

To appear in Journal of Research on Technology in Education

**A Look at the Research on Computer-Based Technology Use in Second Language  
Learning: Review of Literature from 1990-2000**

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RUNNING HEAD: Computer Use and Second Language Learning

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### **ABSTRACT**

This paper reviews the literature on computer uses in second language and foreign language learning from 1990 to 2000 inclusive. Given the strong interest in technology use for language learning, it is important to look at how technology has been used in the field thus far. The goals of this review are (1) to understand how computers have been used in the past eleven years to support second language and foreign language learning, and (2) to explore any research evidence with regards to how computer technology can enhance language skills acquisition. This paper discusses the findings of said review under the following categories: (a) potentials of computer technology and its use in specific areas, (b) software tools used in certain language skill areas, (c) software design considerations, (d) computerized language testing, and (e) research findings from studies using quantitative and/or qualitative methodologies. Finally, issues of importance for future research are also discussed.

(KEYWORDS: second language learning, foreign language learning, computers in language learning, technology enhanced language learning)

## INTRODUCTION

In the eighties, the application of technology in language classrooms included the use of film, radio, television, language labs with audio/video tapes, computers, and interactive video (Cunningham, 1998). Various types of computer-assisted language learning (CALL) also began to become more commonplace (Iandoli, 1990). Although there were some innovative uses of software such as *MacLang*, the majority of CALL uses were limited, in form, to drill and practice exercises. As the technology advanced, we began to see more interactive uses of CALL as well as an increase in the integration of various media into the computer system (Pusack & Otto, 1990). Computer technology became more accessible to both individuals and schools. Moreover, our growing understanding of its potentials has encouraged a shift in emphasis from computer technology itself to its applications. That is, finding ways to use computers for enhancing teaching and learning has gained prominence in the research. Today, the use of multimedia, the Internet (especially the World Wide Web), and various forms of distance learning are wide spread. Interest in using them as tools to support language learning is growing, both from the perspective of a language educator and that of a language learner.

Given the strong interest in the potentials of computer technology for language learning, it is important to examine how computers have been used to support second and foreign language learning in the past. Our task was, therefore, to review the literature on computer uses in second and foreign language learning from 1990 to 2000 inclusive.

It should be noted that for the purpose of this article, we use the terms "second language" and "foreign language" interchangeably, and have included articles that address both. The technologies examined in this review refer to computer-based technology uses in the classrooms, such as traditional computer-assisted language uses, multimedia technology, and the Internet

(local network or the World Wide Web). Any applications not using computers as a central tool were excluded.

### **RESEARCH PURPOSE**

The questions guiding this research are:

- (1) How have computers been used in second/foreign language learning/teaching for the past eleven years?
- (2) Is there any research evidence on how computer-based technology can enhance language skills acquisition?

By examining the literature, we hope to get a better sense of what we already know from the past research and what we need to know while planning research for the future.

### **METHODOLOGY**

Our intent was to review articles that discussed computer technology in second/foreign language learning/teaching in refereed journals, whether they were data-based or not. Our primary data source was from refereed print-based journals and ERIC documents. We decided not to include, as our data source, doctoral dissertations, master's theses/reports, books, unpublished technical reports, non-refereed articles, and abstracts for two reasons: (1) we wanted to review refereed articles; and (2) we considered it virtually impossible to locate and get copies of all dissertations, books, and technical reports, within the seven months time frame of doing this research project. As a result, a total of twenty-one journals and 246 articles were selected for this review. Table 1 lists the names of the journals, and the number of relevant articles found in each included journal. The bibliography provides a complete list of all the articles reviewed for this project. Most of the literature originated in the United States; however, we have included some international references.

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Insert Table 1 here

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## **FINDINGS**

Given what appeared in the literature from 1990-2000, we sorted the articles into the following categories: (1) non-research based, and (2) research based. The non-research based category included conceptual discussions and project descriptions on (a) the potentials of computer technology and its use in specific areas, (b) software tools used in certain language skill areas, (c) software design considerations, and (d) computerized language testing. This section included some references to a few studies due to an overlap in the subject matter. The research based category included seventy studies using quantitative and/or qualitative methodologies on computer use in second/foreign language learning. The findings section is organized accordingly.

### **Potentials of Computer Technology in Second Language Learning**

A significant amount of literature explored the potentials of computer technology with regards to teaching and learning languages more effectively. Dunkel (1990), for example, asserted that the possibilities of computer technology as a tool could include increasing language learners' (1) self esteem, (2) vocational preparedness, (3) language proficiency and (4) overall academic skills. Furthermore, the benefits of multimedia, the Internet, and various forms of distance education were explored by many others (For example: Armstrong & Yetter-Vassot, 1994; Garrett, 1991; Ruschoff, 1993; Sussex, 1991). Educators were particularly interested in technology's interactive capabilities, such as providing immediate feedback and increasing learner autonomy, in addition to the capability of simulating real-world situations via audio,

video, and graphics (Chun & Brandl, 1992; Hoffman, 1995/1996; Jones, 1991, Legenhausen & Wolff, 1990).

Moreover, discussions of the benefits of computer technology included the exploration of the application of certain technologies in specific language areas. Hypermedia technology with its linking and interactive capabilities was discussed as a tool to enhance vocabulary learning (Liu, 1994), and reading comprehension (Hult, Kalaja, Lassila, & Lehtisalo, 1990). Chun and Plass (1997) considered the potentials of using video and audio to support text comprehension. Kramsch and Andersen (1999) argued that multimedia technology could provide authentic cultural contexts that are important for language learning. Others advocated CALL programs, especially voice-interactive CALL for improving learners' speaking skills (Ehsani, & Knodt, 1998; James, 1996). Computer technology in combination with a conferencing system was considered an effective means of providing goal-directed writing courses tailored to different learning styles (Cornu, Decker, Rosseel, & Vanderheiden, 1990). In addition, Cononelos and Oliva (1993) reported employing usenet and email to connect students in an Italian class with native speakers in order to facilitate discussions on cultural issues. Others shared their personal experiences in using electronic dictionaries for reading and writing (Hulstijn, 2000), and *Web Course in a Box* software to teach German (Godwin-Jones, 1999).

The pedagogical benefits of computer mediated communication (CMC) as facilitated through email and programs like *Daedalus* Integrated Writing Environment (DIWE), became one of the most commonly discussed topics in foreign language literature (Salaberry, 1996). Some language educators implemented this new medium in the classroom and reported on its linguistic and psychological benefits (Beauvois, 1992; Beauvois, 1994; Chun, 1994; Gonzalez-Bueno, 1998; González-Bueno & Pérez, 2000; Kelm, 1992; Kern, 1995; Kroonernberg,

1994/1995; Sullivan & Pratt, 1996; Van Handle & Corl, 1998; Warschauer, 1995/1996). Unlike many individual CALL applications, CMC seems to promote meaningful human interaction that can foster the language learning process. That is, advocates claim that CMC can be an excellent medium for cultivating new social relations within or across classrooms, resulting in collaborative, meaningful, and cross-cultural human interactions among members of a discourse community created in cyberspace (Salaberry, 1996; Warschauer, 1997; Warschauer, Turbee, & Roberts, 1996; Zhao, 1996).

### **Software Tools to Support Specific Skills Acquisition**

Realizing the potentials of computer technology, educators have become more interested in its use as a tool to augment foreign language teaching. Much of the reviewed literature regarding software tools consisted of (1) a description of one or more pieces of software, (2) a description of how this software was integrated into the learning environment, (3) a description of the effects of the software on students, and (4) possible implications for further study (Alderson, 2000; Chávez, 1997; Derwing, Munro, & Carbonaro, 2000; Greenia, 1992; Hellebrandt, 1999; Legenhausen, & Wolff, 1990; Levin, Evans, & Gates, 1991; Nicholas & Toporski, 1993). Evaluative software articles also tended to discuss whether or not software was robust enough for school use. Reading and writing were the most frequently addressed skill areas. Numerous software programs were created in foreign languages such as English, French, Spanish, Italian, German, Japanese, and Russian. English as a second/foreign language was, however, the most commonly discussed target language. The literature seems to indicate that the greatest need for software development is in the areas of listening and speaking since these two areas were found to be sparsely represented.

*HyperCard*. Though commercial software (e.g. *Daedalus*) was the topic of a large number of discussions, many articles discussed the tools created by the researchers themselves using an authoring software program. Such authoring packages, according to Motteram (1990), allow educators to author or write computer-based course materials with little or no computer programming experience. *HyperCard*, a Macintosh authoring program, was the most often cited tool among software researchers/developers (Borrás, 1993; Donaldson & Morgan, 1994; Evans, 1993; Liu, 1994; Nagata, 1998). This may be due to the fact that it is relatively inexpensive, highly accessible, and simple to learn and use for educators. Padilla (1990), for example, reported that “HyperCard is very easy to use and can be directly applied to many aspects of instruction that occur every day in the classroom” (p.224). Donaldson and Morgan added that *HyperCard* was the most cost-effective authoring tool for educators considering its low price and ease-of-use. Moreover, researchers’ comments seem to indicate that they appreciate the “...tradition of sharing within the HyperCard community, a set of ‘manners’ which encourages free and open exchange of program code and thus benefit the novice user” (Donaldson & Morgan, p. 47).

*Daedalus*. Many studies on CMC examined the use of *InterChange*, a component of *Daedalus* Integrated Writing Environment (DIWE), in second language-learning classrooms (Beauvois, 1992; Chun, 1994; Kelm, 1992; Kern, 1995). *InterChange* is a synchronous discussion tool, which allows users to have real-time written conversations and was originally developed to teach English composition and literature for the native speakers of English (Bump, 1990). However, its usage has been expanded to L2 instructions including such languages as French, Spanish, and ESL. One of the most important reasons that *InterChange* has received a good deal of attention from L2 professionals is that it enables students to have meaningful and

authentic conversations with others in the target language. This type of computer-mediated communication (CMC) has become an emphasis in recent language movements due partly to the fact that it promotes students' equal participation in the classroom (Chun, 1994; Kern, 1995; Sullivan & Pratt, 1996). In addition, all the language output produced in the *InterChange* session can be saved and sorted according to the sender so that students can reflect on what they or others say. Thus, learners have an opportunity to monitor their own language production and learn from others' language as well.

