1 *Historical foundations of CASLA*

At the annual TESOL convention in San Francisco in 1980, interested and curious participants attended Joan Jamieson's and my workshop introducing the use of computer software for teaching English as a second language (ESL). Joan and I had intended the workshop as a demonstration of existing ESL teaching software with an explanation of how such software is written and used in the curriculum. As newcomers to the profession, we had probably accepted uncritically the fact that the computer *was* used for teaching in the ESL program where we worked. We were therefore intrigued by questions from the audience about whether the computer *should be* used for language teaching. Various forms of this question – whether or not computers should be used for language teaching – were echoed throughout the following decade, but during the 1990s the question gradually changed from 'Should the computer be used in second language teaching?' to 'How can the computer best be used in language teaching?' As we enter the 21st century, everyday language use is so tied to technology that learning language through technology has become a fact of life with important implications for all applied linguists, particularly for those concerned with facets of second language acquisition (SLA).

Forward-looking members of the profession have suggested that the nature of communicative competence has changed in a world where communication occurs with computers and with other people through the use of computers. Writing about communicative competence in the 21st century, Rassool points out:

> in a world increasingly driven by (a) the need for innovation through research and development (R&D), (b) the multilevelled changes brought about in our everyday lives as a result of the nature and speed of technological developments, (c) the volume and range of information available, and its open accessibility, (d) the multimodal features of electronic text as well as (e) its interactive nature, we require significantly *more* than just the ability to read and write in a functional way. (1999: 202; emphasis in original)

If, as Rassool suggests, 'communicative competence refers to the interactive process in which meanings are produced dynamically between information technology and the world in which we live' (Rassool, 1999: 238), language learners are entering a world in which their communicative competence will include electronic literacies, i.e., communication in registers associated with electronic communication (Murray, 2000; Warschauer, 2000).

As a consequence, anyone concerned with second language teaching and learning in the 21st century needs to grasp the nature of the unique technology-mediated tasks learners can engage in for language acquisition and how such tasks can be used for assessment. Language learners typically use computers at least to write papers, receive and send e-mail, and browse the World Wide Web; one challenge for language teachers is to shape some of their computer-using experiences into language learning experiences. To meet the challenge, the study of the features of computer-based tasks that promote learning should be a concern for teachers as well as for SLA researchers who wish to contribute to knowledge about instructed SLA. Many learners will be required to prepare for computer-assisted language tests such as those developed by the Test of English as a Foreign Language (TOEFL) program and the University of Cambridge Local Examinations Syndicate (UCLES) as well as the many Web-based language tests, including those being developed for languages of the European Union through the Diagnostic Language Assessment (DIALANG) project. Therefore, test users need to understand the issues involved in selecting such tests and helping learners prepare for them; equally critical is the knowledge of computer-assisted language testing required of test developers and researchers who construct and evaluate these new testing procedures.

To date the need for an understanding of computer-related issues in SLA has not been met by a coherent set of principles for examining past work and plotting fruitful directions. Instead, cross-disciplinary perspectives have been applied to individual efforts at development and evaluation of computer applications in second language acquisition (CASLA) – perspectives which may enrich the knowledge base concerning computer capabilities and potentials for design and evaluation. Despite the value of cross-disciplinary input, the array of computer-related methods, concepts, and initiatives presented to applied linguists can be overwhelming. Moreover, substantive progress in CASLA requires that its identity be defined, including principles for evaluation drawn from relevant work in applied linguistics. This book lays out such principles to delineate the domain of CASLA as defined through computer-assisted language learning,

computer-assisted language testing, and computer-assisted second language acquisition research. This chapter and the next begin by defining CASLA first through historical development in each of these areas and then in relation to other fields that have influenced CASLA. The following chapters focus on evaluation issues pertaining to computer applications in each area, and the final chapter suggests directions for future work on the basis of needs identified across areas.

