly those with fewer technical skills, to get their written production in front of an online audience.

Grammar, Vocabulary, and Data-driven Learning

Many of the early disk-based CALL programs focused on grammar or vocabulary development, not so much because that represented state of the art language teaching at the time but because such applications were relatively easy to program on computers. Today, authoring systems such as *Hot Potatoes* (<http://hotpot.uvic.ca>) from the University of Victoria have made it easy for language teachers to construct their own grammar exercises using multiple choice, gapped sentences, and matching formats. In addition to these more traditional types of exercises. Higgins (1988) describes alternatives such as Storyboard, in which an entire text is deleted and must be reconstructed. Although not specifically targeted at grammar, such text reconstruction programs do foster grammar awareness. Grammar checkers have been explored as aids to improving grammatical competence, though they need to be used with an understanding of their limitations (Burston, 2001). ICALL (Intelligent CALL) programs have been shown to be effective in assisting grammar learning when used with particular structures so that the range of errors can be anticipated and the feedback appropriately targeted (Nagata, 1993).

Looking at the offerings on the web today, vocabulary is still one of the most common applications, partly because it holds such high face value for language learners and partly because it involves the manipulation of discrete items (words, definitions, translations, etc.) and is therefore easy to program and manage. A key area made possible by CALL is electronic glossing as a support tool for both vocabulary development and reading comprehension. Research questions that have been explored here include differences in visible vs. invisible links to glosses (de Ridder, 2002), L1 vs. L2 glosses (e.g., Yoshii 2006), and various combinations of text, illustration, and video (e.g., Al-Seghayer, 2001; Chun & Plass, 1996). Chun (2006) lists 30 studies in the area of multimedia glossing and electronic dictionary use. Despite somewhat conflicting results in these studies, what has emerged is a generally positive view of the value of digital glossing, a recognition that both L1 and L2 glossing can be helpful, and a sense that visual and text together are generally better than either alone. Along with the research, among the most useful set of vocabulary tools for English language learners, teachers, and researchers is Tom Cobb's Lextutor site (www.lexutor.ca), which includes vocabulary level tests, frequency analyzers, and many other utilities.

The area of data-driven learning (Johns (1994) aims to support students' exploratory learning of grammar and vocabulary using computer applications to help them notice patterns in the target language. The most widely-used type of program is the concordancer, which allows the user to select an item, such as a word, phrase, or in some cases even a stem, and search for examples of it within a particular corpus. The results are typically presented in a series with the selected item in the center and the local context in which it appears on either side. For an example see Edict's Web Concordancer at <http://www.edict.com.hk/concordance>.

Computer Mediated Communication for Language Learning.

CMC Foundations and Conceptualizations

Computer mediated communication, or CMC, is widely practiced and has become perhaps the most researched area in the field of CALL. There seem to be at least two reasons for this. One is practical: when doing text-based CMC studies much or all of the data of interest is collected automatically, saving the hours of transcription associated with research on spoken language. Further, because there is already a range of off-the-shelf programs for CMC, there is no need for a lengthy and sometimes expensive development process as is the case with many dedicated CALL applications. Even those with limited technical skills can readily conduct certain kinds of CMC research. The second reason is that there is a more natural connection between the human-human interaction through CMC and the findings from studies of face-to-face interaction in SLA. CMC environments are thus a logical place to explore both to determine which key characteristics of face-to-face (F2F) interaction they share, especially for situations where the latter is impossible (such as online learning) and to see whether there are additional elements they bring in that improve the learning experience for certain types of students.

CMC is divided along two main dimensions: time--synchronous and asynchronous--and modality—text, audio, and video. Synchronous, or real time, CMC includes chat, instant messaging, and MOOs (multi-user domain, object oriented) in the text mode and most commonly VOIP (Voice Over Internet Protocol) in the audio mode. Asynchronous CMC, where there is a delay between sending and reading/responding, includes email, bulletin or discussion boards and voice boards in the audio mode. There are also a number of newer formats such as blogs allowing posted comments and SMS text messaging on mobile phones. To date, the overwhelming majority of CMC studies have been limited to text though this is likely to change as online audio and video communication become more commonplace.