*Word Processing.* In addition to specific authorware and commercial software, the literature also addressed broader software categories that included word processors, the Internet, and speech recognition software. Word-processing (WP), the most "low-tech" of the tools, "... is perhaps the most accepted and universal use of computers in education today" (Hyland, 1993, p. 21). Typically, word processing software offers such features as spelling checkers, thesauri, dictionaries, style checkers, and grammar checkers (Levy, 1990). Some researchers asserted that WP tended to increase student enjoyment or appreciation of routine assignments by transforming traditional learning tasks into novel ones (Greenia, 1992; Scott & New, 1994).

Greenia described an early use of a computer-based writing program whereby the class created, shared, and turned in soft copy assignments via a floppy disk. The author asserted that this type of composition process facilitated the formation of communicative writing communities, and transformed the conventionally directive role of the instructor into the position of a facilitator for class discourse. Scott and New (1994) proposed that the development of their word processing program *Système D* helped augment the curriculum by placing a focus on the writing process. Nonetheless, despite such positive reports, "research is unable to confirm that

the quality of computer written texts is superior to conventionally produced work” (Hyland, p. 22).

There were also some negative findings with regards to the use of word processing programs in the language classrooms. For instance, some studies suggested that students seemed to revise less on a computer than with paper and pencil (Hyland, 1993). A possible explanation for the negative results yielded by some research may hinge on the assertion that a student's success depends on his or her word processing skills. That is, in addition to their writing skills, students are also inadvertently evaluated based on their word processing skills. Ritter (1993) suggested that positive changes in writing behaviors required additional training time for students to become accustomed to the use of the software. Hyland proposed that at least one semester of word processing was necessary before improvements in writing from novice computer users could appear.

In addition to word processing programs, there were also two articles on the use of answer mark up software, which allows students to receive computer based feedback/corrections on their writing (Ogata, Feng, Hada, & Yano, 2000; Peng, 1993).

*Internet.* Email, synchronous chat, bulletin boards, HTML, DHTML, XML, and digital video are all examples of internet-based tools currently being used in second/foreign language teaching and learning. The literature provided descriptions of projects such as email exchange (e.g. Hellebrandt, 1999; Kroonenberg, 1994/1995), web publishing (e.g. Bicknell, 1999; Pertusa-Seva & Stewart, 2000), and simulated immersion (e.g. Kost, 1999; Legenhausen, & Wolff, 1990; Nelson & Oliver, 1999; Pertusa-Seva & Stewart, 2000). This particular category of tools is generally lauded in the literature as an opportunity to expose students to authentic, culture-laden contexts to which they are able to respond by speaking and writing in the target

language (Hellebrandt, 1999). For example, email was reported as being facilitative for “...very realistic form[s] of communication because it is a real conversation about real, relevant topics with real people” (Kroonenberg, 1994/1995, p. 24). Email and synchronous chat can enhance communicative language skills (Kost, 1999) and be used as an opportunity to share and collaborate (Hellebrandt, 1999). They are also helpful in developing critical thinking skills (Kroonenberg, 1994/1995). Chat, for example, “cultivates the ability to think and compose spontaneously” (Kroonenberg, p.26). Currently, the literature seems to be exploring how access to current authentic materials and native speakers helps to facilitate a “virtual” submersion of students who cannot physically travel to a host country.

*Speech Recognition Software.* Speech recognition (SR) software requires a user to produce meaningful linguistic units that are then translated by a speech recognition program. The implication for second language classrooms is that a student’s oral abilities can be grammatically analyzed in order to assess oral proficiency levels and to provide students with feedback. Derwing, Munro and Carbonaro (2000) stated that the usefulness of speech recognition software for language students hinges on its ability to (1) recognize nonnative utterances and (2) identify problem areas of student production in order to provide corrective feedback. Thus far, research suggests that SR technology is not sufficiently reliable to justify its implementation into the second/foreign language classroom (Coniam, 1998; Derwing et. al., 2000). Furthermore, Derwing and his colleagues reported that while the SR software they evaluated was able to recognize 90% of the words uttered by native speakers, it was only able to understand between 24% and 26% of the non native speakers’ utterances (p. 597). That is, SR software, in its current form, would provide unreliable feedback to foreign language students.

### **Importance of Applying Pedagogy and Design Principles**

Apart from the reported enthusiasm for using computers, the realization that "...technology is essentially impotent without creative and imaginative application" (Bailey, 1996, p. 73) was ever strong in the nineties. Language educators argued, "it is how we use these tools that will ultimately affect our students and the foreign language curriculum" (Armstrong & Yetter-Vassot, 1994, p. 476).

A number of articles discussed the need to create computer software that is based upon sound pedagogy and language learning theories, while others stressed the importance of applying design principles in developing CALL applications (Allen, & Periyasamy, 1997; Armstrong & Yetter-Vassot, 1994; Collentine, 1998; Masters-Wicks, Postlewate, & Lewental, M., 1996; Oller, 1996; Schwartz, 1995; Van Bussel, 1994). In a series of discussions, Chapelle proposed to ground CALL research and development in interactionist second language learning theory (Gass, 1997), and suggested that computers should be viewed as a participant to facilitate communication and CALL activities (Chapelle, 1990; 1994; 1997). An example of applying the interactionist second language learning theory via the web technology was shown to guide the process of CALL development, data collection, analysis, and interpretation (Hegelheimer & Chapelle, 2000). Chapelle also argued that discourse analysis could describe the interaction between the learner and the computer effectively (Chapelle, 1990; 1997).

Designing pedagogically effective CALL activities became a concern. Hoven (1999) proposed a sociocultural theory based instructional design model for listening and viewing comprehension with multimedia. Watts (1997) suggested a learner-based design model focusing on learners' goals and needs, rather than on the technology itself. In those discussions, the importance of technology enhanced student-centered activities was emphasized. Realizing the

lack of design guidelines for language educators, Hemard (1997) presented some design principles for creating hypermedia authoring applications. The principles included "know[ing] and appreciat[ing] the intended users' needs," "user-task match," and "provid[ing] easy error-solving devices." He suggested considering such factors as technical, authoring, task, interface requirements, when authoring hypermedia language applications. Based upon second language acquisition theory, Chapelle (1998) suggested seven criteria for developing multimedia CALL. They were (1) making key linguistic characteristics salient, (2) offering modifications of linguistic input, (3) providing opportunities for 'comprehensible output,' (4) providing opportunities for learners to notice their errors, (5) providing opportunities for learners to correct their linguistic output, (6) supporting modified interaction between the learner and the computer, and (7) acting as a participant in L2 tasks.

### **Computer Assisted Language Testing**

Computer-assisted language testing (CALT) is generally defined as "an integrated procedure in which language performance is elicited and assessed..." by computers (Noijons, 1994, p. 38). It should be noted, however, that there is some confusion with regards to the terminology used in this area. Computer assisted language testing (CALT) is also referred to as computer based testing (CBT). The abbreviation (CALT) in the literature indicates *computerized adaptive* language testing in some cases and *computer-assisted* language testing in other cases. In this paper, the concept of computer assisted language testing (CALT) is inclusive of computerized adaptive language testing.

Most articles on this topic were discussions of the general benefits and drawbacks of transferring a test from the traditional paper and pencil environment to that of a computer based one. Very few skill specific research studies were found. See Dunkel (1991), Young, Shermis,

Brutten, and Perkins (1996), and Larson (2000) for examples of discussions of computerized testing on skill areas such as listening, reading, and speaking respectively.

Major benefits of using computer testing cited in the literature included the possibility of immediate feedback, individualized testing, and randomization via test banks to increase testing security (Alderson, 2000; Brown, 1997; Dunkel, 1999). The main criticisms were: (1) productive language abilities (i.e. speaking and writing) could not be assessed by current software with an acceptable level of accuracy, (2) lack of computer literacy may disadvantage novice computer users, and (3) limitation in testing formats could lead to decontextualized forms of assessment (Alderson, 2000; Brown, 1997; Dunkel, 1999).

In 1994, Noijons pointed out that CALL literature had largely ignored computer assisted language testing. In 1999, Dunkel asserted, "Today, the question no longer seems to be, 'Should we use or create a CBT [computer based testing] or a [computer adaptive test]?' but rather, 'What do we need to know about computer-based or computer-adaptive testing to design or use such tests'" (p.78). Alderson (2000) supported this assertion by adding that "...the long-prophesied use of IT for language testing is finally coming about," citing such as examples as the Educational Testing Services' computer based TOEFL (p.593). Dunkel (1999) discussed at length issues surrounding the development of computer adaptive language tests, which can be generalized to all computerized tests. Questions such as, "Is CALT appropriate, valid, and reliable?", "Is the equipment needed for the CALT adequate?", and "Is the integrity of scores secure?" were important considerations. The literature indicates that future CALT research will continue to explore the possibilities of computerized adaptive testing (Brown, 1997; Dunkel, 1999; Meunier, 1994; Noijons, 1994) focusing on the following:

1. Innovations provided by Internet based tests

2. The assessment of productive skills-- writing and speaking. (See Larson (2000) for further information on the development of oral testing software, for example.)
3. The employment of self-assessment items on low stakes diagnostic tests (Alderson, 2000; Dunkel, 1999; Larson, 2000),
4. The use of live action simulations (Meunier, 1994).

### **Research Based Studies**

This category was of particular importance and interest to us, as we hoped to find an answer to our guiding research question, "Is there any research evidence on how computer-based technology can enhance language skills acquisition?"

This category included data based studies using qualitative and/or quantitative methods. Of the seventy studies reviewed, thirty-three of them provided theoretical underpinnings for their research. Of these thirty-three, thirteen presented minimal theoretical comments (Beauvois, 1994; Beauvois & Eledge, 1996; Blyth, 1999; Carel, 1999; González-Bueno, 1998; González-Bueno & Pérez, 2000; Grace, 1998a; 1998b; Jackobsdottir & Hooper, 1995; Kern, 1995; Osuna & Meskill 1998; Sullivan & Pratt, 1996; Warschauer, 1995/1996). More ample theoretical frameworks were presented in the other twenty studies (Blake, 2000; Brett, 1997; Chun, 1994; Grace, 2000; Kang & Dennis, 1995; Kasper, 2000; Lam, 2000; Lee, 1997; Liu, 1995; Liu & Reed, 1994; Liu & Reed, 1995; Meunier, 1995/1996; Merlet, 2000; Meskill, 1993; Nagata, 1997; Plass, Chun, Mayer, & Leutner, 1998; Soo & Ngeow, 1998; Sotillo, 2000; Thorson, 2000; Ulitsky, 2000). The studies reviewed are presented in Table 2.

