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Computers for Education

A Brief History of CALL Theory

■ **During the past 10 years, computer-using teachers have applied ingenuity and creativity in using devices and software made for nonpedagogical applications, often by nonteachers. During this compressed time period, the history of CALL pedagogy has replicated the 50-year history of development in TESOL theory and practice. Technology-using teachers today are leading the way in innovative teaching ideas, the exploration of culture and language, the inclusion of special needs learners, the promotion of student autonomy, and anywhere-anytime learning. This brief history of CALL theory also includes an indication of possible future trends and issues.**

Through the past decade, the personal computer has emerged as a significant tool for language teaching and learning. The widespread use of software, local area networks, and the Internet has created enormous opportunities for learners to enhance their communicative abilities, both by individualizing practice and by tapping into a global community of other learners. Computer use has been proclaimed by some futurists to be as important to cultural change as the invention of movable type. The silicon chip is changing the way we work, how we communicate, whom we communicate with, and where and how we live.

Given the enormous and far-reaching consequences of computer chip innovation, it is no wonder that CALL (computer-assisted language learning, to use its most common denomination) has struggled with what Carla Meskill (1999) calls the "hand-me-down" syndrome; that is, every technological innovation used in CALL has arisen first in some other field and for some other purpose. The enormous ingenuity and creative genius of computer-using teachers has thus been all the more remarkable in applying technological innovation to language education. As an introduction to a consideration of how and why people use computers, I would like to consider the history of pedagogical theory in CALL and possible future trends and issues in CALL practices.

The Early Years

Much of the early history of computers in language learning, from the early 1980s to 1990s, was spent in trying to keep up with technological change. Mainframe computers were at first seen as the taskmaster: the PLATO system (Bitzer, 1960) at many universities supplied a number of content courses, particularly in English grammar, computer science, and math. Students went to a lab, sat in rows, one to a computer (which some of us now think of as "solitary confinement"), and "mastered" each piece of a topic bit by bit, through presentation and "practice" in the form of tests. My own experience with PLATO, besides my attempt to create a vocabulary/reading program, included the discovery that my most difficult student had ignored the set of grammar exercises I had carefully selected for him but was spending 2-3 hours a day working crossword puzzles on the machine.

In the mid-1980s, the field suddenly changed when silicon chips and the desktop personal computer burst on the scene. Many of us remember the days of dragging out an Apple computer on an OHP stand from the broom closet to let a small group of students use it in rotation. Those were the days when the user had to run the operating system from a 5-1/4" diskette, and an enhanced Apple had 64K (not MB) of memory. The "killer application" was a spreadsheet program that crunched numbers in slow motion. Word-processing was almost an afterthought. However, the miniaturization of electronics meant that each year, small personal computers increased in speed and power, until "multimedia" has become virtually synonymous with "computer." As a result of the constant changes in computers, and their evolution from mainframe to laptop, much written about CALL in its early years was devoted to how to use the new technology, rather than to its empirical effects on learning. One recurrent theme throughout these early days, nonetheless, was the crucial pedagogical debate, largely framed by John Higgins and Tim Johns, about whether the computer was "master" of or "slave" to the learning process (Higgins & Johns, 1984). Was the computer to be a replacement for the teacher, or merely an obedient servant to the student?

The early uses of computers, particularly during the era before the microchip, promoted the behavioristic tutorial-and-test approach (also called "drill-and-kill") of audio-lingualism, an approach dominant in TESOL in the 1940s and '50s. One reason for this return in CALL to an earlier pedagogical model was no doubt the limitation of early technology; another reason was that computer programmers were not particularly knowledgeable about how language learning worked. No doubt inspired by a "cultural revolution" that swept much of the native-English-speaking world, a flood of new pedagogical approaches in the 1960s and '70s washed over audio-lingualism and were firmly entrenched long before the microchip came to play a role in CALL. Among these experimental approaches were Silent Way, Suggestopedia, and Community Language Learning. (For excellent short summaries and primary documents on these precursors to communicative language teaching, see Blair, 1982.) Computer-using teachers yearned to employ these more experi-

mental models of communicative teaching and learning, some of which implied an unprecedented control by students over their own learning.

