A THEORETICAL FOUNDATION FOR THE DEVELOPMENT OF PEDAGOGICAL TASKS IN COMPUTER MEDIATED COMMUNICATION

M.RAFAEL SALABERRY
Cornell University

ABSTRACT

Computer Mediated Communication (CMC) permits users to engage in purposeful exchanges with other humans (and with on-line databases) both synchronously and asynchronously. Yet, disappointment with previous technological "revolutions" may cause language teachers to be less receptive to the pedagogical uses of this new medium. A historical review of some of pedagogical claims of Computer Assisted Language Learning (CALL), multimedia applications, and their eventual outcomes, as well as new research in Second Language Acquisition (SLA), support the proposition that CMC gives second language learners the opportunity to enhance their learning experience. A theoretical framework is suggested for the development of pedagogical tasks based on CMC environments.

KEYWORDS

CALL, computer mediated communication, internet, multimedia, natural versus classroom settings, second language acquisition, second language pedagogy.

INTRODUCTION

The use of instructional media in the second language classroom has been a common practice for a long time. For instance, Price (1987) reports that teachers used pictures to teach Latin in the seventeenth century. In modern times the use of computer technology has captivated the attention of the teaching community. However, technological innovations have not always been conducive to higher achievement in language learning. Nelson (1995) argues that some of the innovations in language teaching tend to suffer from the extravagant claims made by their proponents. The introduction of the tape recorder or the VCR, for example, have presented teachers

with incredible breakthroughs in technology which have not been paralleled with equal advances in learning outcomes. In fact, in some cases these advances have helped create the wrong teaching paradigm (e.g., the language learning lab in conjunction with the strictly behavioristic audio lingual method). The recent "explosion" of the internet has presented second language teachers with yet another promise of a technological innovation which will create "a paradigmatic shift" in teaching and learning second languages. However, some researchers have already offered their verdict on that prediction. For example, Bates (1995) cautions against the overly optimistic reliance on the emergence of new paradigms in learning as a consequence of improved telecommunication systems. He predicts that computers will become "as significant to the learner as the electricity that carries the power to the refrigerator: essential for its operation, but *independent of the function that the refrigerator performs*" (P. 227, italics added). More important, Muns (1995) contends that the Internet has not created any "radically new conceptual means of communicating" (P. 152).

The pedagogical benefits of Computer Mediated Communication (CMC) in L2 (Second Language) learning is rapidly becoming one of the most discussed topics in foreign language teaching. In this article I will address the pedagogical merits of this new medium of communication in relation to current research 'in Anthropology, Cognitive Psychology, Communication Theory, Linguistics, and Second Language Acquisition (SLA). The outline of the paper is as follows. Section 2 analyzes the use of computer technology in SLA: a review of the uses of CALL applications, Intelligent CALL programs, and ALS (Advanced Language Systems). Section 3 presents a principled approach to the uses of CALL-based systems according to their inherent limitations. Section 4 outlines the proposed theoretical foundation that supports the design of pedagogical applications for CMC environments. Section 5 describes the types of pedagogical uses of computer based telecommunications according to the theory developed in the previous part. Finally, section 6 presents the conclusion and suggestions for further research.

THE USE OF TECHNOLOGY IN EDUCATION

Many inventions have shown the promise of starting a revolution in the transfer of information among humans. The following are prominent examples of such predicted revolutions: the first appearance of writing systems, the invention of the printing press by Gutenberg, the invention of the telephone by Bell, the mass production of audio and video tape recorders, the invention of the photocopy machine by Xerox, and the widely extended use of "microcomputers." The appearance of the Internet has been hailed as the latest technological innovation for sharing information. A recent article in *Newsweek* magazine (Levy 1995) praises the Internet as the new frontier in the transfer of

information: "You talk about a revolution? For once, the shoe fits... It really is about opening communication to the masses. And 1995 was the year that the masses started coming" (P.27). In fact, the Worldwide Web (WWW) has been doubling every 53 days in a sort of factorial growth. Language teaching professionals wonder whether the emergence of a system which opens up a myriad of communication channels will have lasting effects on pedagogical practices. The relevant question is: does the pervasive nature of an information transfer system such as Internet create a paradigmatic shift on the teaching of foreign languages (or education in general)? Some researchers have argued forcefully in favor of such a paradigm shift (e.g., Harasim 1990; Dede 1993; Berge and Collins 1995). For instance, Berge and Collins argue that CMC generates a shift from instructor-centered to student-centered learning (p. 2). However, is this shift a direct consequence of the emergence of computer based telecommunications?, or is it a result of the pedagogical approach of the teaching practices that rely on that medium? It is true that, perhaps, the advent of a new communication system reveals hitherto unnoticed features of a successful learning environment. In fact, Berge and Collins acknowledge that CMC is changing instructional methodology in two ways: generating improved technological tools to use a full range of interactive methodologies, and --more important -- by focusing teachers' perspectives on the appropriate learner-centered design of instruction (P. 2), This is no minor feat. However, many L2 teachers would not be impressed by such an discovery. After all, foreign language teachers have been promoting a learner-centered approach for quite some time (see Canale and Swain 1980; Savignon 1983; Rivers 1987; Kenning and Kenning 1990 *inter alia*).

The potential pedagogical effect of the technological tools used in L2 instruction (e.g., VCRs, audio tape recorders, satellite TV, etc.) is inherently dependent on the particular theoretical or methodological approach that guides its application. In fact, in some cases, the emergence of technological breakthroughs has been wrongfully guided by inaccurate theoretical assumptions: the use of the language learning lab in conjunction with the audiolingual method (ALM). That is why Price (1987) notices that *different methodological approaches* favor the use of one medium over another. In other words, it is not the medium itself that determines the pedagogical outcome, but the specific focus of the theoretical approach on the language learning phenomena. On the other hand, instruction which is well designed and rightfully targeted can be extremely successful even if the nature of the technology itself is not in accordance with the major tenets of the prevalent methodological approach. Hence, TV programs such as Sesame Street and Mr. Rogers are successful for delivering instruction to large groups of children in spite of the passive nature of TV viewing (Ahern and Repman 1994). These examples of the use of technological tools (the language learning lab and children's TV programs) reveal that educators should be knowledgeable in two areas: educational theory and practice, and the

process of instructional design and use of different technologies (Bates, p. 246). Without a strong foundation in those two bodies of knowledge L2 teachers will not be able to make principle-guided decisions in their pedagogical use of technological tools. A case in point has been the relative failure of Computer Assisted Instruction (CAI) in the creation of significant instructional changes in the L2 classroom.