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*Qualitative studies.* Five studies were qualitative in nature. Three of them investigated college level students' reactions to technology while two others looked at high school students' use of the technology. Blyth (1999) and Bradley and Lomicka (2000) examined college students' perceptions and experiences with technology in a computer-assisted language learning environment. Through students' written feedback, Blyth (1999) concluded that successful implementation of new pedagogical approaches in software design and learning activities had to consider the learning context as well as the background of the students. Students coming from a traditional textbook experience that emphasized grammar with drill exercises, would have difficulty adapting to multimedia material that was culturally based. Bradley and Lomicka (2000) found that simply using the computer to generate materials, authentic or not, was not enough. Rather, tasks and activities that involve the use of such materials were found to promote successful learning. In addition, Chávez (1990) determined that technology in combination with tasks that were based on "meaningful interactional purposes" could be used to promote a positive L2 learning environment.

In the Lam (2000) case study, the researcher studied an ESL learner as he created his own web site as a 'space' in which he became part of a community sharing similar interests and experiencing a sense of belonging. Framed within theories of identity, self and shared culture, and community, the study showed the strength of self-directed activities, and the importance of socio-cultural factors in learning a foreign language. Samples of email messages, on-line exchanges and discussions via the web as illustrated in the study provided convincing evidence that the technology could be used to promote writing.

Carel (1999) proposed that high school students could be taught to conduct a 'virtual ethnography' to learn aspects of a language that go beyond verbal utterances. Working with

*Virtual Ethnographer* (software created by the researcher using Macromedia *Authorware*) and using a linguistic speech act model developed by Dell Hymes called speaking, high school students developed an awareness of pragmatic features of French. The study emphasized the importance of training high school teachers in the creation and design of software materials to suit the instructional needs of their students.

*Non-qualitative studies.* While it was simple to identify the five studies that were qualitatively designed, it was not easy to group the remaining sixty-five as purely quantitative studies. Of these sixty-five studies, some research designs were experimental; others reported findings using descriptive statistics. Still, others employed mixed methods, and a sizeable number focused on self-reported data. In addition, the studies regarding CMC included discourse and conversation analyses. These studies focused largely on improving specific language skills or on strategies used to improve global language skills.

Of the many studies examining L2 writing using computers, some investigated specific aspects of writing skills like grammar and grammatical accuracy (Gonzalez-Bueno & Perez, 2000; Liou, Wang & Hung-Yeh, 1992); error feedback (Ogata, Feng, Hada & Yano, 2000; Van der Linden, 1993); the writing process (Thorson, 2000), or the writing environments (Sullivan & Pratt, 1996).

The majority of the studies, however, focused on the development and increase of written communication skills using synchronous and/or asynchronous communication tools. We recognize the genre of writing promoted by the use of CMC is very similar to oral communication in tone, register, and spontaneity. Nevertheless, the language output in CMC is printed and produced via the keyboard rather than orally with the result that there is no evidence

of accuracy in pronunciation, intonation, prominence, and stress. We therefore present the discussion of the CMC studies under the section dealing with writing skills.

The most widely acclaimed benefits of CMC are that it allows more equal and increased participation than in regular face-to-face classroom based activities (Blake 2000; Bump, 1990; Cahill & Catanzaro, 1997; Chun, 1994; Kelm, 1992; Kern, 1995; Sullivan & Pratt, 1996; Warschauer, 1995/1996), positive attitudes (Beauvois, 1994), greater student empowerment and decreased teacher control and dominance (Kern, 1995; Sullivan & Pratt, 1996), and a wider variety of discourse functions and interactional modifications (Chun, 1994; Sotillo, 2000). Other advantages of CMC include increased opportunities for individualized instruction leading to more attention to diverse students' needs.

Though there was an increase in the quantity of language output in an online discussion classroom using a synchronous conferencing tool such as *InterChange*, there were mixed results with regard to the syntactic complexity of language output. For example, Chun (1994) and Kern (1995) found that students produced a higher proportion of simple sentences than complex ones in the *InterChange* session, while Warschauer (1995/1996) found that the language output produced in the online discussion received higher values on syntactic complex measure and lexical range measure, than the face-to-face oral discussion. Asynchronous communication using e-mail also received positive reactions (Liaw, 1998; Gonzalez-Bueno, 1998; Gonzalez-Bueno & Perez, 2000; Van Handle & Corl, 1999; Donaldson & Kotter, 1999) and specially designed software to promote writing skills were generally found to be helpful (Nicholas & Toporski, 1993).

Thirteen studies focused on reading. Some research assessed the value of computer assisted reading (Hong, 1997). However, two aspects of reading received the most attention by

research: the use of glossing formats and the acquisition of vocabulary. Glossing formats are aids used to assist the reader in understanding the meaning of words or phrases. The effects of various forms of glosses received attention (Adair-Hauck, Willingham-Mclain, & Youngs, 1999; Davis & Lyman-Hager, 1997; Lomicka, 1998; Nagata, 1999). The second aspect that received major attention was the acquisition of vocabulary for supporting reading comprehension (Chun & Plass, 1996; Grace 1998a; 1998b, 2000; Kang & Dennis, 1995; Liu, 1995; Liu & Reed, 1995; Van Bussel, 1994). Studies showed that computer supported glossing formats proved to be helpful in developing reading proficiency, and that vocabulary learning could be greatly enhanced by incorporating a variety of annotations for words through visual media in multimedia technology.

Six studies investigated how technology could be used to promote speaking skills (Borrás, 1993; Coniam, 1998; Derwing, Munro, & Carbonaro, 2000; González-Edfelt, 1990; Johnston & Milne 1995; Liaw, 1997). Liaw's (1997) research described a group of students using computer books and the conversations that took place as they read them. The study found that as the students became more prolific readers, their discussions shifted from dealing with technological difficulties to the content of the books. Furthermore, the study suggested that for meaningful discussions to take place, learners must have something to talk about. Computer books could provide the content on which discussions could evolve.

Borrás (1993) and Johnston and Milne (1995) found that the multimedia software allowed for an increase in meaningful communicative exchanges. Coniam (1998) and Derwing, Munro, and Carbonaro (2000) addressed the use of speech recognition (SR) software to draw attention to production errors for foreign language learners. Results, thus far, seem to indicate that SR software shows a great deal of promise; however it is currently not feasible for use in

foreign language learning due to its inability to provide reliable feedback on non-native speaker utterances.

Three studies focused on the development of listening. Brett (1997) examined the usefulness of multimedia technology over simple audio and video equipment in promoting listening skills and concluded that multimedia could appeal to different modalities and hence may more effectively deal with different learning styles. Jakobsdottir and Hooper's study (1995) had a unique focus. They used a modified Total Physical Response method to gauge elementary students' listening skills. Students selected buttons and graphics on a computer screen in response to commands given in Norwegian. They concluded that providing congruent text with spoken words facilitated acquisition of listening skills, at least for these elementary students. Merlet (2000) examined the effects of lexical and semantic previews on comprehending a computerized illustrated dialog and found that semantic previews improved information recall.

The remaining twenty-three studies looked at other areas of language and technology use. Four examined combined skills like reading and writing (Nagata 1998), writing and culture (Lee, 1997), and global/holistic language development using websites (Kubota, 1999; Osuna, 2000). The review found one study that focused on culture learning (Osuna & Meskill, 1998); one that examined students' evaluation of the computer tools (Olivia & Pollastrini, 1995), one that surveyed students' opinions of the technology (Lee, 1998), one that looked at how educators across the state of New York used the technology (Meskill & Mossop, 2000) and one that focused on a software designer as he moved through stages of task design (Wolach, 1994). Eleven studies dealt with various learning strategies that can be enhanced by using technology. These studies focused on computer instruction in grammar over teacher instruction (Nutta, 1998), working in pairs or alone (Chang & Smith, 1991); autonomy (Sciarone & Meijer, 1993);

student interactions (Meskill, 1993); comparisons between using and not using multimedia or intelligent computer instruction (Nagata, 1996; 1997; Soo & Ngeow, 1998); adult learning strategies (Ulitsky, 2000); strategies in using voice hints (Ikeda, 1999), different modes of instruction (Plass et al, 1998); students' learning styles and learning strategies (Liu & Reed, 1994); and the use of multimedia to encourage linguistic, metacognitive, socio-affective and academic skills, (Kasper, 2000).

Chang and Smith (1991) compared students working in pairs in front the computer and students working alone and found no difference in language gains between the two groups. Meskill (1993) looked at interactions between non-native speakers of English and native speakers and found a tendency for conversation to be dominated by the native speakers. In their study on learner autonomy, Sciarone and Meijer (1993) found that full autonomy to use the technology did not ensure completion of tasks since the students needed feedback and structure to complete the assignments. Others compared classroom performances with or without the use of multimedia (Nagata, 1997; Soo & Ngeow, 1998) and found that different learning situations required different pedagogical approaches. The teacher in a multimedia environment needed to assume the role of a facilitator, resource advisor and may have to dedicate more time to one-on-one teacher-student interactions.

While students' perceptions and attitudes toward technology were examined as part of the research focus in many studies, two studies focused entirely on students' attitudes toward computer use in a language learning classroom. Beauvois and Eledge (1996) examined the attitudes of university students toward using a synchronous tool and found that most of students, regardless of their personality profiles (by Meyers-Briggs Type Indicator personality test), perceived computer assisted classroom discussion to be beneficial linguistically, affectively, and

interpersonally. In a similar survey study, Meunier (1995/1996) found that computer based learning was more strongly related to personality differences and mastery in using the keyboard than to gender differences.

## DISCUSSION

### Computer Use in Second Language Learning from 1990 to 2000

So, "How have computers been used in the past eleven years to support second and foreign language learning?" It is clear that the benefits of CALL have been widely accepted and educators agree that it can be an effective instructional tool. Both CALL advantages and limitations were explored and discussed with regard to its applications in various skills areas, with reading and writing as the two most frequently explored areas. The interest in technology appeared to center on the multimedia capabilities of providing authentic learning situations, and local or distant networking capabilities (such as email, synchronous and asynchronous exchange as in *Daedalus*) for facilitating written communication. The use of the WWW in language classrooms has increased in recent years.