Stephen Krashen's significant body of work in the 1970s and '80s (see especially his widely read *Principles and Practices,* 1982) gave a clear focus to the experimental approaches and led TESOL into an era of "communicative language learning." The predicament for CALL was whether students were to communicate with the computer (the patient and friendly teacher in a box) or with each other, with the computer merely a stimulus to the conversation. One hope was that something like a sophisticated version of Eliza (Bender & Weizenbaum, 1998), the shareware "therapist" who reflected back student/patient input, might be useful to language learning. In Eliza's case, when the user typed input, the software would randomly ask a question in reply, such as "Why?" or "What does that suggest to you?"—thus creating a sometimes uncanny virtual dialogue. The standard for artificial intelligence today is still "When the computer answers, can you tell (or how long does it take to tell) if it is human?" However, since natural languages are almost infinitely more complex than computer languages, the computer has never become a satisfactory conversation partner.

The use of pairs and triads around the computer in games, simulations, and grammar drills was an attempt to bring some human interaction into the realm of technology in the late 1980s and early '90s. A number of papers and research experiments at that time dealt with whether language was really being taught or learned simply by putting students in groups. I recall one researcher who concluded that the most significant target language use—while students worked in groups to generate sentences at the computer—came when one student lit up a cigarette in the lab and had to be told to put it out. At the time, most computer "teaching" programs were still so limited in their pedagogical approach that students were mainly attracted by using the new technology, not by what they could learn with and about language. At the same time, the word processor became perhaps the first computer application that truly supported an innovative pedagogy: the "process approach" to writing, which evolved in the late 1980s, would have been only wishful thinking without the facility the word processor provided in multiple drafting, revising, and editing.

With the increased speed and power of personal computers came another landmark, HyperCard for the Apple environment. This simple authoring program was a godsend to teachers who were trying to bring multimedia and interactivity into the world of technology—best of all it was distributed free. Programs created with HyperCard or its many imitators on PCs for ESL/EFL students, as well as native-speaker-oriented programs adapted for use in English for Speakers of Other Languages (ESOL) classrooms, flourished in the early '90s. The collection made by TESOL's CALL Interest Section back in 1996, TESOL/CELIA '96 CD-ROM, is perhaps the best example of teacher ingenuity, originality, and dedicated effort in a shareware environment.[1] Other, more sophisticated, authoring software quickly followed, though again, much of it was limited by a behavioristic notion of learning.

Moving Into the Present

The emphasis on natural or "authentic" language expressed itself in TESOL practice in two related but somewhat divergent communicative movements: content-based learning (in some contexts expressing itself as "Sheltered English" or SDAIE, "Specially Designed Academic Instruction in English"; see Cantoni-Harvey, 1987) and task-based learning (see Nunan, 1989, 1995). Fortunately, by the early 1990s, as these approaches came to have considerable (and continuing) influence in the schools, computer technology was catching up to its potential.

Content-based learning is greatly enhanced by the computer, since so much information can be brought into the classroom on content CDs and via the Internet. In a very tiny space, one may store and search a fully multimedia-enhanced version of the *Encyclopedia Britannica*, the entire history of art in pictures, or the complete publications of the National Geographic Society. One may download from the Internet the complete works of authors from Project Gutenberg, or directly access the U.S. government's satellite pictures of Mars from the NASA site (Mars Exploration, http://mars.jpl. nasa.gov/odyssey/index.html).

Task-based learning is also much enhanced by the use of the computer. CALL has made two significant contributions to this pedagogy: one is the use of simulations and adventure games, in which the learner plays a role to uncover information, while also learning how to use the typical collocations of the simulation or adventure. The power of the computer to crunch numbers saves hundreds of hours of painstaking labor and gives students instant results when they attempt all the "What-ifs" that the exploration of a simulated environment demands—all without producing fatal errors, such as blowing up the chemistry lab. Another aspect of task-based learning enhanced by CALL is the use of multimedia tools for students to create their own presentations. Simple authoring programs allow students to record their own voices, draw pictures, and import graphics, photos, and videos they have made themselves or downloaded from the Internet. Creating Web pages is itself a major task-based learning component in many technology-enhanced classrooms. Multimedia can help students discover their own best learning strategies, while preparing them for a world inundated by graphic images (see Hanson-Smith, 1997). Both simulations and multimedia projects also provide the impetus to use groups to solve problems cooperatively, develop communication skills, and practice written and oral language appropriate to the context of learners' study.

Content-based and task-based approaches seemed to solve many of the problems of earlier grammar-based and aural-oral language approaches because of the rich input provided. Yet such input was far too often totally uncontrolled, particularly in the wild and wooly Internet environment. Natural language, even with all the supporting apparatus of sound and pictures, creates a vast sea of words, words, words—hardly "$i + 1$." Thus technology-using teachers often spend considerable time developing appropriate

lessons to support students who perform research on CDs and the Internet or who use simulations and games created, for the most part, for native speakers (with a few notable exceptions such as Escape from Planet Arizona).