A review of CALL applications in L2 teaching

A critical analysis of the pedagogical uses of CALL applications may be presented from three different perspectives: the theoretical foundation that guides CALL design, the empirical research that measures the pedagogical effectiveness of CALL, and the technological capabilities of computers. First, a minimal theoretical framework in CALL applications should recognize that the "effective use of any medium in language teaching depends on *the role* the message in that medium plays in the language-learning situation, *the content* of the materials, and the *ways these two interact within each student's language-learning experience*" (Price 1987: 156; italics added). However, the majority of CALL applications have not relied on any type of theoretical rationale except for the theoretical framework already built into basic CALL exercises: the computer is the ideal environment for the implementation of the type of Programmed Learning from the behavioristic tradition (the "wrong-try-again" approach: Underwood 1984, 45). Nevertheless, there are several examples of principle-based applications of technology in the L2 literature which reflect the basic tenets of a learner-centered curriculum (Künzel 1995). For instance, Higgins (1988) developed a theoretical foundation for the design of CALL programs based on the notion of the computer as a magister or a pedagogue.[1] Another example is Communicative CALL (Underwood 1984) which reflects a true paradigmatic shift in teaching: a change in pedagogical theory but not necessarily due to a change in technology. The computer formerly used for grammatical drill practice was no longer seen as a teacher or as a tool, but rather as a helper or facilitator.[2] The theoretical rationale of Underwood was based on the ideas of Chomsky (language "grows" in a normally rich linguistic environment) and Krashen (comprehensible input). Even in the absence of consensus on these theoretical foundations in particular, it is important to underline that Communicative CALL reflects a well-informed pedagogical practice due to its strong theoretical base. In fact, Underwood lists a set of criteria that should guide the development of "Communicative CALL": communication is the goal, grammar is taught implicitly, only the target language is used, the program is flexible (more than one single response allowed), it allows exploration of content, it provides on and off-screen tasks, it does not attempt to incorporate tasks which are better implemented in other media, and, most important, it is fun!

On the other hand, a principled approach to the use of technology in the classroom may also lead to the reassessment of dismissed technological options. For example, the demise of the language learning laboratory came about as a consequence of the fall of the behavioristic tradition that informed the audiolingual method (Chomsky 1959). However, a proper assessment of the pedagogical value of the language lab within a principled approach of SLA has led Underwood to conclude that the value of the dismissed language learning laboratory of the 60s and 70s should be reassessed: "the solution ... is to use the lab as a true audiovisual or multimedia center" (p. 37). In sum, the most recent CALL programs have assigned a great deal of importance to a principle-based approach to developing computer based instruction. On the other hand, it is quite noticeable that the majority of theoretical arguments favoring the latest development of CALL applications are based on the hypotheses developed by Krashen and colleagues (e.g., Underwood 1984; Higgins 1988; Kenning and Kenning 1990; Nelson 1995).[3] This particular theoretical approach does not invalidate the pedagogical value of those CALL programs. However, it does raise some concerns about the validity of embracing such a monolithic approach in a field of inquiry with so many theoretical perspectives. More specifically, the history of support of Krashen's perspective is not comforting considering the fact that many researchers have argued forcefully against Krashen's hypotheses.[4]

A second drawback of archetypal CALL programs has been the lack of appropriate empirical studies that assess the benefits of such programs. Alternatively, these studies may generate useful research hypotheses which can properly frame the potential use of CALL programs within a variety of pedagogical approaches. Several investigators have reported various deficiencies in the few empirical studies addressing the pedagogical benefits of CAI on learning (e.g., Reeves 1993; Schmitt 1991). Schmitt has noted the following four major research design flaws: small sample sizes, lack of criteria for what constitutes appropriate software, faulty statistical analysis, and inadequate length of treatment to measure educational outcomes. Reeves mentions the lack of a theoretical framework, the infrequency and brevity of the experimental treatments, the small sample sizes, and the large attrition in number of participating subjects. Reeves claims that research on computer based instruction has traversed three distinct stages: research on the effect of computer literacy (do computers help learning?), research specific types of applications, and finally, research on the analysis of learner control variables (how learners selections of rate, content, and nature of feedback affect learning). From a theoretical perspective, the final stage is the most valuable: interactive instruction gives the learner the chance to choose the learning path. It is also the most relevant because it underlies most of the research efforts of the recent multimedia environments. However, the contradictory results of most empirical studies addressing the issue of learner control variables reveal fundamental research design problems. Another major methodological

problem of some of these empirical studies includes the lack of use of a control group to measure increased learning as an outcome of the use of CALL applications (e.g., Chapelle and Jamieson 1986; Liu and Reed 1995).[5] The study of Chapelle and Jamieson serves to exemplify yet another difficult issue in the design of empirical studies analyzing CALL: the Hawthorne effect (positive effect of exposure to something new: Künzel 1995). The solution offered by Reeves to solve these problems is to conduct extensive, in-depth studies to "observe human behavior in our field and relate the observations to meaningful learning theory that may be later susceptible to quantitative theory" (p. 44). This is a necessary step considering the fact that very few working hypotheses are available to explain the phenomena under study. Qualitative descriptive studies can generate a number of specific hypotheses which can be tested later. However, the use of qualitative studies should not rule out the design of quantitative studies that present a clear theoretical rationale and a sound research design.

A critical review of previous CALL studies is important because the newly arrived studies on the effect of computer based telecommunications on learning show similar defects. For example, the study conducted by Veasey (1991) on the use of e-mail as a pedagogical tool shows some of the above mentioned problems. First, Veasey does not present a theoretical framework: the intent was to examine the benefits and uses of e-mail as an instructional support tool in the classroom environment without an explanation of why those benefits were expected. Second, the research design was poorly controlled: the dependent variable was the gain score from a pre test to a post test even though these tests were clearly different (a written exam and a course project). Third, the scoring of the tests was not done by independent judges, but by the researcher who was also the instructor of the course. Finally, the frequency and brevity of the e-mail contacts was clearly insufficient to measure any significant effects: a weekly e-mail message per student during a period of three months: roughly 12 messages total![6] However, it is important to mention that the procedure of data collection of this study included a student journal and a follow-up open-ended informal interview. These two additional features of the research design provided some valuable analysis in the discussion section of that study.

Finally, the major drawback of using CALL applications to enhance L2 learning is the fact that computers are not good at conversations (Nelson 1995, 2). That is precisely why Underwood claims that communicative drills are an obstacle for CALL design (p. 62). In spite of their inherent limitations, some researchers have attempted to recreate the normal sociocultural nature of human interaction in computer-human exchanges. Weizenbaum's Eliza (1976) is a notorious example. However, Eliza could only deceive a human for a certain period of time, because the machine could not "interact" with humans; it could only create the illusion (Kossuth 1984). Should we expect that future developments in AI

(Artificial Intelligence) will improve the quality of human-machine interactions? We should now turn to the analysis of what has been labeled Intelligent CALL: ICALL.

Is ICALL a viable alternative to the shortcomings of CALL?