In the early 1990's, some critics still questioned the value of computer technology and the value of implementing it into the foreign language classroom. At present, the focus is not on whether to accept computer technology. Rather, research is now centered on how to integrate it more effectively into the learning/teaching of languages. The research focus has shifted from simply describing and examining computer technology to exploring how to use it in order to enhance language learning. Educators have realized that effective use of technology can influence student learning.

Apart from software such as *Daedalus*, commercial word-processing and email programs, researcher-developed tools (using authoring programs) represented the majority of the tools

discussed in the literature. There has been a growing concern that quality software must be grounded in language learning theories and design principles. The same pedagogical principles that guide teachers in designing classroom activities catering to gender differences and learning styles in culturally contextualized situations must also guide software design.

Few articles, however, dealt with teacher/faculty training for using technology. Daud (1992) provided some suggestions to help teachers use technology more comfortably in training. Bowman, Boyle, Greenstone, Herndon and Valente (2000) suggested such applications as a peer mentoring program via the Internet to allow opportunities for online reflection for teachers. Motteram (1992) proposed that the inclusion of technologies in teacher training helps to enable "...teachers to become more critically aware of available software" (p. 149).

### **Research Evidence on Computer Use in Second Language Learning**

"Is there any research evidence on how computer-based technology can enhance language skills acquisition?" Research from 1990-2000 provided some evidence on the effectiveness of computer technology in second language learning. Findings from numerous studies suggested that the use of visual media supported vocabulary acquisition and reading comprehension, and helped increase achievement scores. The use of online communication tools has been shown to improve writing skills in a number of studies. Studies on using *Daedalus*, in particular, showed that its use allowed all learners to have an equal opportunity to participate.

The National Standards for foreign language teaching urges teachers to place equal emphasis on all skills (ACTFL, 1997). The standards provide suggestions and guidelines for developing activities to promote speaking and listening. Computer technology holds the promise and potential for offering ways in which teachers can help students improve their oral and listening skills. Yet, only a few studies focused on listening and speaking. Instead, most of the

studies addressed reading and writing skills. The imbalance is obvious. Even in the field of reading, can technology offer support that goes beyond vocabulary understanding and retention? Can it be used to promote higher level reading skills such as inferencing, transferring, synthesizing, or summarizing?

Though there has not been convincing evidence on the use of computer technology to improve language skills in all areas, the majority of the studies reviewed indicated enthusiastic responses and positive attitudes toward technology use from the students. Ritter (1993), for instance, reported that 92% of the students preferred learning new vocabulary using a computer program since they considered it “good fun;” and “88% regard[ed] it as a good addition to more traditional ways of vocabulary acquisition...” (p.66). Students’ anxiety levels were reported to be lower when they used the technology and when their anxiety level was lowered, students became more active participants in the learning process.

There were some exceptions. For example, students who participated in the Oliva and Pollastrani's study (1995) expressed a preference for classroom discussions over working at the computers. Nevertheless, students generally reported enjoying the autonomy of working alone and at their own pace afforded by computer-based technologies. However, two studies seemed to suggest that autonomy and self-direction did not necessarily lead to improved language learning (Sciarone & Meijer, 1993; Soo & Ngeow, 1998). Still, it appeared that students liked internet activities that allowed for social interaction with both native and non-native speakers (Donaldson & Kotter, 1999; Lee, 1997,1998; Osuna, 2000; Van Handle & Corl, 1998).

Why were the researchers so concerned about students' reactions to using the technology? A probable explanation is that because the technology is relatively new, using it presents a shift from traditional classroom instruction. If the shift is too drastic and students perceive the change

negatively, there may be resistance that could result in poor performance. Since students are consumers of the new educational tools, their perceptions and evaluations are essential to ensure quality instruction. Positive affective states (i.e. enjoyment, anxiety) can provide additional incentive for students to learn. Although second language acquisition theorists do not unanimously agree on the impact of affective factors on language acquisition, most research concedes that there is a relationship/correlation between the two (Ellis, 1992). A positive emotional state like enjoyment and decreased anxiety could help increase student enthusiasm for a subject matter so that “Learning happens- perhaps not effortlessly, but at least willingly” (Donaldson & Morgan, 1994, p.56).

Many studies reviewed had clear theoretical underpinnings, which were not apparent in the others. Some studies employed pre- and post- tests, semester exams, and e-mail messages, where concrete evidence on whether language skills were improved or not was clearly presented. The use of well-established measures with clear reliability and validity information was, however, minimal. Many studies relied on students' self-reports with small numbers in responses and provided little reliability information on the instruments used. One concern with regards to using such informal reports as the main data source for informing educators is that it is possible to come to the wrong conclusions. A student, for example, may think, "My language improved through interacting with an e-mail pal," without considering that he or she may be using a great amount of language incorrectly. Some researchers questioned the measures used and called for research grounded in second language theories (Chapelle, 1997). It is also important to point out that the majority of the studies reviewed occurred at a college level, with few in the K-12 setting.

### **Implications for Future Research**

Given what was found in the literature, the following are important issues to address as we plan for future studies in second language learning.

- Research needs to have a solid foundation in theories;
- Software needs to be based upon relevant pedagogical and design principles for them to be effective;
- Studies need to use well-established and reliable measures;
- Research focus should go beyond anxiety, attitudes, vocabulary acquisition, language production;
- More research needs to be conducted in the less explored skills areas such as speaking, listening, and culture;
- More research needs to be conducted at the K-12 level.

Language learning is a multifaceted social and cultural phenomenon, even more so when it involves new technologies that promote a variety of social interactions (Kern & Warschauer, 2000). Studies employing both quantitative and qualitative measures are needed to explain the complex interaction of social, cultural, and individual factors that shape the language learning process in a computer assisted environment. In-depth studies which address contextual factors such as types of learning tasks and teacher's beliefs about language learning (Warschauer, 2000) could provide valuable information for implementing the new technology and further enrich our knowledge of the language learning process in this unique environment.

The majority of the studies reviewed from 1990 to 2000 attempted to show the advantages of using computers in the classroom, with a few exceptions. Rather than focusing on the benefits and potentials of computer technology, research needs to move toward explaining how computers can be used to support second language learning—i.e. what kinds of tasks or

activities should be used and in what kinds of settings. Such contextual factors can significantly influence the process of L2 learning in a technology supported environment. The importance of research in this direction is well emphasized by Salaberry who asserted, “the alleged pedagogical benefits of computer networking in language learning and teaching may not be realized as expected because previous pedagogical claims in computer networking focused primarily on the technological capabilities of the new medium and neglected to analyze the pedagogical design of instructional activities” (2000, p. 29). Although the aforementioned quotation is directed toward computer networking use, it may also be applied to other areas of computer use in second language learning as well. Chun (1992) might also add, “We need to develop foreign language software beyond the typical drill-and-practice stage and begin to foster more genuine conveying of messages, negotiation of meaning, and understanding of how form affects communication” (p.263).

## **ACKNOWLEDGEMENT**

The authors wish to acknowledge the assistance of Charla Neuroth in searching and gathering the articles for this research project.

Table 1. Names of the journals, and the numbers of the relevant articles included

<b>Name of the Journal</b>	<b>Total # of Articles (1990-2000)</b>	<b>Number of Articles Relevant</b>
Modern Language Journal	284	13
CALICO Journal	184	69
Computers and Education	581	15
Computers and the Humanities	333	2
Computers in human behavior	383	5
Computers in the Schools	295	12
Educational Psychology	563	1
Educational Technology Research & Development	243	4
Foreign Language Annals	368	34
Journal of Computer Assisted Learning (1999-2000) <sup>1</sup>	114	2
Journal of Computer-Based Instruction (discontinued in 1993)	91	0
Journal of Educational Computing Research	382	13
Journal of Educational Multimedia and Hypermedia (1995-2000)	62	1
Journal of Educational Technology Systems	269	2
Journal of Interactive Learning Research (1997-2000)	66	1
Language Learning and Technology (online,1997-2000)	34	21
System	343	32
TESOL Journal	118	10
TESOL Quarterly	278	9
<b>Total</b>	<b>4981</b>	<b>246</b>

<sup>1</sup> It has been published since 1985, but only starting in 1999 with vol. 15, No.1 was it available via the Web. Since its hardcopy is not available at the Univ. of Texas-Austin, we included it since 1999. Its information can be accessed at URL: [www.blackwell-science.com/jca/ab](http://www.blackwell-science.com/jca/ab)

Table 2. Research Studies on Computer Use in Second Language Learning

No	Reference	Research Focus	Technology Used	Sample Size & Grade Level	General Findings
1	Adair-Hauck Willingham-Mclain, & Youngs (1999)	Reports findings of an assessment of the integration of technology enhanced language learning into a second semester college-level French course	<i>Dasher</i> , instructional videos, online spell-checker, and online French/English Glossary	33 second semester French students	In reading and writing and on overall achievement tests, students with technology enhanced language learning outperformed those who were in a traditional learning environment.
2	Beauvois (1994)	Attitudes and motivation toward computer assisted classroom discussion	InterChange (Daedalus)	41 college students in third semester of French course	Students reported the positive attitudes and motivation in the use of CACD.
3	Beauvois & Eledge (1996)	Personality types and students' attitudes toward CMC	Interchange (Daedalus)	19 students in an intermediate French course	Students' perceived benefits from linguistic, affective, interpersonal perspectives
4	Blake (2000)	Negotiation in the electronic discussion	RTA (Remote Technical Assistance)-a synchronous chat program	50 intermediate L2 Spanish learners at college level	Jigsaw tasks promote negotiations in synchronous electronic discussion
5	Blyth (1999)	Implementing a culture based Language program	CD-ROM multimedia and Internet	216 college level, beginning French	Students showed overwhelming support for the multimedia program, but felt that cultural activities were a distraction from "more important" grammar and vocabulary lessons.
6	Borrás (1993)	Chronicles the development and evaluation of PSF software, a multimedia program designed to assess the effects of subtitled video on oral communication	<i>Practicing Spoken French (PSF)</i> authored with HyperCard 2.1 and Voyager VideoStack	44 college students in an intermediate French reading conversation course & an intermediate French Reading course	<i>PSF</i> has some limitations; however, overall, it was determined to be an effective FL learning/teaching tool (e.g. <i>PSF</i> created a meaningful learning context and provided a tension-free environment).
7	Bradley & Lomicka (2000)	Learner reaction to technology	Computer-enhanced classroom	5 undergraduate French an Spanish students	Students enjoyed learning with computers. They found lab environment more relaxed than learning in traditional classrooms.
8	Brett (1997)	Which medium is better to teach listening skills?	CD-ROM- English for Business	49 college advanced English learners	Gains in learning in multimedia environment were reported
9	Bump (1990)	Effects of a real time networking program (InterChange) in the classroom discussion	InterChange (Daedalus)	18 students in a freshman English class; 33 seniors of English; 12 graduate students of English	Increased student participation, esp., equal participation from those traditionally marginalized including women and shy students.
10	Cahill & Catanzaro (1997)	To compare the writing performance of students enrolled in on-line Spanish course with those enrolled in traditional classroom-	Electronic messaging system, multimedia, & the world wide web	1 <sup>st</sup> year university Spanish students 43 students in traditional courses & 20 students in the online class (N=63)	"On-line" students outperformed students who were enrolled in traditional classroom-based sections