Further, as communicative approaches—group work, content-based curricula, and tasks—gained favor, researchers such as Merrill Swain were already pointing out that input wasn't enough: output, interaction, and the negotiation of meaning are also essential to language-learning mastery (Swain, 1985; Swain & Lapkin, 1995). During the mid- to late 1990s, as the Internet grew like a giant amoeba, language teachers found a remarkable tool for student-to-student communication: email. Communication over distance or even within a networked classroom provided fascinating "content" in the ordinary discourse of people learning more about each other and each others' cultures (see Cummins & Sayers, 1995), even as they shared information about academic topics. At the same time, networked writing offered a written record of interactions that could be studied and interpreted and used for language "scaffolding"—much as Community Language Learning had attempted to do some 30 years before, but without the tedium of hand-typing transcripts. (For more on scaffolding, see the summary of a large body of work by Holliday, Pica, and many others in Holliday, 1999; see also Peyton, 2000.) Email and the increasingly popular live chat interactions also have the advantage of occurring primarily at the "i + 1" level in an environment where students have time to reflect on input and to query their interlocutors about both content and form—in other words, an ideal language learning environment. Synchronous text, audio, and video chat, while posing additional problems in timing and chaos management, are also being studied as significant aids in building language facility and conversational skills.

Luckily, the intersection of multimedia technology with communicative methods occurred just as teachers and researchers renewed their interest in the cognitive side of learning. There has been much interest in the late 1990s and the early 2000s in a pedagogical theory called "constructivism." Originally put forward by Sydney Papert, creator of the computer language LOGO, constructivism describes learning by doing and creating meanings, particularly by using the tools of the computer to explore simulated—but also very real—worlds (see Buell, 1996-97). This theory of learning, reaching back to John Dewey (1938) at its roots, dovetails nicely with the recent recognition in language pedagogy of the need to encompass higher cognitive processes in the learning task. Anna Uhl Chamot and Michael O'Malley (1996), creators of the Cognitive Academic Language Learning Approach or CALLA, are probably the chief proponents of this view (see also Anderson, 1999, on metacognitive strategies in reading). The cognitive approach speaks to the need for students to be aware of their own learning processes, and to organize and structure their learning themselves. The plethora of information now available electronically makes just such cognitive demands on the language student, while technology can provide the means to easily structure and organize new information and incorporate it into the learning process.

The very conscious use students make of their own cognitive abilities while learning a language—and how computers might make this effort easier—came home to me many years ago as I watched a video of a student at a computer. The student was highlighting a word or phrase in a sentence to hear and repeat it—more than 20 times. It is difficult to imagine assigning a student to listen to and repeat a word or phrase 20 times, but the computer controls allow this kind of intensive, individualized, autonomous practice without the physical difficulties entailed in, say, audiotape. Nor would any teacher have the patience to repeat something 20 times—leaving aside the problem of what the rest of the class might do during this operation. This student was in control of his own learning, its pace, and the input he needed at that moment.

In constructivism, technology-assisted language learning has found a viable pedagogical theory. One might apply this general theory of knowledge to language learning as follows: to learn a language is to construct a series of approximations of the correspondences between meanings and variations in phonemes, morphemes, and syntax. In part this process takes place through exposure to "experts" in the language (Krashen's Input Hypothesis), and in part through trial and error, or hypothesis testing: learners, whether of a first or a second language, try out various expressions and hope to receive more information based on the results of the transactions (Swain's output "hypothesis" and the negotiation of meaning). While some of this process is perhaps subconscious, and for first-language learners apparently dependent on some innate acquisition mechanism, for second- and third-language learners, some of this process is also conscious and accessible to the planned use of memory, deliberate practice, and schema building.

In summary, the field of TESOL has passed through pedagogical stages in 10-12 year cycles: audio-lingualism in the '40s and '50s, the experimental era of Silent Way, Suggestopedia, and Community Language Learning in the '60s and '70s, the Natural Approach in the '70s and '80s, communicative language teaching in the '80s and '90s, and the new cognitivism in the late '90s (notice how many articles now refer to "language development" rather than the more problematic "language acquisition"). CALL has, interestingly, replicated this 50-year development in a foreshortened or accelerated manner, retracing the entire pedagogical history of TESOL methods in only about 12 years. At present in CALL, audio-lingualism is still with us (especially since HTML suffers some of the same limitations as early mainframes), and many manufacturers of language software—and classroom teachers and administrators—still perceive of the computer as a replacement for the teacher. Yet, we are primarily in a communicative/cognitive stage, with most good new software (and I include here the Internet) incorporating elements of group work, task-based learning, authentic language (particularly in computer-mediated communication or CMC), content-based learning, conscious schema-building, and attention to a variety of learning styles. The chaotic information of the Internet will no doubt enhance the cognitive side of the paradigm, because

students will need organizing schema and strategies to access and use this largely native-speaker-oriented content resource.