The most recent research on artificial intelligence has centered on the development of expert systems (programs that try to match human expertise in some domain). This line of research is an elaboration of the notion of multiple intelligences developed by Gardner (1983): intelligent behavior in any domain requires a lot of knowledge in that specific area. Anderson (1990) argues that viable attempts to elaborate expert systems should be concerned with the teaching of specialized levels of expertise (e.g., complex problem-solving skills). Anderson analyzed the effect of a machine tutor that helped computer science students learn the production rules that underlie the use of a computer programming language (LISP). The students' success revealed that what underlies the acquisition of a complex skill such as computer programming is the finite system of 500 production rules encoded in the LISP tutor. However, it is doubtful that the success obtained in the above mentioned problem-solving domain (algorithmic nature) could be reproduced in a second language learning situation. Intelligent machine tutors that teach language require the following base components: a representation of the subject knowledge, a model of the learner, a language understanding system, and a means of self-adjustment, i.e., learning from experience (Higgins 1988, 19). Except for the representation of subject matter (and only to a certain extent) machines fail in the representation of the other three components.[7] This is not surprising. After all, as in any systemic approach to computer assisted instruction (Steinberg 1991), the real "magister" is not the machine but the person who writes the program. To develop an algorithmic representation of all the subject matter of linguistics, cognitive psychology (model of the learner), and even a procedure to learn from experience is a hopeless endeavor. We have not yet been able to represent these bodies of knowledge explicitly.[8] Hence, Higgins argues that the attempt to create "intelligent tutoring systems" is a fallacy.

AI architecture is still a long way from being able to create anything close to mirror the complex system of communication instantiated in any human language and is, hence, unable to introduce any qualitative leap in the design of CALL programs. In fact, none other should be the case according to Weizenbaum (1976) because language "involves the histories of those using it, hence the history of society, indeed of all humanity generally." In essence, linguistics has not been able to encode the complexity of natural language in a finite number of discrete rules (e.g., Pinker 1979; Chomsky 1980, 1988).[9] That problem has been acknowledged by several of the most adamant proponents of Intelligent CALL.

Holland (1995) lists the reasons that have prevented ICALL from becoming an alternative answer to CALL. The most important reason for this failure is that NLP (Natural Language Processing) programs - which underlie the development of ICALL - cannot account for the full complexity of natural human languages (p. viii). As a consequence, ICALL programs present the following shortcomings: NLP-based programs are still at an experimental stage, most NLP applications require the use of large and expensive computers, and consequently, little attention is given to interface design.[10] The valuable contribution of ICALL programs lies on the provision of form-focused instruction - a more humble goal. In this respect, Garrett (1995) argues that ICALL programs may offer a challenge to two major assumptions which underlie the development of Communicative CALL: the use of individual learning strategies/styles, and the learner-centered approach of communicative teaching.[11]

As far as the type of language teaching that machine tutors can provide, one readily thinks of the type of grammar instruction which may be synchronized with the particular stages of development of the students' normative grammar. The machine tutor can become a high tech version of a combination of reference grammar, dictionary, thesaurus, etc.: an on-line reference database. But, most important, the vast majority of studies in cognitive psychology recognize that machine tutors cannot gauge appropriately the needs of the students: lack of self-adjustment and learning from experience (e.g., Weizenbaum 1976; Anderson 1990). Anderson states that "private human tutors appear to be quite tuned to the needs of students" compared to machine tutors (P. 267). That is to say, the feedback provided by machine tutors does not respond appropriately to the needs of the students because machines cannot adapt efficiently or effectively to the constraints of the learning situation for each individual case. Bloom (1984) has shown that the vast majority of students (approximately 98 percent) do better when they receive private tutoring instead of classroom instruction. This shows that students learn better when they receive the type of instruction that responds to their individual needs (individual abilities, expertise level, increased motivation, etc.). Ironically, the advantage of machine tutoring systems resides on the fact that they constitute a particular type of individualized instruction which is cost-effective even if not as pedagogically effective as the human counterpart. In sum, machine tutors cannot achieve the same level of responsiveness to the learning situations as humans (Higgins' *pedagogue*), but they do constitute a better alternative than most types of mass instruction (Higgins' *magister*). In any case, it is important to underline that current pedagogical practices in the L2 classroom rely mostly on interactive teaching and learning and not lecturing (e.g., Crookes and Gass 1993; Nunan 1992; Rivers 1987).

Summarizing the previous discussion, it is clear that developers of ICALL should be responsive to the needs of the L2 student when developing language learning programs. In that respect, I wonder why we should rely on programs based on AI to carry out a pedagogical task that can be implemented more effectively and efficiently in various other ways (e.g., direct human contact, e-mail exchanges, telephone conversations, etc.). Furthermore, it seems irrelevant to argue that we can increase the communicative value of AI-based exercises by exchanging information in class, since that feature of the activity is not a prerogative of AI-based exercises. If "Intelligent" machine tutors cannot provide a cogent and practical pedagogical alternative to CALL, can we, instead, rely on the capacity of computers to store information and combine different media to improve language learning? This alternative proposition is perhaps less sophisticated than ICALL, even though it does not lack supporters who have labeled it as the "true revolution" of CALL (Dede 1993; Gayeski 1993; Jacobson and Spiro 1995; Liu and Reed 1995; Murray 1991; *inter alia*).

Advanced Language Systems: on the cutting edge?

Multimedia "is a class of *computer-driven interactive communication* systems which create, store, transmit, and retrieve textual, graphic, and auditory networks of information" (Gayeski 1995, 4, italics added). Without further analysis, notice that in this definition interactions are "driven" by the computer (as opposed to human-driven interactions). In other words, the machine takes control of the learning process: the *Magister* in Higgins' terms. This word of caution finds an echo in exaggerated claims made by some of the proponents of multimedia with respect to the pedagogical value of the (interactive) use of various media (e.g., Fredericksen, Donin and Décary 1995; Jonassen and Wang 1993; Jacobson and Spiro 1995).

For example, Murray (1991) claims that "we are beginning to see the possibility of inventing methods that promise to be different in kind rather than degree" (p. 1).[12] Murray distinguishes various levels within an ALS: natural language processing, knowledge representation, discourse structure and narrative structure (p. 3). It is possible to cluster these four groups into just two if we take into account the operational distinction between Al and interactive Multimedia features of such a system.[13] The first two levels defined by Murray can be associated with the AI architecture of the program: a language parser which would be able to approach the human's language capacity in order to create "real life exchanges" with the computer (see above discussion on drawbacks of NLP parsers). On the other hand, the design of the interactive multimedia section should be more concerned with discourse and narrative structure: the level at which we encounter the functional use of language (the sociocultural "parser" of language). With respect to this second level (i.e., hypertext and multimedia environments), the author

makes a good argument in regards to the potential pedagogical value of using such a new medium. For instance, she isolates the two basic elements of narratives — character and plot — in order to show how their manipulation in a hypermedia environment can add different degrees of "texture" to the narrative "text."[14] This factor becomes a crucial one for dealing with different discourse modes/cultural perceptions as is particularly the case in SLA: "(t)he experience of the narrative may be an experience of this variation of visions of the same event rather than a succession of events" (p. 11).