		based sections of Spanish			
11	Carel (1999)	Students using ethnographic procedures to learn pragmatic features	Multimedia	20 High school students learning French	Giving students a framework to understand pragmatic features can help them learn
12	Chávez (1990)	1 Of 3 research questions was relevant: What types of primary or second language story writing patterns will develop within the Writing To Read (WTR)/ESL classroom.	Word processing in WTR laboratory	3- 1st and 2 <sup>nd</sup> grade limited English proficient students	“The WTR Lab promoted a positive environment for developing oral L2 skills by using English for meaningful interactional purposes” (p.140).
13	Chang & Smith (1991)	Which is better? Using CALL working alone or in pairs?	Computer based interactive video	113 beginning Spanish college level	No significant difference between the two was found
14	Chun (1994)	The use of computer assisted classroom discussion and acquisition of interactive competence	Interchange (Daedalus)	23 Advanced college level German students	The data show that CACD provides excellent opportunities for foreign language learners to develop their discourse skills and interactive competence.
15	Chun & Plass (1996)	How well is vocabulary learned incidentally when the task is reading comprehension? How effective are different types of annotation? What is the relationship between look-up behavior and performance on vocab. tests?	Cyberbuch for German	160 college level students studying German	There is a higher rate of incidental learning when the task is reading comprehension. Picture and text annotations seemed to be more effective than video and text or text alone. There is a correlation between look-up behavior and performance.
16	Coniam (1998)	Explores the potential for the use of speech recognition technology to test the oral proficiency of ESL learners	Speech recognition software	N=20 (10 native speakers and 10 nonnative speakers of English)	Speech recognition software is not developed sufficiently to provide reliable feedback on nonnative speakers’ speech since software has to be trained to individual speakers
17	Davis & Lyman-Hager (1997)	How helpful is the use of glossing?	Computer-based text on software authored by the researchers based on the Bernhardt model of L2 reading	42 third semester French students	Students liked using the glossing, but there was no evidence that it enhanced comprehension
18	Derwing, Munro, & Carbonaro (2000)	Does popular speech recognition software work with ESL speech?	Automatic Speech Recognition Software	N=30 (speakers) N=41 (listeners)	SR software is not feasible for FL students since it recognizes only a low percentage of non native speaker utterances
19	Donaldson & Kotter (1999)	Using Internet to increase language skills	MOO	13 US college students in US and 8 German adults in Germany.	Overall positive responses reported by students. Interacting with native speakers in both countries helped increase language use.
20	González-Edfelt (1990)	Explores the computer as a tool for verbal/social interaction	The computer (in general)	16 students from 2 fifth-grade bilingual classrooms from two	Computer activities lead to increased collaborative interaction among

		(i.e. students' preference to work in groups at the computer). Can the computer provide opportunities for student interaction?		schools	participants
21	González-Bueno (1998)	Effectiveness of using e-mail in foreign language learning	E-mail	50 students of first and second semester Spanish at college level	Greater amount of language production and language functions and higher level of accuracy in discourse of e-mail
22	González-Bueno & Perez (2000)	Grammatical and lexical accuracy and quantity of language using e-mail	E-mail	30 community college students from two Spanish 111 classes	Significant advantages of using E-mail over the paper-and-pencil based dialogue journal in terms of quantity of language, but no advantages in lexical and grammatical accuracy.
23	Grace (1998a)	CALL and gender differences in vocabulary retention and access to translations	CD-ROM with French program	181 college level first year French	CALL is equally beneficial for both males and females.
24	Grace (1998b)	Vocabulary retention and personality types	CD-ROM and French program	181 college level first year French	No significant differences
25	Grace (2000)	Personality types and vocabulary retention	CD-ROM in French	181 first year college level French students	A combination of contextual and definitional approaches will increase retention
26	Hong (1997)	Can multimedia help improve reading?	Software for Business Chinese	20 students at college level	Computer assisted reading is more effective in improving L2 student learning than conventional reading methods.
27	Ikeda (1999)	Learning strategies on using sound hints	Drill-type CAI	21 students studying Japanese	Upper and lower level students used sound hints differently
28	Jakobsdottir & Hooper (1995)	Text and gender in Listening Comprehension	Computer-based lessons	109 elementary students learning Norwegian.	Congruent text with spoken words facilitates development of listening skills
29	Johnston & Milne (1995)	Scaffolding L2 communicative discourse using software <i>The Teacher's Partner</i>	A multimedia tool with communicative exchanges	15 1 <sup>st</sup> year French and 28 2 <sup>nd</sup> year French high school students	The software created increase in communicative discourse among teacher and students
30	Kang & Dennis (1995)	Can CALL improve vocabulary learning?	Program authored in Hypercard	76 Korean elementary students	Improved long term vocabulary retention
31	Kasper (2000)	Content-based pedagogy for developing literacy	E-mail and electronic bulletin	50 ESL college level, multi-ethnic backgrounds	Outperformed students in other ESL classes.
32	Kelm (1992)	Descriptive report on use of computer assisted classroom discussion	InterChange (Daedalus)	15 native speakers of English learning Brazilian Portuguese at college level	Increased participation from all of the students in the electronic discussion
33	Kern (1995)	Effects on students' participation and language output in the electronic discussion	InterChange (Daedalus)	40 students in French 2 at college level	Increased participation and increased language output in the electronic discussion
34	Kubota (1999)	Description of 4 WWW projects	WWW	14 college level Japanese students	Students' response showed excitement; overall improvement in language

					skills
35	Lam (2000)	Use of Internet for writing	WWW	One male ESL student	Dramatic improvement in writing
36	Lee (1997)	Internet and its advantages for foreign language learning	Communication with native speakers via internet	124 college Intermediate level Spanish students	Self-reported greater motivation and more cultural information
37	Lee (1998)	Internet to enhance skills Survey of experiences	On-line chat and on-line newspapers	62 Spanish college level	Positive results and improved learning
38	Liaw (1997)	Using computer books in an ESL class to encourage discussions	Computer books	14 ESL elementary school students	As more books were read, more discussions of stories increased
39	Liaw (1998)	Efficacy of integrating email into EFL classrooms	E-mail	52 EFL college students in Taiwan	The use of email encouraged greater communicative use of the L2.
40	Liou, Wang & Hung-Yeh (1992)	Can Grammatical CALL help EFL writing?	Researcher created, drill & practice courseware	42 EFL students, 1 <sup>st</sup> year university students	Combination of instruction and CALL seems to contribute to L2 learning more than just traditional instruction alone.
41	Liu (1995)	Contextual aids via hypermedia technology & vocabulary learning	Hypermedia with videodisc	63 ESL students, college level	When target words were less familiar, access to contextual aids increased significantly. When words were unfamiliar, more video context was accessed. No indication that contextual aids access was correlated with performance scores.
42	Liu & Reed (1994)	This study examined the different learning strategies by Field-independent and field dependent students in a hypermedia assisted language learning environment.	Hypermedia with videodisc	63 international students studying English in a university Intensive English Program	Students with different learning styles used different learning strategies and hypermedia can accommodate students' needs through its rich environments
43	Liu & Reed (1995)	Hypermedia & vocabulary learning	Hypermedia with videodisc	63 ESL students, college level	Achievement scores increased significantly from pre-to post-, across all learning style groups. Computer anxiety was reduced and attitudes increased significantly
44	Lomicka (1998)	Investigated the effects of multimedia reading software (that provided glosses) on reading comprehension	<i>Glossing Authentic Language Texts (Galt) program</i> adapted from <i>Une vie de Boy</i> software	12 second semester French students at a university	"...computerized reading with full glossing may promote a deeper level of text comprehension" (p.41).
45	Merlet (2000)	Effects of lexical and semantic previews on comprehension of a computerized illustrated dialog	Computerized illustrated dialog	30 French undergraduate students of English as a foreign language	Lexical preview decreased frequency of control actions while listening; semantic preview improved quality of info recalled
46	Meskill (1993)	Student interactions while working at the computers	Computers	12 ESL college level	Very little interaction
47	Meskill & Mossop (2000)	To characterize what language professionals and mainstream Teachers do well with	CALL, word processing, reference tools, presentation software	ESL learners in the State of New York: from elementary thru high school	Computers are used in socio-collaborative ways