CASLA before the microcomputer

CASLA began with projects exploring development and use of computer-assisted language learning (CALL)[1] within the field of educational technology and was therefore shaped by perspectives in education as well as by computer hardware and software developed for purposes other than language instruction (Kerr, 1996; Saettler, 1990). In the US, computer-assisted instruction was first used in the 1950s, but examples of CALL are not documented until the 1960s, when a number of projects were undertaken to explore how the computer could be used for foreign language instruction in higher education. With a few exceptions, such projects were initiated by an individual who used computer equipment and software which had been acquired on campuses for other purposes. For example, Collett (1980), in New Zealand, reported that the idea for his French program came from a colleague in physics who had used the university's mainframe for computer-assisted instruction. Boyle, Smith, and Eckert (1976) reported a computer-based diagnostic French test also developed on a mainframe computer at a university. In the 1960s and 1970s, these small-scale individual projects, along with a few larger efforts, comprised the first experiences with CASLA.

CALL in the 1960s was supported by mainframe computers connected to terminals on a single campus or by telephone lines to terminals off campus. Computer-based learning activities, called 'courseware' were developed using programming languages and were stored on a mainframe for students to access as needed. The mainframe computers and their general-purpose programming languages of the 1970s were able to support the basic interaction

[1] Computer-assisted language learning (CALL) was the expression agreed upon at the 1983 TESOL convention in Toronto in a meeting of all interested participants. I have retained this term throughout this volume to refer to the area of technology and second language teaching and learning despite the fact that revisions for the term are suggested regularly.

required to implement the instructional design for this era of CALL. By today's standards, courseware was not technologically sophisticated even though it was often carefully planned. The fact that the software was stored on a single mainframe at an institution allowed for record keeping in a central location and communication among users. The mainframe also meant, however, that expenses were incurred for writing and using courseware. Because early CALL users were participating in expensive innovation, pressure existed to ensure that CALL was time well spent for learners.

Despite obstacles such as cost, individual language teachers throughout the world were fascinated by the prospects CALL appeared to offer. In the UK, for example, Rex Last and Graham Davies had each been exploring the construction of authoring software (which would simplify production of CALL) for years before they met in 1979.[2] Their individual experiences (e.g., Last, 1979) later became a valuable resource for an early commercial producer of language learning software in the UK. Davies' experience also made him the logical choice to head the government-funded National Centre for Computer Assisted Language Learning established in 1985.

The best-known early CALL project in North America was initiated as one part of a larger computer-assisted instruction project at Stanford University in the Institute for Mathematical Studies in the Social Sciences directed by Richard Atkinson and Patrick Suppes. The project began in collaboration with IBM, and later received funding from federal government sources. Atkinson's early research on learning foreign language vocabulary (Atkinson, 1972), still cited as having useful implications for principled design of CALL (N. C. Ellis, 1995a), was based on his mathematical learning theory rather than on then-current foreign language pedagogical practices. Atkinson (1972) found that learning, as measured by a test a week after the instruction, could be optimized significantly by having a computer program select items for practice on the basis of learners' past history of performance and item difficulty.

The work at Stanford was important also because its directors, Atkinson and Suppes, went on to form the Computer Curriculum Corporation in 1967, which continued to provide instruction in English as a second language (Saettler, 1990: 308). IBM also initiated an early project at the State University of New York at Stony Brook by funding experimental CALL materials for German (Elling, 1995).

[2] I am grateful to Graham Davies for the historical information he provided. For an account of past work in Europe, see Davies (1989; 1993).

Another early project began in Canada through a coordinated effort among three Ontario universities, Western Ontario, Guelph, Waterloo (and later the University of Alberta) resulting in CLEF (Computer-Assisted Learning Exercises for French), a series of 62 lessons covering basic French grammar (Paramskas, 1983), which would later be used by over 200 institutions in Canada and more abroad (Paramskas, 1995).