Murray states that ALS systems "would be the natural extension of classroom simulation games and role playing, enriched by interactive video materials that capture authentic situations and language" (p. 12). In other words, with ALS, computers are still assisting language learning by means of their amazing capacity to store information, not by introducing a new, hidden dimension in the social development of a second language. Granted, it is true that the advent of interactive multimedia introduced a new perspective on the concept of storage of information. However, we have not yet devised any new approach to take advantage of that amazing power except for what is already an inherent trait of the new technological medium (Jacobson and Spiro 1995). In fact, Murray does not address the issue of the psycholinguistic validity for the use of such a medium in order to aid the language acquisition process. In other words, hypermedia in general appears to be a promising tool for achieving pedagogical purposes, even though there is yet no theoretical foundation for the design of psycholinguistically sound and valid programs in hypermedia. In essence, the design of ALS must be able to go beyond making use of the inherent technological capabilities of the hypermedia environment, and develop the kind of rationale based on what SLA theories can inform us about the process of acquiring a second language.

A more radical perspective on the use of multimedia is based on the hope that these systems will foster a new model of teaching "based on learners' navigation and creation of knowledge webs" (Dede, 114), This radical perspective is formally defined as hypermedia technology.[15] Hypermedia is the "computerized way of representing the semantic network in human memory through its nodes and links" (Liu and Reed, 159).[16] Hypermedia systems are assumed to foster higher order thinking skills representing a paradigmatic shift in pedagogical practices brought about by a revolutionary technology. However, the arguments displayed by these researchers are not convincing. In some cases, the arguments are unfounded: knowledge representation can evolve into knowledge construction (Dede, 119), users will develop metacognition: thinking about thinking (Dede, 119), etc. In other cases, the authors do not offer any rationale that explains why these proposed qualitative changes in cognitive processing will occur due to the *use and interaction with multimedia systems*. The failure of ALS is the attempt to emulate on the

computer all relevant aspects of the language learning situation. A more modest — but more feasible objective — is to regard the computer as a mere storage of large multimedia databases. In this way researchers and designers can approach the task of creating software applications from a more realistic perspective.

TOWARDS A RATIONALE FOR THE APPROPRIATE USE OF CALL AND MULTIMEDIA APPLICATIONS

The previous analysis of CALL and multimedia applications has shown that the so-called paradigmatic shift in the learning process might be more of a novelty rather than a true revolution in the use of an emerging technology. However, it is not accurate to say that the advent of the microcomputer has not brought about some fundamental changes in the educational process. These innovations can be classified into four major types: (i) innovative research technologies, (ii) new procedures for the assessment of students' learning profiles, (iii) a new rationalization for the preparation and management of teaching resources, and (iv) an extended resource/reference database for the students.

(i) Computers are powerful processors of data. As such, they constitute an appropriate tool to collect, store and analyze information from notoriously rich and complex processes such as language learning. This is especially true considering the fact that the lack of a precise theory of SLA does not allow researchers to obviate any minor aspect of the data collection procedure. Doughty (1992) argues that more than using them as teachers, computers are better exploited for collecting data and testing second language acquisition.

(ii) In the same vein, computers can be used to model the developmental path of the learner, or the interaction of the learner with the input data. For instance, learner computer tracking systems "record meticulously the number of keystrokes, content items seen by the user, navigation strategies, and paths constructed through the program" (Gay and Mazur 1993, 46). Gay and Mazur report that their tracking system allowed them to investigate the interpretation and use of an interactive multimedia fiction program: *El Avión Hispano*.[17] The tracking data was created in **HyperCard**, and later converted into an Excel spreadsheet form. The analysis of the students' construction of the story space allowed designers and researchers to investigate the styles of use of the fiction program, the effect of the interface (e.g., use of cinematic techniques in the design), the use of linguistic resources (e.g., low use of the thesaurus), etc. Similarly, Garrett (1995) argues that machines are probably much better than humans at recording, tabulating, and organizing the data that can inform teachers of the learning history of each learner.

(iii) Computers have helped teachers manage educational resources and carry out administrative tasks in an efficient way. When computers are regarded as data storage devices of the same nature of audio tapes, video tapes, notebooks, etc., teachers realize that pedagogical tasks can only be designed by humans and not by machines (there is no risk of machines taking the place of teachers). The recent appearance of some relatively unsophisticated authoring programs (**HyperCard**-based) such as **CALM** (Computer Assisted Language Multimedia) represents an example of the type of resources that give teachers the chance to create an enormous amount of academic activities tailored to the needs of the students in little or no time.[18] Kenning and Kenning (1990) argue that if L2 teachers let the computer manage the learning process, pedagogical activities may well turn out to be second rate applications. As a consequence, teachers should "treat the computer in the same way as any other resource... the teacher must identify the learning experiences that should be provided, and then consider whether the computer is able to provide them more effectively than other means" (p. 78). The design of successful CALL applications should incorporate the following components: the selection of suitable materials (content), the selection of an adequate methodology to achieve the pedagogical goal, the proper analysis of the type of interface required by the teaching objective (e.g., computer based instruction versus computer assisted instruction), *and the careful planning and management of the teaching resources* (Kenning and Kenning, 81).

(iv) The large data storage of computers brings about the powerful nature of multimedia systems: providers of target language input in sufficient quantities (e.g., Kenning and Kenning 1990; Stevens 1992). From this standpoint, the true interactivity of multimedia — the associative nonlinear interaction of video, audio, text, and graphics — becomes the central asset of the system. There is no need to pose any breakthrough for the cognitive processing of multimedia environments (e.g., Dede 1993; Murray 1991) to recognize the value of a more extended database of information. It is true that the extended availability of resources enhances the learning activity. However, the real cause of improved performance is the nature of the learning process in such environments: learner-centered instruction. From a learner-centered approach, the interaction with extensive multimedia databases is prompted by the learner's curiosity, problem-solving needs (i.e., hypothesis testing), learning style/strategy, etc. This is a very positive outcome of the use of multimedia systems. However, it is essential to recognize that we are still far from identifying any qualitative changes in the cognitive processing of an information database which integrates various media.[19] A principle-based approach to language teaching-learning should be able to account for the "real engine of change" (causative mechanisms) in the development of the target language: the involvement of the learner in the learning process. In this respect it is reasonable to assume that CMC may foster extended interaction in the L2. For instance, Berge and Collins (1995) claim that "if designed well,

CMC applications can be used effectively to facilitate collaboration among students" (p. 4). Does computer mediated interaction constitute a more revolutionary change in the development of language learning technologies?

COMPUTER MEDIATED COMMUNICATION

Is there a revolution yet?