		technologies			
48	Meunier (1995/1996)	Gender, personality type and keyboard control	Carmen Santiago Software	60 second year college level French	Personality more than gender affects keyboard control and language learning
49	Nagata (1996)	Intelligent computer versus workbook grammar instruction	CALI computer instruction in grammar	26 college Japanese students	Computer instruction is more effective for teaching grammatical skills & intelligent feedback is important
50	Nagata (1997)	Computer assisted meta-linguistic instruction to teach grammatical structures	2 programs to test students' use of the Japanese particle	14 second year college students studying Japanese	Computer exercises with metalinguistic feedback helped students understand complex grammatical concepts
51	Nagata (1998)	Examines the effectiveness of computer-assisted comprehension practice (input) and production practice (output) on second language acquisition	2 programs called Banzai: Honorifics, which was developed in HyperCard by the researchers	14 students in a second semester Japanese course (university)	Output focused practice is more effective than input-focused practice for the development of the production of Japanese honorifics and is equally effective for the comprehension of said honorifics
52	Nagata (1999)	Effectiveness of glossing formats	Software authored by researcher	26 college students, second semester learning Japanese	Multiple choice glossing with feedback is useful
53	Nicholas & Toporshi (1993)	Using a program with Russian film clips to promote speaking and writing	Program authored in ASYMETRIX TOOLBOOK	Students from different learning Russian	Students still need teacher's feedback and support
54	Nutta, (1998)	Computer-based grammar instruction and teacher Instruction	CALL and ELLIS	53 ESL students college level	Computer-based grammar instruction was reported to be effective and in some cases more effective than teacher instruction
55	Ogata, Feng, Hada, & Yano (2000)	Describes a markup-based communicative correction system called Communicative Collection Assisting System (CoCoA)	Communicative Collection Assisting System (CoCoA)	N=6 in a Japanese language learning class at Fukui Prefectural University in Japan	CoCoA is an effective environment for learning writing for foreign language students
56	Oliva & Pollastrini (1995)	Self-assessment of skills and evaluation of tools	E-mail, Usenet, Gopher, IRC	88 advanced Italian college level	Internet found most helpful. Most students reported improvement
57	Osuna, (2000)	What happens when students used the Internet to gain cultural knowledge	WWW, PowerPoint	23 college level Spanish students	Learning can be assisted by computers when tasks are framed within a socio-constructivist model.
58	Osuna & Meskill (1998)	Role of Internet and cultural learning	Internet	13 beginning students of Spanish, college level	Great enthusiasm and increased learning
59	Plass, Chun, Mayer, & Leutner (1998)	For whom is multimedia instruction effective?	Interactive multimedia	103 college level students studying German	Performed best with both visual and verbal modes of instruction
60	Sciarone & Meijer (1993)	Does autonomy lead to improved Language learning?	Computer Aided Learning systems	30 adults seeking admissions to a Dutch University	Freedom to work at the computer did not lead to gains in language learning
61	Sotillo (2000)	Comparison between synchronous and asynchronous chat in	IRC (Internet Relay Chat) and the discussion forum on	25 students from two advanced ESL writing classes	Wider variety discourse functions in synchronous discussion, but syntactically

		discourse functions and syntactic complexity	the World Wide Web		more complex language output in asynchronous discussion
62	Soo & Ngeow (1998)	Can students working with Interactive media perform better than those in a regular classroom?	ELLIS	188 college level preparing for TOEFL	Better performance on TOEFL by the multimedia group
63	Sullivan & Pratt (1996)	Comparing two ESL environments: a computer-assisted classroom and a traditional classroom	Interchange (Daedalus)	38 students second year ESL in Puerto Rico	Positive attitudes of students Significant gains in writing, but no significant differences in oral discussions
64	Thorson (2000)	Differences in writing in L1 and L2	J-Edit, a word-processing program	18 students of German at college level	Students wrote less in L2, but revised more than when writing in L1.
65	Ulitsky (2000)	Adult learning strategies in a multimedia environment	<i>Destinos</i> in Spanish and <i>French in Action</i> on laserdiscs	27 pre-service and in-service teachers	Participants preferred interacting with real-people in real situations. They needed feedback.
66	Van Bussell (1994)	A series of experiments aimed to help derive design guidelines from work on computer-supported learning of vocabulary in a second language (English)	Computer based word translation tests created by the researcher	Experienced and novice language learners from Dutch elementary students to Dutch university students	Seven specific rules are identified, focusing on the idea that "...instruction and training should aim at the enhancement of the quantity and quality of elaborative learning activities" (p.63).
67	Van der Linden (1993)	Feedback and language learning-- Does it help improve writing?	CALL for French	23 students first year French, college level	Simple short feedback with little explanation was preferred over lengthy involved explanations
68	Van handle & Corl (1999)	Use of e-mail	E-mail and Internet	Not stated	Richer oral exchanges, increase in new vocabulary & better compositions
69	Warschauer (1995/1996)	Equality of student participation in face-to-face vs. electronic discussion	InterChange (Daedalus)	16 students from an advanced ESL composition class at college level	More equal participation in the electronic discussion
70	Wolach (1994)	Shows how a software developer can be used as the subject in a series of experiments to determine parameters for a program that presents English to Spanish and Spanish to English word pairs	<i>PresenPr.EXE</i>	1 software developer	A test with feedback should be administered for a given lesson at 5 to 10 day intervals. Lessons that occur in 3 consecutive days are more effective than repeated lessons on one day. Order of presentation does not seem to matter.

## BIBLIOGRAPHY

\* References reviewed and cited in the text

\*\*Reference not reviewed but cited in the text

\*\*ACTFL. (1997). *National standards in foreign language education*. Yonkers: American Council on the Teaching of Foreign Languages.

\*Adair-Hauck, B., Willingham-McLain, L., & Youngs, B. E. (1999). Evaluating the integration of technology and second language learning. *CALICO Journal*, 17(2), 269-306.

\*Alderson, J. C. (2000). Technology in testing: The present and the future. *System*, 28(4), 593-603.

\*Allen, J., & Periyasamy, K. (1997). Software engineering principles applied to computer assisted language learning. *CALICO Journal*, 14(2-4), 34-49.

Arias, J., A., & Bellman, B. (1990). Computer-mediated classrooms for culturally and linguistically diverse learners. *Computers in the Schools*, 7(1/2), 227-242.

Arias, M. B. (1990). Computer access for Hispanic secondary students. *Computers in the Schools*, 7(1/2), 243-256.

\*Armstrong, K. M., & Yetter-Vassot, C. (1994). Transforming teaching through technology. *Foreign Language Annals*, 27(4), 475-486.

Bader, M. (2000). Choosing CALL software: Beginning the evaluation process. *TESOL Journal*, 9(2), 18-22.

\*Bailey, J. (1996). Teaching about technology in the foreign language class. *Foreign Language Annals*, 29(1), 82-90.

\*Beauvois, M. H. (1992). Computer-assisted classroom discussion in the foreign language classroom: Conversation in slow motion. *Foreign Language Annals*, 25(5), 445-464.

\*Beauvois, M. H. (1994). E-talk: Attitudes and motivation in computer-assisted classroom discussion. *Computers and the Humanities*, 28, 177-190.

\*Beauvois, M. H., & Eledge, J. (1996). Personality types and megabytes: Student attitudes toward computer mediated communication (CMC) in the language classroom. *CALICO Journal*, 13(2&3), 27-46.

\*Bicknell, J. (1999). Promoting writing and computer literacy skills through student-authored web pages. *TESOL Journal*, 8(1), 20-26.

\*Blake, R. (2000). Computer mediated communication: A window on L2 Spanish interlanguage. *Language Learning and Technology*, 4(1), 120-136. Retrieved February 1, 2001 from the World Wide Web: <http://llt.msu.edu/vol4num1/blake/default.html>.

Blake, R. J. (1999). Nuevos Destinos: A CD-ROM for advanced beginning Spanish. *CALICO Journal*, 17(1), 9-24.

\*Blyth, C. (1999). Implementing technology in the foreign language curriculum: Redefining the boundaries between language and culture. *Journal of Educational Computing Research*, 20(1), 39-58.

\*Borras, I. (1993). Developing and assessing "Practicing Spoken French": A multimedia program for improving speaking skills. *Educational Technology Research and Development*, 41(4), 91-103.

Borras, I., & Lafayette, R. C. (1994). Effects of multimedia courseware subtitling on the speaking performance of college students of French. *Modern Language Journal*, 78(1), 61-75.

\*Bowman, I., Boyle, B., Greenstone, K., Herndon, L., & Valente, A. (2000). Connecting teachers across continents through on-line reflection and sharing. *TESOL Journal*, 9(3), 15-18.

\*Bradley, T., & Lomicka, L. (2000). A case study of learner interaction in technology-enhanced language learning environment. *Journal of Educational Computing Research*, 22(3), 347-368.

Brett, P. (1995). Multimedia for listening comprehension: The design of a multimedia-based resource for developing listening skill. *System*, 23(1), 77-85.

\*Brett, P. (1997). A comparative study of the effects of the use of multimedia on listening comprehension. *System*, 25(1), 39-53.

\*Brown, J. D. (1997). Computers in language testing: Present research and some future directions. *Language Learning and Technology*, 1(1), 44-59. Retrieved February 13, 2001 from the World Wide Web: <http://llt.msu.edu/vol1num1/brown/default.html>.

Bull, S. (1994). Student modeling for second language acquisition. *Computers and Education*, 23(1/2), 13-20.

\*Bump, J. (1990). Radical changes in class discussion using networked computers. *Computers and the Humanities*, 24, 49-65.

Burnett, J. (1999). Classroom-management-classroom survival: One teacher's story of constructing practice in a computer-equipped foreign language classroom. *Foreign Language Annals*, 32(3), 279-294.

Burston, J. (1991). Using System-D in a classroom environment. *CALICO Journal*, 8(4), 51-53.

Burston, J. (1993). Exploiting available technology. *CALICO Journal*, 11(1), 47-52.

Bush, M. (2000). Digital Versatile Disc (DVD): The new medium for interactive video. *CALICO Journal*, 17(3), 453-474.

\*Cahill, D., & Catanzaro, D. (1997). Teaching first-year Spanish on-line. *CALICO Journal*, 14(2-4), 97-114.

\*Carel, S. (1999). Developing awareness of French pragmatics: A case study of students' interactive use of a foreign language multimedia program. *Journal of Educational Computing Research*, 20(1), 11-24.

\*Chang, K.-Y. R., & Smith, W. F. (1991). Cooperative Learning and CALL/IVD in beginning Spanish: An experiment. *Modern Language Journal*, 75(2), 205-211.

\*Chapelle, C. (1990). The discourse of computer-assisted language learning: Toward a context for descriptive research. *TESOL Quarterly*, 24(2), 199-225.

\*Chapelle, C. (1994). CALL activities: Are they all the same? *System*, 22(1), 33-45.

\*Chapelle, C. (1997). Call in the year 2000: Still in search of research paradigms?. *Language Learning and Technology*, 1(1), 19-43. Retrieved February 13, 2001 from the World Wide Web: <http://llt.msu.edu/vol1num1/chapelle/default.html>.

\*Chapelle, C. (1998). Multimedia call: Lessons to be learned from research on instructed SLA. *Language Learning and Technology*, 2(1), 22-34. Retrieved February 13, 2001 from the World Wide Web: <http://llt.msu.edu/vol2num1/article1/index.html>.