These are just a few of the many CALL projects that were undertaken by individuals on their university's mainframe computer during this period. Holmes and Kidd (1982) review some important ones, describing them as 'modest', emphasizing 'pedagogical principles and practical applications.' The pedagogical principles tended to go beyond the behaviorist/audio-lingual paradigms of early teaching machines by providing learners with grammatical explanations and specific feedback about their responses. For example, a German CALL project of this era at Massachusetts Institute of Technology was described as follows:

> [The] tutorial to teach German reading uses the computer as a source of information to be consulted by the student as needed; the [other aspect of the program] . . . uses a model of the structure of the language being taught to enable the program to determine whether a response is correct and to provide the student with useful error analysis if it is not. (Nelson, Ward, Desch & Kaplow, 1976: 28)

The practicality and efficiency of computer use were seen as essential by instructors who were using expensive mainframe computer time. Decker (1976), for example, described his innovative approach, which involved having the computer illustrate how to perform particular grammatical operations on French learners' sentences. He then explained how this innovation would be sequenced as the first step of a process including illustration, drill, and testing to ensure that the learners had benefited. As Decker's application illustrates, and Holmes & Kidd (1982) concluded, CALL of this era was seen as a supplement to rather than as a replacement for classroom instruction. Multiple initiatives around the world explored ways in which instructional goals could be accomplished more efficiently through the use of the computer.

These projects formed the profession's initial perceptions of CALL, but what was perhaps the greatest impact on the field in this era resulted from the major commitment made in the early 1970s by the US government to support computer-assisted instruction across the curriculum. Saettler (1990) described the irony of the decision that precipitated this significant phase in the evolution of CALL.

> Despite the decline of [computer-assisted instruction (CAI)], the federal government, through the National Science Foundation (NSF), decided to determine whether CAI could be made effective and available to as many teachers and schools as possible. This was the viewpoint behind the $10 million made available in 1971 to two private companies, Control Data Corporation (CDC) and Mitre Corporation, with the idea that the two companies would compete with each other and that at least one viable CAI national system would emerge. (1990: 307)

Control Data Corporation worked with the University of Illinois at Urbana-Champaign to develop the hardware and software for the PLATO (Programmed Logic for Automatic Teaching Operations) system; the Mitre Corporation contracted with Brigham Young University in Utah to develop the TICCIT (Time-Shared, Interactive, Computer-Controlled Information Television) project. These projects, providing mainframe computer systems and software designed specifically for instruction, impacted the evolution of CALL in two ways. First, each system included major CALL components. By early 1980, TICCIT had an extensive collection of courseware that was used as an adjunct to classes in ESL, French, German, Spanish and Italian (Hendricks, Bennion & Larson, 1983) and PLATO had courseware for those languages in addition to many others such as Arabic, Chinese, Hindi, Hebrew, and Swedish (Hart, 1981a).

Second, each provided laboratories for investigation of CALL and sowed the seeds for future professional infrastructure. The TICCIT project produced a core of faculty in language teaching prepared to contribute to the evolution of technology in SLA. By the late 1970s they were pioneering videodisk technology, which resulted in one landmark project in the evolution of CALL (Schneider & Bennion, 1983). Brigham Young faculty were also leaders in computer-adaptive testing for foreign languages (e.g., Madsen, 1991). In addition, a faculty member of Brigham Young University, Frank Otto, was founder and executive director of the professional organization Computer-Assisted Language Instruction Consortium (CALICO), which has provided a forum for intellectual collaboration and growth in the field since 1984.

The PLATO project also contributed to the professional expertise in CALL. The courseware developed on that system, which supported audio (input to learners), graphics, and flexible response analysis, was the product of language teachers' best judgement of what supplemental course materials should consist of in the late 1970s. As a result of his many years of developing courseware on PLATO, Robert Hart summarized the accomplishments and identified directions for growth in 1981:

> Eight years of intensive development have brought the PLATO IV grammar drill design to a high state of sophistication, so much so that further work in this direction will bring diminishing marginal returns. If we wish to make [CALL] a more powerful tool for language instruction, we really must begin to investigate qualitatively new design possibilities. (1981b: 16)

The new design possibilities he suggested were the following: (1) use of artificial intelligence techniques for analysis of learners' language in order to provide an appropriate instructional strategy, (2) diagnostic assessment of grammatical competence, (3) exploration of games and simulations which require use of 'non-trivial grammar while remaining interesting and computationally tractable' (1981b: 20), and (4) task analysis of language production, comprehension, and learning in CALL.