Synchronous CMC

Although there was some use of bulletin board postings and email in the 1980s, CMC began to emerge as a major subfield of CALL in the 1990s, and a lot of interest shifted to text-based synchronous CMC. By the mid-1990s a number of studies of classroom text-based discussion had been published, and these were followed by out of class studies with online chat. Among the more interesting research results have been the following. CMC interaction seems to allow more balanced participation than a face-to-face discussion (Roed 2003; Warschauer, 1995/1996). One reason for this may be the absence of visual cues as to who is holding the floor and the possibility of maintaining anonymity in some cases. Another may be technical—most chat programs allow the composer to type the message and review it before sending, letting those of a reflective nature participate without having to either interrupt or be concerned about being interrupted. CMC environments can also lead to greater language production in terms of messages and turns than face-to-face (Kern, 1995). Certain types of CMC tasks, like those in face-to-face settings, support negotiation of meaning and modified output (Blake, 2000;

Pellettieri, 2000), although there are differences in the discourse patterns of those negotiations that require expanding the general model (Smith, 2003). Most important, extended text-based CMC practice seems to transfer to improved oral proficiency (Payne & Whitney, 2002), suggesting that the input and output practice in this environment combined with the pressures of real-time interaction may tap into developing an underlying linguistic competence available to the learner regardless of the modality.

While the majority of synchronous CMC research and practice has been carried out in some version of a chat environment, an alternative approach is to use a MOO. A MOO setting is sometimes referred to as a virtual environment: it differs from chat in that the interaction is embedded in a context, where the participants describe through text where they are and what they are doing along with the dialogue. Schwienhorst (2008) presents a detailed overview of the use of MOOs in language learning, providing arguments for how these environments support the development of learner autonomy. In the past couple of years, there has been growing interest in another type of virtual environment, one where participants move in the form of an avatar through a three-dimensional world, using both synchronous text and in some cases voice CMC to interact with others' avatars. The most popular of these virtual worlds at this time for language learning is Second Life (www.secondlife.com).

Asynchronous and Mixed CMC

Despite the strong interest in synchronous CMC noted above, there is also a body of research on asynchronous CMC using email and discussion boards. Email has been used for some time to allow teachers and students to communicate with one another (Warschauer, 1995). Outside of class, the penpals of traditional language learning have been replaced by “keypals”, and the possibilities for tandem language learning by pairs of classes have increased dramatically. Although a number of studies have touted the positive outcomes of such projects, Belz (2001), Thorne (2003), and Ware (2005) all note situations when these classroom connections fail because of conflicting expectations or imbalances in language level. Not all email projects are tandem experiences: Stockwell & Harrington (2003) for example report on a successful email exchange conducted entirely in Japanese between learners of Japanese in Australia and university students in an intercultural communications class in Japan.

Discussion boards represent a different sort of opportunity for communication. Postings to boards allow students to be more reflective and can trigger more complex discourse and a greater focus on both form and meaning than is possible in the fast-paced synchronous setting (Sotillo, 2000). As such, when used with an appropriate task, they can support development of writing skills in a forum that includes an authentic audience. Blogs represent some of the same communicative functions as discussion boards, where a posting by a teacher or student can become the basis of further written commentary by other students.

An increasing number of studies look at settings in which asynchronous and synchronous CMC are mixed. The collaborative project in Belz (2001), for instance, included chat

sessions as well as email exchanges. Learning management systems like Blackboard and WebCT typically include both chat and discussion board applications as well as integrated email systems. For both synchronous and asynchronous CMC, we are moving into an era where language students will already be familiar with a range of communicative options and will be more inclined to select the one that seems to fit the task best (Thorne, 2003).

Present Trends and Future Directions in CALL.