Several authors have stated that the major goal that we are pursuing in the development of CALL or multimedia programs is the "general discourse competence that includes the ability to express, interpret, and negotiate meanings within the social context of interpersonal interactions" (Murray 1991, 2). That being the case, we can actually devise much more effective and efficient exercises than the ones proposed by advocates of ALSs if we do not let the nature of the medium govern the design of the activity to achieve the final objective. For instance, with only e-mail we can accomplish the same goals of various ALS programs like "No Recuerdo," "A la Recherche de Philipe," etc. in a very effective and efficient way. With only two computer terminals at two different sites (i.e., two countries which represent the target languages) we can devise problem-solving activities, simulations, cooperative tasks, etc. to create meaningful interaction through e-mail. The options for the design of pedagogical activities are endless, and only determined by the technological limitations of e-mail communication, not by the lack of creative options for setting up a task of this sort.[20]

Santoro (1995) defines CMC as the "use of computer systems and networks for the transfer, storage, and retrieval of information among humans" (p. 11). This definition can be interpreted in its broadest term comprising three different categories: Computer Assisted Instruction (CAI), Information (internet resources in general), and Conferencing Services (electronic mad, bulletin boards, listservs, etc.). These three categories reflect a continuum of the role of computer mediation in normal human interaction. The maximal use of computer mediation occurs in CAI/CALL applications where the computer is the sole "interlocutor." Hence, CALL, ICALL, and ALS are all dependent on a large database of information that allows the computer to create the illusion of true interaction (humanlike). The minimal use of computer mediation occurs in Conferencing Services. For the purposes of this analysis I will only consider Information and Conferencing Services as the representatives of computer based interactions. Based on the work of Bates (1995), Berge and Collins (1995), Steinberg (1992) and the previous discussion, I win present a list of the major characteristics of CMC which should guide the design of pedagogical activities implemented in that medium:

* the learner addresses a specific audience for purposes other than demonstrating a skill

* expansion of the network of peers (sharing the work with fellow students)

* increased access to cross-cultural information (sharing information with other communities)

* increased access to experts' advice/guidance (expert-novice interaction, native speaker-nonnative speaker contacts, etc.).

* freedom from time and location constraints (e.g., non accessible regions or conflicting schedules)

* emergence of new discursive environments: absence of nonverbal cues (e.g., more spontaneous participation in group work, increased participation of minorities)

* emotional involvement (increased motivation)

* unparalleled access to information databases and help on-line

* emergence and expansion of a new asynchronous mode of communication (e.g., e-mail)

* safer environment in which learners may try to communicate with more advanced speakers without "losing face"[21]

These various features have been previously analyzed by several researchers, even though it is possible that not all investigators agree on one single list of characteristics of CMC environments. However, I believe that this list is particularly useful for the analysis of interaction among L2 learners. I will underline the three most important traits of the above mentioned features of CMC environments as they appear to be especially relevant ones for the design of pedagogical environments in the L2 classroom: interaction for purposes other than strictly academic skills, the new discursive nature of electronic communication, and the asynchronous nature of computer based telecommunications.

One of the most important features of CMC is the fact that students contextualize their learning when they interact with other users (usually outside their academic environment). These out-of-classroom users are more interested in hearing about the content of the students' activities rather than in assigning the students a grade, As a consequence, learners direct their own learning because they are in charge of their own

actions. In other words, the students go about the process of constructing knowledge from problem to solution (contextualized) instead of going from solution to problem (decontextualized academic environment). From this perspective, the notion of problem is necessarily tied to its social nature as explained in Lave and Wenger (1991), or Schön (1983). For example, the traditional grammatical syllabus in L2 teaching gives learners the means to achieve a goal that is not existent yet in the students' representation of the problem space. The appropriate and real contextualization of the activity, through - for example - tandem e-mail projects, simulations, Usenet discussions, etc. gives students the chance of engaging in the socially, mediated construction of knowledge through CMC.

Another influential feature of CMC environments is the emergence of a new discursive world. As such, the discourse properties of CMC environments are the product of a new cultural context. For example, users of e-mail have become quite adept at communicating certain emotions by means of using a combination of keyboard symbols that present a pictorial representation of emotional states: smileys such as :o) or ;-). This shows the discourse of e-mail to be qualitatively different from traditional written or oral communication. Some of the features of this new medium are the following: lack of nonverbal communication (neither paralinguistic nor nonlinguistic cues), a new set of turn taking skills, and finally the cohesion of CMC discourse. CMC discourse is more disconnected at the level of adjacent contributions "in favor of a more complex cohesion pattern that extends over a long discourse domain" (Graddol 1991, 335). Of these features, the absence of nonverbal communication seems to have the most consequences. For example, the two following effects have been reported in the literature on CMC: minority interests are better represented (Graddol, 336), and students are more spontaneous to share ideas (Ahern 1994, 236; Rheingold 1994, 62-64). It is clear that these are not minor consequences of the use of CMC. For some users such as people with physical disabilities they constitute the most important feature of this new medium (Kinner and Coomb 1995). For others, the type of nonverbal communication of CMC environments can generate more interesting discussions on-line (as opposed to classroom interaction).

The asynchronous nature of interaction (except for cases in which real-time interaction is purposefully used such as Inter Relay Chat: IRC) implies first, the flexibility of asynchronous communication which eliminates all the constraints and difficulties of time schedules; second, a time lag between transmission and reception of messages which gives the user more time to reflect on the answer; and third, an array of choices which this time lag offers to different groups as they structure information (Ahern and Repman 1994).[22] The defining features of CMC environments reviewed above generate interesting questions about the nature of human interaction and the possible impact of various pedagogical uses of the Internet. However, why should we assume that collaboration

helps learners develop their linguistic system? To answer this questions one must define the notions of collaboration and interaction as they pertain to CINIC.

Situated cognition: interaction around the computer

Several researchers have explicitly argued for a clear distinction between "on-screen" and "off-screen" learning environments in the context of CALL. Boyd-Barrett and Scanlon (1991) state that "the educational significance of computing to I significant 'de, not in the machines, but in the ways in which teachers and learners interact with them, and in doing so, the ways in which teachers and learners interact among themselves (p. vii). The analysis of the *interaction with the machine* has prompted many researchers to investigate the effects of learning in multimedia environments (see above for strengths and weaknesses). On the other hand, the analysis of *interaction around the computer* has induced researchers to investigate the nature of the social setting of learning.[23] For example, Crook (1991) argues that intelligence is normally exercised in social contexts, and Hymes (1972) states that language acquisition does not occur in a vacuum: language use is what determines language. Even neo-Cartesian perspectives on language (the notions of competence and performance in the Chomskyan paradigm) give a special status to the effect of the social setting on language: the notion of "pragmatic competence" (Chomsky 1980).

However, some researchers have argued for an even more pervasive and deeper effect of normal social interaction on cognitive development (e.g., Crook 1991; Gay and Grosz-Ngate 1994; Graddol 1991; Steinberg 1991). For example, Crook states that "cognitive development involves a necessary coordination of our thinking with that of others" (p. 158), Steinberg argues that current research in cognitive psychology shows that students "construct understanding rather than reproduce instruction" (p. 18). And, Gay and Grosz-Ngate argue that working in groups promotes learning as an interactive process; thereby, developing critical thinking, social skills and the acquisition of specific knowledge (P. 420). Most of these positions constitute a development of the work of notable psychologists and philosophers like Vygotsky (cognitive functions are socially mediated or constructed) or Wittgenstein (linguistic knowledge is tied to "language games"). In general these positions reflect a profound reappraisal of the social nature of language acquisition: situated cognition. For example, according to Vygotsky (1978), the mechanism of thought is the internalization of external behaviors which occur while interacting with others. The most important "tool" used in social interaction is language; hence, language is assumed to mediate thinking: from interindividual contexts to intraindividual cognition. This is the major component of a theory of situated cognition: it places the emphasis on how knowledge is attuned to the socio-historical environment instead of searching for general structures of knowledge (Resnick 1994).