\*Chávez, R. (1990). The development of story writing within an IBM writing to read program lab among language minority students: Preliminary findings. *Computers in the Schools*, 7(1/2), 121-144.

\*Chávez, C. L. (1997). Students take flight with Daedalus: Learning Spanish in a networked classroom. *Foreign Language Annals*, 30(1), 27-37.

Cheung, D., Wong, I., & Foong, Y. (1990). The development of GRAMSKILL: A CALL grammar program for learners of English as a second language. *Computers and Education*, 15(1-3), 105-110.

\*Chun, D. (1994). Using computer networking to facilitate the acquisition of interactive competence. *System*, 22(1), 17-31.

Chun, D. (1998). Signal analysis software for teaching discourse intonation. *Language Learning and Technology*, 2(1), 61-77. Retrieved February 13, 2001 from the World Wide Web: <http://llt.msu.edu/vol2num1/article4/index.html>.

\*Chun, D., & Brandl, K. K. (1992). Beyond form-based drill and practice: Meaning-enhancing CALL on the Macintosh. *Foreign Language Annals*, 25(3), 255-265.

\*Chun, D., & Plass, J. (1996). Effects of multimedia annotations on vocabulary acquisition. *Modern Language Journal*, 80(2), 183-198.

\*Chun, D., & Plass, J. (1997). Research on text comprehension in multimedia environments. *Language Learning and Technology*, 1(1), 60-81. Retrieved February 13, 2001 from the World Wide Web: [http://llt.msu.edu/vol1num1/chun\\_plass/default.html](http://llt.msu.edu/vol1num1/chun_plass/default.html).

Clark, D. (1999). The use of digitized films for teaching honorifics in Japanese. *Journal of Educational Computing Research*, 20(1), 25-38.

Clifford, R. (1998). Mirror, mirror, on the wall: Reflections on computer assisted language learning. *CALICO Journal*, 16(1), 1-10.

\*Collentine, J. (1998). Cognitive principles and CALL grammar instruction: A mind-centered, input approach. *CALICO Journal*, 15(1-3), 1-18.

\*Collentine, J. (2000). Insights into the construction of grammatical knowledge provided by user-behavior tracking technologies. *Language Learning and Technology*, 3(2), 44-57. Retrieved February 13, 2001 from the World Wide Web: <http://llt.msu.edu/vol3num2/collentine/index.html>.

\*Coniam, D. (1998). The use of speech recognition software as an English language oral assessment instrument: An exploratory study. *CALICO Journal*, 15(4), 7-23.

\*Cononelos, T., & Oliva, M. (1993). Using computer networks to enhance foreign language/culture education. *Foreign Language Annals*, 26(4), 527-534.

\*Cornu, A. M., Decker, B., Rosseel, P., & Vanderheiden, M. (1990). Investigating the teaching of writing techniques in a foreign language: A pedagogical issue. *System*, 18(3), 361-372.

Cumming, G., Sussex, R., & Cropp, S. (1993). Learning English as a second language towards the "Mayday" intelligent educational system. *Computers and Education*, 20(1), 119-126.

Cummins, J., & Sayers, D. (1990). Education 2001: Learning networks and educational reform. *Computers in the Schools*, 7(1-2), 1-29.

\*\*Cunningham, D. (1998). 25 years of technology in language teaching: A personal experience. *Babel: Journal of the Australian Federation of Modern Language Teachers' Associations*, *33*(1), 4-7, 35.

\*Daud, N. M. (1992). Issues in CALL implementation and its implications on teacher training. *CALICO Journal*, *10*(1), 69-78.

Davis, B., & Ye-Ling, C. (1994/1995). Long-distance collaboration with on-line conferencing. *TESOL Journal*, *4*(2), 28-31.

Davis, E. A., Linn, M. C., & Clancy, M. J. (1995). Students' off-line and on-line experiences. *Journal of Educational Computing Research*, *12*(2), 109-134.

\*Davis, J. N., & Lyman-Hager, M. A. (1997). Computers and L2 reading: Student performance, student attitude. *Foreign Language Annals*, *30*(1), 58-72.

Davis, J. N., Lyman-Hager, M. A., & Hayden, S. B. (1992). Assessing user needs in early stages of program development: The case of foreign language reading. *CALICO Journal*, *9*(4), 21-27.

de Haan, A., & Oppenhuizen, T. (1994). SPELLER: A reflexive ITS to support the learning of second language spelling. *Computers in Human Behavior*, *10*, 21-31.

\*Derwing, T., Munro, M., & Carbonaro, M. (2000). Does popular speech recognition software work with ESL Speech? *TESOL Quarterly*, *34*(3), 592-602.

Dodigovic, M. (1998). Elements of research in CALL software development projects. *CALICO Journal*, *15*(4), 25-38.

\*Donaldson, R., & Kotter, M. (1999). Language learning in cyberspace: Teleporting the classroom into the target culture. *CALICO Journal*, *16*(4), 530-557.

\*Donaldson, R. P., & Morgan, L. Z. (1994). Making the most of scarce resources: A small college language department's experiences with HyperCard. *CALICO Journal*, *11*(4), 41-60.

\*Dunkel, P. (1990). Implications of the CAI effectiveness research for limited English proficient learners. *Computers in the Schools*, *7*(1/2), 31-52.

\*Dunkel, P. (1991). Computerized testing of nonparticipatory L2 listening comprehension proficiency: An ESL prototype development effort. *Modern Language Journal*, *75*(1), 64-73.

\*Dunkel, P. (1999). Considerations in developing or using second/foreign language proficiency computer-adaptive tests. *Language Learning and Technology*, *2*(2), 77-93. Retrieved February 13, 2001 from the World Wide Web: <http://llt.msu.edu/vol2num2/article4/index.html>.

Ehrmann, S. C. (1995). Facing the triple challenge: You can't do it alone. *CALICO Journal*, 13(1), 5-25.

\*\*Ellis, R. (1994). *The study of second language acquisition*. Oxford: Oxford University Press.

\*Eshani, F., & Knodt, E. (1998). Speech technology in computer-aided language learning: Strengths and limitations of a new CALL paradigm. *Language Learning and Technology*, 2(1), 45-60. Retrieved February 13, 2001 from the World Wide Web: <http://ilt.msu.edu/vol2num1/article3/index.html>.

\*Evans, M. (1993). Nicolas: Using Hypercard with intermediate-level French learners. *System*, 21(2), 213-229.

Fidelman, C. G. (1998). Growth of Internet use by language professionals. *CALICO Journal*, 15(4), 39-58.

Fischer, R. (1999). Computer applications and research agendas: Another dimension in professional development. *CALICO Journal*, 16(4), 559-571.

Forrest, T., & Wrigley, H. S. (1993). Teaching issues, technology and the language classroom: Available technology, ways of using technology in language and literacy teaching. *TESOL Quarterly*, 27(2), 316-322.

Fox, J. (1993). EC research in language learning and IT - some experiences with LINGUA. *Journal of Computer Assisted Learning*, 9, 100-106.

Furugori, T. (1990). A computer-based learning of basic Japanese. *CALICO Journal*, 8(2), 7-24.

Garrett, N. (1990). Reaction: Applying instructional technologies. *Foreign Language Annals*, 23(5), 427-429.

\*Garrett, N. (1991). Technology in the service of language learning: Trends and issues. *Modern Language Journal*, 75(1), 74-101.

\*\*Gass, S. M. (1997). *Input, interaction, and the second language learner*. Mahwah, NJ: Lawrence Erlbaum Associates.

\*Godwin-Jones, R. (1999). Web course design and creation for language learning. *CALICO Journal*, 17(1), 43-58.

Gonglewski, M. R. (1999). Linking the Internet to the National Standards for Foreign Language Learning. *Foreign Language Annals*, 32(3), 348-362.

\*González-Bueno, M. (1998). The effects of electronic mail on Spanish L2 discourse. *Language Learning and Technology*, 1(2), 55-70. Retrieved February 13, 2001 from the World Wide Web: <http://llt.msu.edu/vol1num2/article3/default.html>.

\*Gonzalez-Bueno, M., & Perez, L. C. (2000). Electronic mail in foreign language writing: A study of grammatical and lexical accuracy, and quantity of language. *Foreign Language Annals*, 33(2), 189-198.

González-Edfelt, N. (1990). Oral interaction and collaboration at the computer: Learning English as a second language with the help of your peers. *Computers in the Schools*, 7(1/2), 53-90.

Goodfellow, R. (1994). Design principles for computer-aided vocabulary learning. *Computers and Education*, 23(1/2), 53-62.

Goodwin, A. (1993). Instructional delivery via electronic mail. *TESOL Journal*, 3(1), 19-23.

Goodwin, A., Hamrick, J., & Stewart, T. (1994/1995). Instructional delivery via electronic mail. *TESOL Journal*, 4(2), 24-27.

\*Grace, C. (1998a). Personality type, tolerance of ambiguity, and vocabulary retention in CALL. *CALICO Journal*, 15(1-3), 19-45.

\*Grace, C. A. (1998b). Retention of word meanings inferred from context and sentence-level translations: Implications for the design of beginning-level CALL software. *Modern Language Journal*, 82(4), 533-544.

Grace, C. A. (2000). Gender differences: Vocabulary retention and access to translations for beginning language learners in CALL. *Modern Language Journal*, 84(2), 214-224.

Green, A. (1997). A beginner's guide to the Internet in the foreign language classroom with a focus on the World Wide Web. *Foreign Language Annals*, 30(2), 253-264.

\*Greenia, G. D. (1992). Computers and teaching composition in a foreign language. *Foreign Language Annals*, 25(1), 33-46.

Groot, P. (2000). Computer assisted second language vocabulary acquisition. *Language Learning and Technology*, 4(1), 60-81. Retrieved February 13, 2001 from the World Wide Web: <http://llt.msu.edu/vol4num1/groot/default.html>.

Handle, D. C. V., & Corl, K. A. (1998). Extending the dialogue: Using electronic mail and the Internet to promote conversation and writing in intermediate level German classes. *CALICO Journal*, 15(1-3), 129-144.

Hart, R. S. (1995). The Illinois PLATO foreign language project. *CALICO Journal*, 12(4), 15-37.