Besides the major topic areas described above, there are a number of other uses for computers in second language learning and teaching that are covered in the present set of volumes. These include the rapidly-growing field of online learning, computer-based assessment, teacher and learner training, intelligent CALL (ICALL), and a number of emerging areas such as mobile language learning and virtual worlds.

Online Learning

Online learning is a natural extension of earlier forms of distance education. The key concept is that when circumstances dictate, teachers and learners can be physically apart from one another. Online learning described most broadly can cover quite a range: independent learning through the Internet, recorded or programmed materials delivered online with or without CMC linkage to instructional assistance, one-to-one synchronous tutorials, the same class taught face-to-face to some but remotely to others, classes taught partly face-to-face and partly online (so called hybrid or blended learning), classes taught synchronously to a group entirely online, or any combination of the preceding. Studies in this area have recognized that online learning requires more than simply presenting the same curriculum in the same way over the new medium. In many cases, there is an initial need to develop a community, train instructors appropriately (Hampel & Hauck, 2004; Jones & Youngs, 2006), and be prepared to handle technical issues, both expected and unforeseen. Recognizing these differences in the skills necessary for online teaching, TESOL (Teachers of English to Speakers of Other Languages) has been running a certificate program for several years: see <http://www.tesol.org>.

The online learning literature overlaps with that of CMC since communication is a critical part of most online instructional processes. However, in addition to text-based CMC, audio-conferencing is often a component of current real-time online learning. Hampel & Hauck (2004) describe a pedagogical framework for integrating audio-conferencing effectively in distance language courses at their institution. At least two edited volumes have appeared in recent years on this topic: Holmberg, Shelley & White (2005) and Goertler & Winke (2008).

Assessment

Computer assisted language testing (CALT) is an important and growing sub-field that is sometimes considered outside of CALL because the testing itself is not necessarily a learning experience and what is being tested in the students may not have involved computers. Nevertheless, it seems appropriate to discuss it here because articles in CALT

appear in CALL journals, presentations in CALT are offered at CALL conferences, and assessment is clearly an integral part of the overall teaching and learning process.

In what might be considered basic CALT, a test that could have been administered in a classroom is administered instead by computer, allowing for control of time, potentially greater security, and automatic scoring and reporting. In more elaborate versions test items of similar difficulty may be drawn randomly from a pool so that each student receives a different test. In this case the primary advantage is efficiency. A type of testing that is only possible by computer is adaptive testing, where items are presented to the student at a targeted level of challenge, becoming easier or harder depending on the answers to preceding questions, ideally resulting in a shorter, more efficient test experience for both the student and institution. Brown (1997) offers a description of early adaptive tests and an outline of issues for future development.

The computer has also made possible types of automatic scoring that were previously impossible. Chapelle & Douglas (2006) note two that have already been implemented. Educational Testing Service (ETS) has developed a system called Criterion to automatically rate texts produced on a predetermined set of topics and provide holistic scores as well as error analysis and comments on organization and style (see <http://www.ets.org/criterion>). This system is used for both native writers and English language learners. An innovative test designed exclusively for language testing is Ordinate's SET-10, formerly PhonePass, an oral proficiency exam that is taken over the phone and is entirely machine scored using automatic speech recognition (ASR) techniques: see <http://www.ordinate.com>.

Learner training and autonomy

The past few years have seen promising development in the area of learner training along with the more general movement in the language teaching profession toward developing learner autonomy. The fundamental insight here is that while computer applications give language learners unprecedented access to materials and both dedicated and general applications to support their learning, we cannot assume that they have the necessary skills and specific strategies to use these applications most effectively in their learning activities (Hubbard, 2004). For both effectiveness in their current coursework and movement toward autonomy (Blin, 2004; Schwienhorst, 2008) more attention should be given to how students use computers on their own and what training content and processes can help them be more successful. There is some evidence as well that attention to CALL learner training by language teachers can actually be transformative for them (Kolaitis et al, 2006).