More recently, there have been a series of attempts at raising awareness of what constitutes the true nature of the learning process in situated cognition (e.g., Lave and Wenger 1991; Resnick 1994; Sch6n 1983). Lave and Wenger have claimed that learning can be regarded as the special type of social practice commonly found in apprenticeships: legitimate peripheral participation. In apprenticeships, participation is legitimate because it gives access to the social organization of the working environment, and it is peripheral because of the gradual process of incorporation to the social structure of the practicing community. The increased access of learners to participatory frameworks entails a great deal more of learning than in typical decontextualized settings such as academic environments. Lave and Wenger have emphasized that the success of many types of apprenticeships reveals the social nature of learning and knowing. They claim that a learning curriculum is "a field of learning resources in everyday practice *viewed from the perspective of the learner*" (p. 97, italics added). On the other hand, academic curricula constrain and limit the choices of the learner and the structuring of resources, in essence, "the meaning of what is learned" (p. 97). Lave and Wenger argue that the advantages of apprenticeship over regular schooling are based on the following differences: a broad initial view of the task by taking part in ongoing activities instead of the discrete presentation of the system (grammatical syllabus), the importance of being in a relevant setting for learning (immersion in target language communities), and the existence of strong goals for learning.

The notion of a teaching curriculum as not beneficial for learning finds an echo in the work of Schön (1983) who has developed the concept of the reflective practitioner. The reflective practitioner "does not keep means and ends separate, but defines them interactively as he frames a problematic situation" (P. 68). In other words, academic work leads students to be skillful at "selective inattention." As a consequence, immersion in the uncertainty of the natural social environment overwhelms the person who has learned to manage the situation in a controlled, decontextualized way. For example, native speakers cannot describe the knowledge that underlies their use of language (nor can linguistic theory); however, L2 learners are exposed to a standardized version of the target language in academic instruction which places the emphasis on linguistic structure instead of pragmatic knowledge. Most classroom learners who have had the opportunity to engage in normal linguistic interaction (outside of the classroom) have a hard time understanding that appropriate interaction in the L2 relies as much on pragmatic as on morphosyntactic knowledge. Resnick has cogently summarized this predicament: "the special situation of the classroom — calling for private rather than socially shared work and isolating mental activity from engagement in the social and physical world — builds skill and knowledge that allow students to function in school, but often fail to transfer to the worlds of work, civic, and personal life" (p. 491).

In sum, there are two major effects of true social interaction on the L2 learning process: an increased awareness of the sociocultural nature of the target language, and the development of situated cognition (from the interindividual context to intraindividual cognition). There is abundant evidence in the literature of SLA for both effects. For instance, Porter (1986) argues that offering learners the opportunity to interact with native speakers outside of the classroom helps these students acquire adequate sociocultural models of the L2 (e.g., pragmatic features of communication such as prompts and repairs). On the other hand, allowing learners to interact with other fellow students — nonnative speakers — with a similar level of proficiency helps learners engage in more extended interactions that help them refine their nonnative grammatical system (e.g., morphosyntax).[24] Finally, it is important to highlight the fact that situated cognition does not entail doing without some type of instruction. In particular, Lave and Wenger have emphasized the fact that their notion of LPP does not constitute a teaching methodology (p. 40). Hence, the pedagogical design of CMC activities in the L2 classroom will be necessarily dependent on what we know about L2 development (within the constraints of situated cognition).

The research findings of SLA: immersion settings

I have argued that the type of pedagogical practices based on CMC environments may offer a more "revolutionary" perspective than the most sophisticated ALSs. I have also claimed that this revolution does not come about because of the nature of the technological medium per se, but because of the type of learning that it promotes: a learner-centered interactive approach. Concomitantly, there exists a wealth of empirical evidence in SLA that justifies the contention that CMC will be beneficial for promoting language development. In fact, the concept of interactive teaching and learning has been part of pedagogical practices of the L2 classroom for quite some time. For example, Rivers (1987) is a collection of papers that highlights the role of interaction in L2 learning. Rivers claims that linguistic interaction is represented by collaborative activity among two interlocutors and the context of the situation: interaction involves expressing one's ideas and comprehending the ideas of others (P. 4). Many pedagogical practices reflect this concern about the nature and function of social interaction in L2 learning. For example, Strevens (1987) suggests "bypassing the inescapable intermediary" —the language teacher — and search for valuable resources in the nonacademic community (telephone friendships, national cultural agencies, penpals, etc.). In the same vein, Dough and Ryan (1987) show how the case study method used in the classroom can generate the careful listening to others and the effective expression of one's own ideas so necessary for social interaction (see also Kramsch 1993).[25]

Accordingly, several L2 researchers have investigated the validity of such pedagogical practices. For example, Doughty and Pica (1986) and Long (1985) have proposed that the role of negotiation of meaning in normal conversation is the key factor in the overall process of SLA. Doughty and Pica argue that group and pair work are essential for increasing the amount of student practice time in classroom teaching (avoidance of teacher fronted classes). Most important, group work generates the type of information exchange in which learners engage in conversational modification (clarification requests, confirmation and comprehension checks). This type of modified interaction is argued to be absolutely essential to make input comprehensible, and eventually to lead to successful acquisition of the target language.[26] Accordingly, we have seen that CMC promotes a great deal of linguistic interaction: notice that L2 learners have increased access to language interaction with the target language community. However, is the environment created by computer based telecommunications appropriate to generate the pedagogical conditions of interactions argued by Doughty and Pica?

In the acquisition literature it has been claimed that natural settings are qualitatively better than pedagogically constrained environments (e.g., classrooms) because they provide positive instead of negative evidence (Pinker 1979). For example, Schwartz (1993) argues that natural settings constitute the right language learning environment because "negative data do not figure prominently, if at all... in the input these L2ers receive" (p. 161). But, this is not true. judging by the vast majority of case studies, it is clear that learners resort to a conscious processing of the L2 (at least for highly literate learners who are the normal subjects of these types of studies). This analytic process occurs when students seek to validate their "working hypotheses" with native speakers (or any available data at their disposal). For instance, Schmidt and Frota (1986) analyzed the data from the diaries kept by Schmidt while learning Portuguese in Brazil. Even though Schmidt was actually taking formal classes in Portuguese, he was resistant to the formal teaching of grammar in the classroom: he was an avid seeker of communication opportunities to improve his L2 in the context of natural interaction. At the end of the study Schmidt acknowledged that it is extremely difficult to achieve any degree of success in the L2 unless the adult learner resorts to an active conscious processing of the L2 system. Therefore, it is difficult to uphold Schwartz' argument on the non-effect of negative data: negative feedback seems to have been absolutely necessary for Schmidt and many other literate subjects learning the L2 in the natural setting. On the other hand, if Schwartz prefers to rely on the study of "less literate" subjects, one should remember that there is a wealth of evidence pointing in the direction of less than perfect results even in those circumstances (e.g., Perdue and Klein 1992; Schmidt 1983). Hence, are classroom learners at a disadvantage compared with students who learn the L2 in the natural setting?