In retrospect, these experience-based suggestions proved to be ahead of their time. Because so few were engaged in the development and use of CALL in 1981, evolutionary progress resulting from professional discussion was not yet possible. The large majority of those who had experimented with CALL on a mainframe, or who were beginning to learn to program a microcomputer, seemed focused on the challenge of getting general-purpose hardware and software to perform for language instruction. However, primitive computer equipment and lack of professional organization were only two reasons why the early 1980s saw minimal work on these research directions. A third was perhaps that research in applied linguistics was not yet mature enough to offer principled guidance.

It would be difficult to document the many seeds sown during this period that would develop into the first attempts at computer-assisted language testing projects and computer-assisted SLA research. However, it was not an accident that early examples in the US were at Brigham Young University, where Harold Madsen and Jerry Larsen were the first in the early 1980s to report on efforts to develop computer-adaptive language testing, and the University of Illinois, where Nina Garrett began her work on computer-assisted SLA research investigating German syntax through data collected on the PLATO system (Garrett, 1982). Despite these and a few other pioneering efforts in testing and SLA research, the pre-microcomputer era of CASLA was devoted primarily to exploration of CALL.

The first microcomputers

Computers became widely available to language teachers in the early 1980s. Since microcomputers did not require users to be attached to

a mainframe computer maintained by a university or business, any academic department, language school, or individual teacher could purchase one and explore its potentials for language teaching. During this period, some became interested in computer-assisted language testing (CALT) and computer-assisted second language research (CASLR), but the primary activity continued to be in CALL.

Because of the microcomputer, just three years after the inquisitive participants gathered at the San Francisco workshop, CALL had gained enough professional visibility that those working on CALL converged to discuss methodological issues, and begin formal professionalization of CALL. The 1983 annual TESOL convention in North America included papers arguing methodological issues in CALL,[3] and a suggestion was made to establish a professional organization (CALICO) devoted to the issues involved in language learning technology. By the following year, TESOL members were working to establish a CALL Interest Section. One year later in the UK, the British Council sponsored a course on CALL at Lancaster University which proved so popular that subsequent gatherings were organized to discuss and learn about CALL. The 1986 gathering turned out to be the founding meeting for the EuroCALL professional organization, which later received funding from the European Commission to act as a pan-European organization for CALL. In Europe, North America, and Australia, CALL's status had developed from a local curriculum or classroom issue to an international professional concern. The need was evident for teacher education through courses such as the one the British Council sponsored in 1984 at Lancaster University. In addition, a market had developed for production of introductory materials explaining computers and their classroom uses, and within a four-year period a large number of such books were published.[4]

By coincidence, this period overlapped the height of Steven Krashen's[5] popularity and hence it was fashionable to invent CALL that could be claimed to promote 'acquisition' rather than 'learning.'

[3] Prior to 1983, there had been only one or two sessions each year at the TESOL convention concerned with computers and language teaching.

[4] The following books are among those based on work of the early 1980s that were produced for teacher education: Ahmad, Corbett, Rogers, & Sussex, 1985; Brumfit, Phillips, & Skehan, 1986; Cameron, Dodd, & Rahtz, 1986; Davies, 1985; Hainline, 1987; Higgins & Johns, 1984; Hope, Taylor, & Pusack, 1984; Jones & Fortescue, 1987; Kenning & Kenning, 1983; Last, 1984; Leech & Candlin, 1986; Underwood, 1984; Wyatt, 1984.

[5] Krashen's view of SLA, laid out in his 1982 book, depicts two separate and unrelated processes: unconscious 'acquisition' and conscious 'learning,' the former being the most effective, in his view.