Teacher Education

Although teacher training for CALL has been reported on since the 1980s, it is only in the past few years that it has become a visible sub-field within CALL. A special issue of *Language Learning & Technology* in 2002 offered the first collection devoted to this topic. In 2005, CALICO (Computer Assisted Language Instruction Consortium) initiated a special interest group for teacher education, and a similar group was inaugurated at the EuroCALL conference in 2008. Edited volumes by Hubbard & Levy (2006) and Kassen,

Levine, Murphy-Judy & Peters (2007) combine with additional journal articles to provide a research and practice base for this domain.

Teacher education is divided broadly between pre-service and in-service. Pre-service training is presently sporadic, with the majority of teacher candidates still receiving little or no formal preparation (Kessler, 2006). A set of technology standards for teachers and language learners currently being developed by TESOL (<http://www.tesol.org>) is anticipated to bring this area further into the mainstream.

Intelligent CALL

A subfield that continues to hold interest in fulfilling an earlier promise of CALL, where the computer would take on more of the role of the teacher, is that of intelligent computer assisted language learning, or ICALL (also referred to as NLPCALL for “natural language processing”, at least for some applications). There are at least three possible objectives for ICALL. One, perhaps the best developed to date when the domain is restricted, is the ability to identify errors in student input and provide feedback so that the student can address them (Nagata 1993; Heift 2002). A second area is the ability to manage a student’s learning based on building a model of the student’s achieved proficiency and providing materials and tasks appropriate for further development at that level. A third area is the capacity to interact with the student through conversational agents, programmed entities that simulate the linguistic facility of a human interlocutor, reacting and responding appropriately to student input. These can either be dedicated programs as part of a language lesson, such as the Japanese agent in Subarashii (Bernstein, Najmi & Ehsani, 1998) or chatbots, which maintain conversations through a clever mix of set responses and integration of keywords (Coniam, 2008). Some progress has been made toward each of these objectives, but ICALL use remains fairly limited at present.

Future Directions

So where is CALL headed at the time of this writing? There are at least three relatively new areas already being developed by CALL practitioners that look promising. One is linked to the proliferation of what has been called Web 2.0, a more participatory version of the web with greater collaboration and democratization, including social networks like Facebook (<http://www.facebook.com>), folksonomies (social tagging and indexing) replacing taxonomies, text publication through blogs, video publication through sites like YouTube (<http://www.youtube.com>), and collaboration through wikis, including massive collaborations like Wikipedia (<http://www.wikipedia.org>). A second is mobile language learning, which offers the opportunity for ubiquitous connection with language learning materials and applications. Research is already providing some direction to this frontier (e.g., Thornton & Houser, 2004) and as the distinction between “computer” and “mobile phone” becomes more blurred, we can expect to see further developments. The third area is that of virtual worlds, where learners in the form of avatars explore, create, and interact through chat and increasingly voice with one another and other denizens of these domains. Already EuroCALL has set up a virtual headquarters in one of these worlds, Second Life (<http://www.secondlife.com>).

As pointed out at the beginning of this paper, CALL is a dynamic field that changes rapidly because the technology that helps to define it changes rapidly. Thus, even the newest material in the volumes in this set is in a sense obsolete by the time readers encounter it. In fact much of it falls into what Levy and Stockwell (2006) would label established rather than emergent CALL, and some of it may appear on the surface to have limited relevance to today's technology and learning environments. I believe, however, that looking a bit below the surface, there are valuable lessons to be learned. Asimov (1964), writing about his experiences as a graduate student presents a cautionary note to those who would ignore or dismiss the contributions of the past: "I had fallen victim to the fallacy of the 'growing edge'; the belief that only the very frontier of scientific advance counted; that everything that had been left behind by that advance was faded and dead" (p. ix). "If the growing edge only is studied," he continues, "science begins to seem a revelation without a history of development" (p. x). As the field of CALL keeps evolving and more of what astounds us today becomes commonplace, it is hoped that the articles in *Computer Assisted Language Learning: Critical Concepts in Linguistics* will continue to capture valuable insights about where we have come from to help provide a foundation for understanding where to go next.

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