According to popular wisdom semester-abroad programs are more successful than regular classroom learning (participants appear to be more "fluent"). However, Huebner (1995) presents some data showing that study abroad students do not seem to be approaching the task of language learning in any way different than they approach regular classroom instruction. Similarly, DeKeyser (1991) argues that such notion of success has been greatly exaggerated: his data show that most students enrolled in programs abroad merely transfer the same learning strategies previously received in classroom instruction. Hence, immersion in the natural language environment (second language versus foreign language learning) is not necessarily the actual determinant of success in L2 attainment. It might be more accurate to say that the natural setting constitutes the environment in which the real causes of success can be better implemented. That is to say, there might be no qualitative differences between classroom-based courses and semester abroad programs. Any differential success could be attributed to different degrees of motivation, amount of exposure to the L2 data, varied settings of language use, heightened communication requirements created by native speakers, interactional exchanges in the target language, etc. Quite clearly, these conditions are normally present in natural settings. But, instead of attributing any "magical effect" to the students' participation in semester-abroad programs, we should define the actual causing factors of success in the L2 to implement sound pedagogical practices in academic environments as well.

DeKeyser claims that there are two major advantages on the side of naturalistic environments. First, they provide the learner with a sort of natural communicative drill because so many communicative contexts keep reoccurring. Gass and Varonis (1994) argue that the interactive nature of negotiation helps learners to focus their attention on the problematic parts of the learners' discourse ("language" as a whole). The results of this heightened attention to the imperfect nature of their IL system, will show up at a later time. Second, natural settings provide learners with a greater variety of contextual information which, in turn, leads to a better integration of language related events in long-term memory (episodic memory). There is no reason to believe that these conditions could not be implemented in regular on-campus courses.[27] In fact, some universities already provide opportunities for immersion-like environments (e.g., Language House programs, language clubs, etc.).[28] However, these programs are very expensive both in terms of financial costs and in terms of human resources. A more effective and efficient alternative is provided by the type of learning environment brought about by computer based telecommunications where the amount and frequency of interaction among users is only limited by the interest of the students themselves.

PEDAGOGICAL USES OF COMPUTER MEDIATED COMMUNICATION

One of the most important features that define a technological tool is the increase in efficiency to perform a given task. Computer based telecommunications offer language teachers an extremely cost-effective medium to generate different types of interaction among students (both in terms of financial investment and time resources). For example, to program a simulation of human interaction requires a lot of effort in time and money; but, to design a communicative-based pedagogical activity, on the internet requires almost no programming effort. Moreover, the results can be more effective especially regarding the access to audiences outside the academic environment. Nevertheless, pedagogical tasks using computer based telecommunications should be carefully designed. For example, without skillful preparation the interaction can be poor and the students can remain passive: real discussion is unlikely to occur without careful planning and preparation (Bates, p. 206). I believe that the implementation of pedagogical tasks in CMC environments should be attentive to two important features of the design process: the nature of interaction among humans (communication paradigm) and the roles of the learner in such interaction (language learning goals).

With respect to the type of communication occurring in CMC environments, I propose that a distinction be made between the concepts of interaction and communication to the effects of providing a better theoretical foundation for the pedagogical uses of internet environments. Reddy (1979) has argued that the concept of communication as the packaging of ideas into language form is a fallacy (the conduit metaphor). Humans do not encode and decode meaning, but they actually construct meaning out of linguistic (and nonlinguistic) interaction (e.g., Frawley and Lantolf 1985). The technical distinction between interaction (mutual or reciprocal action or influence) and communication (a process by which meanings are exchanged between individuals through a common system of symbols) can help us keep in perspective the pedagogical value of Computer Mediated Interaction (CMI) for L2 learning. Information on how to design activities for the L2 classroom around communication/interaction paradigms is available from multiple sources including online references (Frizzler 1995). For example, Paulsen (1995) presents a classification of four types of techniques according to the communication paradigm they represent: information retrieval (one-alone), electronic mail (one-to-one), bulletin boards (one-to-many), and computer conferencing (many-to-many).

Second, to better understand the role of the type of learning associated with CMI it is useful to rely on a framework of reference that defines the various roles of the learner. In L2 learning, Higgins (1988) has identified four learner types (absorber, experiencer, explorer and practitioner) according to a classification of CALL lessons into four types

(instructional, revelatory, conjectural, and emancipatory) (p. 39). The Instructional lesson — typical of programmed learning — is based on the metaphor of the learner's mind as an empty vessel that is to be filled with knowledge: student as absorber. The revelatory lesson presents a structured experience (e.g., a simulation) that will presumably guide the learner towards discovery: student as experiencer. The conjectural lesson sets a series of tasks that the learner must complete (task-based): student as explorer. Finally, the emancipatory lesson provides tools (e.g., online resources such as dictionaries, etc.) to facilitate learning: student as practitioner. The first two types of lessons are the least effective towards learning because the computer takes over the instructional process: the learner is not in charge of learning, but s/he is the subject of teaching (see analysis of Lave and Wenger above). The third and fourth types of instruction are more conducive to learning according to the above discussion. More specifically, the third type of lesson is based on the notion of a pedagogue that guides the learner towards acquisition of knowledge (Zone of Proximal Development, master-apprentice, etc.). On the other hand, the fourth type (emancipatory) does not specify the goals of instruction for the students (learning curriculum of Lave and Wenger). CALL applications and Multimedia environments have created lessons of the first three types mentioned by Higgins (instructional, revelatory and conjectural). On the other hand, I believe that we can assume that CMI environments will be conducive to the types of lesson that generate situated learning (types 3 and 4: conjectural and emancipatory).

The actual design of pedagogical activities based on CMI environments will be tied to the particular goals of the teacher and the students. In this respect, several researchers have already developed a series of basic guidelines that should inform teachers the specific design of pedagogical applications on the internet including online references (e.g., Frizzler 1995; Paulsen 1995; Warschauer 1995). Hence, I will refer the reader to such resources for concrete applications as the analysis of particular techniques lies beyond the scope of this paper. In contrast my goal has been to offer a theoretical rationale for the pedagogical use of CM; environments to enhance L2 acquisition.

CONCLUSION

With the advent of CMI the computer is moving away from the role of substitute teacher to becoming a tool that facilitates the learning process (e.g., Bates 1995; Higgins 1988; Kenning and Kenning 1990; Underwood 1984). However, CMI represents only the medium where this type of learner-centered instruction (the real engine of pedagogical innovation) is thriving. More important, it is not true that "the internet mediates human interaction better than any other medium" (Levy 1995, 27). The fact that a new set of rules of discursive interaction has emerged in the internet does not entail that CMI is more conducive to communication than, for instance, face-to-face interaction.[28] Further

research should implement well-designed studies that assess the effectiveness of CMI environments on the development of second languages as specified in the above mentioned theoretical accounts. More important, future empirical investigations should avoid the pitfalls of some of the original studies on the effectiveness of CAI applications. In particular, experimental studies should include a clear theoretical rationale that guides the investigation, an iterative design that promotes a more encompassing framework of analysis (Gay and Grosz-Ngate, 419), various mechanisms that report on students' participation (journals, videotaped activities, computer tracking tools, follow-up questionnaires, etc.), and the isolation and analysis of discrete grammatical items instead of relying on global measurements of proficiency.