The Future?

It remains to see where the future of CALL and TESOL pedagogy will take us. Or perhaps the question is really "Where will CALL take TESOL?"

Several factors contribute to what I perceive as a future dominance of CALL in the search for language pedagogy. Of import among these factors is the value of technology-supported or -enhanced research in second language acquisition (see Hulstijn, 2000). Where every keystroke, voice message, Webcam file, or Internet search may be recorded and tracked, we have an enormously useful tool for analyzing how students participate in and direct their own learning. Concordance programs allow us to compare any set of texts to each other, for example, the differences between written and spoken collocations, giving us (and our students) new insights into the nature of language. The technology-based tools for research are as yet only barely being applied, but they should considerably enhance our understanding of linguistics and second language acquisition. Lloyd Holliday's analysis of a huge corpus of student email messages gives us some idea of procedures that may be fruitful (see a summary in Holliday, 1999).

Another factor is "convergence," the tendency of technologies to meld into and reinvent each other. We are very close to an affordable cell phone-PDA-computer-Internet combination, probably in a "wearable" format that will give maximum mobility and convenience to the learner. Learn anywhere, anytime, through any medium is a clearly attainable proposition, and it is especially attractive in countries where the lack of ground infrastructure can be leapfrogged by satellite telecommunications. It is also a proposition that offers inclusion to students with physical disabilities that may now prevent them from access to learning at their own pace and in their own mode. How will CALL translate the convergence of voice, video, and mobility into a new paradigm for language teaching and learning?[2]

I have already mentioned the value of the Internet in the communicative/cognitive paradigm. But further, as culturally sensitive teachers, we must keep in mind the significance of "glocalization," that is, being both local and global at the same time. The English language is still dominant on the Internet, followed closely by Spanish. This replicates a similar dominance in print media. No doubt our jobs as English teachers will be secure through much of this century, but that dominance may eventually change. How will CALL prepare the citizens of a world culture for multilingualism on a grand scale while preserving the uniqueness and worth of the many sometimes tiny cultures that drink from and contribute to that fast-flowing stream of information? As distance learning, especially Internet-based education, becomes the dominant mode, technology-using teachers have a responsibility to look ahead and plan for that eventuality. One important aspect of such planning would be the creation of standards for technology-based distance learning.

Virtually every university, public and private, charlatan and genuine, is putting courses and whole degrees on the Web. How will students know which to choose?

Finally, regardless of where an individual teacher or program stands on the communicative/cognitive spectrum, technology has become an environment for learning language. Teachers and students quickly realize the implications of a technology-enhanced environment: once they have technology, there is no going back to unadulterated chalkboards and lined theme paper. Teachers cannot afford to be the "sage on the stage" (or the drone on the throne) when any student can seek information, communicate with peers and experts, and control learning individually. The old debate over tutor versus tool or master versus slave takes on different shades of meaning when the role of the teacher itself has changed from instructor/taskmaster to guide/mentor. The computer is no longer master, but neither is it simply a tool, for it changes what learning (or "education") is, just as the printing press changed learning and culture in the late Middle Ages of Europe. The debate is no longer over whether to use CALL, but only how best to do so. (See also my article on the "quiet revolution," Hanson-Smith, 1999.) And while I have raised, rather than answered, the question of where CALL will take TESOL, the field of language pedagogy is increasingly looking to technology itself to help provide answers.

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Endnotes

[1] Most of the programs are also still available from the CELIA archive at: http://www.latrobe.edu.au/education/celia/celia.html

[2] See a history of wearable computers and examples of wearables at MIThril, http://www.media.mit.edu/wearables/lizzy.index.html; wearables are already used in industry, for example to keep a hands-free diagram of airplane wiring before the technician's eye in a head-mounted display similar to eyeglasses.

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He called these questions antinomies (that is, contradictions) of pure reason because he felt that there were equally compelling arguments for believing the thesis, that the universe had a beginning, and the antithesis, that it had existed forever. His argument for the thesis was that if the universe did not have a beginning, there would be an infinite period of time before any event, which he considered absurd.Â Hubbleâ€™s observations suggested that there was a time, called the big bang, when the universe was infinitesimally small and infinitely dense. Under such conditions all the laws of science, and therefore all ability to predict the future, would break down. If there were events earlier than this time, then they could not affect what happens at the present time.