During this time, much of CALL's history was lost because what might have been the best accomplishments (e.g., perhaps Atkinson's optimal vocabulary acquisition paradigm) as well as suggested research needs (e.g., Hart's suggestion for diagnosis of grammatical competence) of the previous decades were labeled as 'learning-oriented' and therefore irrelevant to acquisition – and to CALL's future (e.g., Cook, 1985; Sanders & Kenner, 1983).[6] The two most influential books of this era attempted to promote CALL by explicitly attempting to dispel the idea that it must be limited to activities focusing on 'learning.' Higgins and Johns denounced the link between CALL and explicit teaching as follows:

> The computer, some say, serves only the conscious process of learning, and can do nothing to facilitate acquisition . . . [W]e hope to be able to show that this view is wrong, and that the computer is quite flexible enough to serve a variety of learning theories. (1984: 17)

Underwood made the same point as follows:

> It is important to stress here that this negative view [of computers as useful only for explicit learning through drills and tutorials] by no means reflects limitations in computers themselves, but rather limitations in the programs being written . . . Although much of the literature is devoted to arguing that the computer cannot do this or cannot do that, what is meant is that no one is doing it. (1984: 50)

'It' according to Underwood referred to developing 'Communicative CALL,' which he defined with 13 premises intended to be consistent with Krashen's prescriptions for creating an environment for acquisition (e.g., communicative CALL will not judge all of the language students produce). Central to Underwood's approach to creating communicative CALL was the use of techniques from artificial intelligence (i.e., natural language processing) to recognize learners' input to the computer and to generate responses in order to create a 'meaningful' conversation between computer and learner.[7] These two books are considered seminal works in the evolution of CALL because they supply novel ideas for CALL – programs such as games and activities based on collaborative learning – which the authors saw as providing good contexts for acquisition.

The strand of SLA research stemming from Krashen's ideas about acquisition without explicit instruction failed to provide guidance for

[6] At the same time, some researchers continued to work on substantive technical issues of response recognition and analysis (Pusack, 1983; Lian, 1984).

[7] The microcomputers widely available during the early 1980s did not have enough memory for successful implementation of the type of AI approaches (real-time written conversation) Underwood advocated.

empirically based evaluation. Evaluation of CALL tended to be comprised of the developers' or users' opinion about the extent to which an activity seemed communicative on the basis of the type of tasks it asked learners to engage in. One type of task argued to allow for communicative language practice was based on text reconstruction, which consisted of variations on cloze exercises (Higgins & Johns, 1984). Variations included the following features: words deleted on a fixed-ratio basis, words deleted on the basis of some criteria, or all words deleted;[8] texts that the teacher entered into the program, texts that came with the program, or texts other learners constructed; with help options and scoring, or with simple yes/no judgements concerning the correctness of the learners' entries; with the end result being the completed text, or the end result responses to comprehension questions about the text. Advocates of 'acquisition-oriented' activities saw text reconstruction as sufficiently 'communicative' and 'learner-controlled' to argue for their pedagogical value. But two factors equally instrumental in their popularity were the computational simplicity of the program required to construct such learning activities and the fact that instructors were able to input their own texts, thereby producing customized CALL materials.

Another novel invention of this era was the computer-assisted concordancer activity. Borrowed from corpus linguistics, which had already been established as a mode of inquiry in linguistics when microcomputers became widespread in the early 1980s, concordancer software is used to identify words or expressions requested by the user and display them with reference to the lines in which they occurred in a text. Higgins and Johns (1984) suggested extending the practice of concordancing to language classrooms by showing the learner how to use the concordancer to retrieve the same types of linguistic data that teachers and linguists draw from. This activity was argued to empower the learner to investigate questions of vocabulary use and grammatical collocation on their own.

Although the primary impact of SLA theory was contributed by Krashen's ideas in the early 1980s, another influence came from research on individual differences (H. D. Brown, 1980). In particular, studies looked at hypotheses from SLA about the role of individual differences on the effectiveness of different instructional approaches (Abraham, 1985) and desirability of CALL (Chapelle & Jamieson, 1986). Investigating learning style and task variables in CALL,

[8] Jones and Fortescue (1987) claimed that among the various text reconstruction programs, the type in which all words are deleted, called a storyboard, was the most flexible and popular.