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NOTES

[1] As early as 1988, Higgins state that "computers will gradually enter language classrooms in their most menial roles, as word-processors, as database, …In ten years' time we will look back on this debate and wonder what the fuss was about" (p.103).

[2] Unfortunately, this communicative perspective has not been at the foundation of most widely used programs, which seem still to favor a behavioristic approach.

[3] In fact, it is not surprising that the same single monolithic foundation guides the programs developed in ICALL (see Oxford 1995).

[4] E.g., McLaughlin 1990; Gregg 1984, 1990 *inter alia*. Schwartz constitutes a recent attempt to defend and validate Krashen's view from a formal UG (Universal Grammar) approach (see Gregg 1984 for a critique and Schwartz 1988 for a response). An alternative theoretical position on L2 development is presented in the section on The Research Findings of SLA: immersion Settings.

[5] The lack of a control group does not allow the researcher to rule out the effect of simple exposure to the teaching material as the only cause of increased achievement irrespective of treatment method. The use of both a treatment and a control group shows the incremental effect of instruction with the CALL application versus normal improvement with no treatment.

[6] The fact that the researcher found an effect on the dependent variable in favor of the experimental group does not guarantee that such an effect was caused by the treatment considering the low impact that 12 e-mail messages might have on the outcome of a three-month course.

[7] See Steinberg (1991) for an analysis of the deficiencies of systemic approaches to instructional design (especially pp. 51-79).

[8] Furthermore, researchers in artificial intelligence concede that machines cannot learn from experience the same way humans do (e.g., Weizenbaum 1976).

[9] The whole question is whether "rules" should be sought in the first place. An alternative approach is based on the representation of knowledge in neural networks (e.g., Rumelhart and McClelland, 1986). However connectionist models may also be open to some serious criticisms (see Baumgartner and Payr 1995).

[10] By contrast, most multimedia CALL applications do not attempt to use NSP; thereby, avoiding these problems. However, neither Multimedia nor ICALL can create natural communicative environments that truly represent *human interaction*.

[11] Garrett argues that SLA research has not provided any definitive answer on the use of preferred versus no-preferred learning styles/strategies: would learner s do better if they were taught to use strategies that do not come naturally? (p. 346). However, O'Malley and Chamot (1990) have presented data that show that learners do not seem to respond favorably to the explicit teaching of non-preferred learning strategies. Second, Garret state that "it may be premature to assume that a high degree of learner-centeredness necessarily benefits language learning. Again, we do not have the research evidence to support such as assumption" (p. 347). However, I believe that a learner-centered approach to language learning is supported by a strong theoretical foundation and a growing body of empirical research (for theoretical foundation see Lave and Wenger 1991; Schön 1983; etc; for empirical evidence see DeKeyser 1991; Tarone and Yule 1989; etc.).

[12] However, it is not clear that such a qualitative change may actually happen due to the introduction of multimedia environments.

[13] In fact, Murray implicitly acknowledges such division when she discusses the nature of one of the programs designed by ALLP: "(i)n our most ambitious design, (the) two techniques — keyboard-based conversations and authentic speakers on videodisc — are combined within one exercise" (p.2). That is to say, the author is trying to combine AI and interactive multimedia features of CALL programs.

[14] In this instance the term text is used with reference to the world of meaning created by the receiver (reader) in interaction with the hypermedia environment.

[15] In fact, this idea is not new. The very first goal of the harbinger of the internet in 1950 was to "automate symbol-handling tasks; and thus help people think faster, better…" (Rheingold 1994, 65).

[16] Propositional networks are associative structures of propositions (semantic) which constitute the foundation of connectionist models (e.g. Rumelhart and McClelland 1986).

[17] *El Avión Hispano* (designed by Zulma Iguina, Cornell University) includes full motion video, a composing space for writing, a fortune teller, an in-flight magazine, a thesaurus, grammar help, etc.

[18] The time commitment to learn how to use CALM goes from about four to eight hours.

[19] For example, Dede (1993) mentions that the emergence of the cinema introduced a new "dimension to communication beyond spoken language, written language, and still images" (p. 128). Even though it is true that a new story-telling environment emerged (the narrative style of films is different from written or play narratives) the essence of the story telling process was not altered. In other words, the channel of communication altered the style but not the sociocultural nature of story telling as a human need (Fiske 1990).

[20] Incidentally, research on this type of pedagogically-sound project does not seem to be as attractive as most ALS programs because of the lack of commercial profitability (so far).

[21] To produce language in front of a machine may be less threatening than interacting with another human being; however, only the latter type of language production may possibly qualify as language use. Linguistic exchanges with a computer terminal may just represent language practice (for extended discussion of this topic see the section heading Situated Cognition: Interaction Around the Computer).

[22] L2 learners may become more proficient in the particular type of discourse determined by the restricted communication channel of electronic interaction. In turn, this type of interaction may not necessarily prepare students for successful face-to-face interaction.

[23] The terms in italics have been borrowed from Crook (1991).

[24] The concept of the zone of proximal development (ZPD) of Vygotsky appears to be a necessary tool for the analysis of the types of interactions mentioned by Porter. The ZPD is defined as "…the distance between the actual developmental level as determined by independent problem solving and the level of potential development…under adult guidance or in collaboration with more capable peers" (Wertsch 1985: 273).

[25] In the case study method, students analyze cases (professional or nonprofessional) and they present their findings to the classroom group and/or experts.

[26] However, Sato (1990) argues that clarification requests did not lead her subjects (Tai and Thanh) to the discovery of morphological markers of tense; only lexical markers were incorporated into their IL. Sato argues that there are three possible reasons that may explain those results: past tense verbal inflections in English are not perceptually salient, native speakers tend to produce phonological reductions, and the subjects' L1 does not present consonant clusters in such high frequency as is common in English past tense inflection (p. 91).

[27] There is no need to uphold the acquisition-learning distinction of Krashen and Schwartz (see Gregg 1984; McLaughlin 1990) considering that it is based on the unfalsifiable paradigm of so called conscious/unconscious cognitive processes. I claim that it is not the cognitive structure, but rather the participatory framework of language use that helps adult learners acquire the L2: situated and non-situated cognition (see heading Situated Cognition: Interaction Around the Computer).
[28] Incidentally, to the best of my knowledge, there are not enough published studies that determine whether the students participating in this type of extracurricular on-campus activities achieve the same degree of success attained by semester-abroad students.
[29] This position has obvious pedagogical as well as administrative consequences.

AUTHOR'S BIODATA

Rafael Salaberry is a Ph.D. candidate in Romance Linguistics at Cornell University. His primary research interests include the acquisition of L2 discursive features (aspect, articles, pronouns), critical period effects in L2 acquisition, and the pedagogical value of computer mediated interaction.

AUTHOR'S ADDRESS

Cornell University
Department of Modern Languages
203 Morrill Hall
Ithaca, NY 14853 USA
Phone: (607)272-9311
E-mail: mrs4@cornell.edu