\*Hegelheimer, V., & Chapelle, C. (2000). Methodological issues in research on learner-computer interactions in CALL. *Language Learning and Technology*, 4(1), 41-59. Retrieved February 13, 2001 from the World Wide Web: <http://ilt.msu.edu/vol4num1/hegchap/default.html>.

\*Hellebrandt, J. (1999). Virtual collaborations in the Spanish class: From e-mail to Web design and CD-ROM development. *Journal of Educational Computing Research*, 20(1), 59-70.

\*Hemard, D. P. (1997). Design principles and guidelines for authoring hypermedia language learning applications. *System*, 25(1), 9-27.

Herron, C. A., & Moos, M. A. (1993). Electronic media in the foreign language and literature classroom: A fusion between science and the humanities. *Foreign Language Annals*, 26(4), 479-490.

\*Hoffman, S. (1995/1996). Computers and instructional design in foreign language/ESL instruction. *TESOL Journal*, 5(2), 24-29.

Hong, W. (1997). Multimedia computer-assisted reading in business Chinese. *Foreign Language Annals*, 30(3), 335-344.

\*Hoven, D. (1999). A model for listening and viewing comprehension in multimedia environments. *Language Learning and Technology*, 3(1), 88-103. Retrieved February 13, 2001 from the World Wide Web: <http://ilt.msu.edu/vol3num1/hoven/index.html>.

\*Hulstijn, J. (2000). The use of computer technology in experimental studies of second language acquisition: A survey of some techniques and some ongoing studies. *Language Learning and Technology*, 3(2), 32-43. Retrieved February 13, 2001 from the World Wide Web: <http://ilt.msu.edu/vol3num2/hulstijn/index.html>.

\*Hult, S., Kalaja, M., Lassila, O., & Lehtisalo, T. (1990). HYPERREADER-An interactive course in reading comprehension. *System*, 18(2), 189-198.

Hwu, F. (1997). Providing an effective and affective learning environment for Spanish phonetics with a hypermedia application. *CALICO Journal*, 14(2-4), 115-134.

\*Hyland, K. (1993). ESL computer writers: What can we do to help? *System*, 21(1), 21-29.

\*\*Iandoli, L. J. (1990). CALL and the profession: The current state. *French Review*, 64(2), 261-272.

\*Ikeda, N. (1999). Language learning strategies with sound-hints in computer-based drill. *Journal of Computer Assisted Learning*, 15(4), 312-322.

Ingraham, B. D., Chantier, T., & Emery, C. R. (1994). Language training for various purposes in several languages on a common hypermedia framework. *Computers in Education*, 23(1/2), 107-115.

\*James, R. (1996). CALL and the speaking skill. *System*, 24(1), 15-21.

Jarvis, S. (1984). Language learning technology and alternative for public education. *CALICO Journal*, 1(4), 11-16.

\*Johnston, J., & Milne, L. (1995). Scaffolding second language communicative discourse with teacher-controlled multimedia. *Foreign Language Annals*, 28(3), 315-336.

\*Jokobsdottir, S., & Hooper, S. (1995). Computer-assisted foreign language learning: Effects of text, context, and gender on listening comprehension and motivation. *Educational Technology Research and Development*, 43(4), 43-59.

\*Jones, F. (1991). Mickey Mouse and the state of the art: Program sophistication and classroom methodology in communicative CALL. *System*, 19(1-2), 1-13.

Kamhi-Stein, L. (2000). Looking to the future of TESOL teacher education: Web-based bulletin board discussions in a methods course. *TESOL Quarterly*, 34(3), 423-456.

\*Kang, S.-H., & Dennis, J. R. (1995). The effects of computer-enhanced vocabulary on achievement of ESL grade school children. *Computers in the Schools*, 11(3), 25-35.

\*Kasper, L. (2000). New technologies, new literacies: Focus discipline research and ESL learning communities. *Language Learning and Technology*, 4(2), 105-128. Retrieved February 13, 2001 from the World Wide Web: <http://ilt.msu.edu/vol4num2/kasper/default.html>.

\*Kelm, O. R. (1992). The use of synchronous computer networks in second language instruction: A preliminary report. *Foreign Language Annals*, 25(5), 441-453.

\*Kern, R. (1995). Restructuring classroom interaction with networked computers: Effects on quantity and characteristics of language production. *Modern Language Journal*, 79(4), 457-476.

Kern, R., & Warschauer, M. (2000). Introduction: Theory and practice of networked-based language teaching. In M. Warschauer & R. Kern (Eds.), *Network-based Language Teaching* (pp.1-19). Cambridge: Cambridge University Press.

Kesner-Bland, S., Noblitt, J. S., Armington, S., & Gay, G. (1990). The native lexical hypothesis: Evidence from computer-assisted language learning. *Modern Language Journal*, 74(4), 440-449.

Kim, W.-C. M. (1991). Conceptual design of an intelligent hypermedia language learning environment. *CALICO Journal*, 8(4), 25-36.

Kornum, L. (1993). Foreign language teaching and learning in a multimedia environment. *CALICO Journal*, 10(3), 65-76.

\*Kost, C. R. (1999). Enhancing communicative language skills through effective use of the World Wide Web in the foreign language classroom. *Foreign Language Annals*, 32(3), 309-320.

\*Kramersch, C., & Andersen, R. (1999). Teaching text and context through multimedia. *Language Learning and Technology*, 2(2), 31-42. Retrieved February 13, 2001 from the World Wide Web: <http://llt.msu.edu/vol2num2/article1/index.html>.

Kreutzer, M., & Neunzig, W. (1997). Computer assisted learning: teacher training methodology and evaluation of a seminar for language teachers. *CALICO Journal*, 14(2-4), 65-80.

\*Kroonenberg, N. (1994/1995). Developing communicative and thinking skills via electronic mail. *TESOL Journal*, 4(2), 24-27.

Kubota, R. (1999). Word processing and WWW projects in a college Japanese language class. *Foreign Language Annals*, 32(2), 205-218.

Kunzel, S. (1995). Processors processing: Learning theory and CALL. *CALICO Journal*, 12(4), 106-113.

\*Lam, W. S. E. (2000). L2 literacy and the design of the self: A case study of a teenager writing on the Internet. *TESOL Quarterly*, 34(3), 457-482.

\*Larson, J. W. (2000). Testing oral language skills via the computer. *CALICO Journal*, 18(1), 53-66.

\*Lee, L. (1997). Using Internet tools as an enhancement of C2 teaching and learning. *Foreign Language Annals*, 30(3), 410-427.

\*Lee, L. (1998). Going beyond classroom learning: Acquiring cultural knowledge via on-line newspapers and intercultural exchanges via on-line chat rooms. *CALICO Journal*, 16(2), 101-120.

\*Legenhausen, L., & Wolff, D. (1990). CALL in use - use of CALL: Evaluating CALL software. *System*, 18(1), 1-14.

\*Levary, E. (1992). Computer activities and the development of transitions in student writing. *Computers and Education*, 18(4), 311-318.

\*Levin, L. S., Evans, D. A., & Gates, D. M. (1991). The Alice system: A workbench for learning and using language. *CALICO Journal*, 8(2), 27-56.

\*Levy, M. (1990). Concordances and their integration into word-processing environment for language learners. *System*, 18(2), 177-188.

Levy, M., & Green, A. (1995). CALL bibliography for postgraduate study. *System*, 23(1), 87-106.

Li, X. (1996). Hyper Characters: A pilot study in computerized learning of Chinese characters. *CALICO Journal*, 14(1), 77-94.

Li, Y. (2000). Linguistic characteristics of ESL writing in task-based e-mail activities. *System*, 28(2), 229-245.

Liaw, M. (1998). Using electronic mail for English as a foreign language instruction. *System*, 26(3), 335-351.

\*Liaw, M. (1997). An analysis of ESL children's verbal interaction during computer book reading. *Computers in the Schools*, 13(3/4), 55-73.

\*Liou, H.-C., Wang, S. H., & Hung-Yeh, Y. (1992). Can grammatical CALL help EFL writing instruction? *CALICO Journal*, 10(1), 23-43.

\*Liu, M. (1994). Hypermedia assisted instruction and second language learning: A semantic-network-based approach. *Computers in the Schools*, 10(3/4), 293-312.

\*Liu, M. (1995). Contextual enrichment through hypermedia technology: Implications for second language learning. *Computers in Human Behavior*, 11(3/4), 439-450.

\*Liu, M., & Reed, W. M. (1994). The relationship between the learning strategies and learning styles in a hypermedia environment. *Computers in Human Behavior*, 10(4), 419-434.

\*Liu, M., & Reed, W. M. (1995). The effect of hypermedia-assisted-instruction on second language learning. *Journal of Educational Computing Research*, 12(2), 159-175.

Lockee, B., & Moore, D. (1997). Hypermedia and the facilitation of native American language learning: Preserving a heritage through the use of technology. *Journal of Educational Technology Systems*, 26(2), 169-179.

\*Lomicka, L. (1998). "To gloss or not to gloss": An investigation of reading comprehension online. *Language Learning and Technology*, 1(2), 41-50. Retrieved February 13, 2001 from the World Wide Web: <http://ilt.msu.edu/vol1num2/article2/default.html>.

Loritz, D. (1995). The adolescence of CALL. *CALICO Journal*, 12(4), 47-56.

Lunde, K. (1990). Using electronic mail as a medium for foreign language study and instruction. *CALICO Journal*, 7(3), 68-79.

Manning, P. (1994). Learner data collection and interpretation in design of intelligent CALL programs. *Computers and Education*, 23(1/2), 3-12.

\*Masters-Wicks, K., Postlewaite, L., & Lewental, M. (1996). Developing Interactive Instructional software for language acquisition. *Foreign Language Annals*, 29(2), 217-222.

Matthews, C. (1993). Grammar frameworks in intelligent CALL. *CALICO Journal*, 11(1), 5-27.

\*Merlet, S. (2000). Understanding multimedia dialogues in a foreign language. *Journal of Computer Assisted Learning*, 16(2), 148-159.

\*Meskill, C. (1993). ESL and multimedia: A case study of the dynamics of paired student discourse. *System*, 21(3), 323-341.

Meskill, C. (2000). Introduction to special issue of the Journal of Educational Computing Research: Research in computer assisted language learning. *Journal of Educational Computing Research*, 22(3), 239-242.

Meskill, C., & Mossop, J. (2000). Electronic texts in ESOL classrooms. *TESOL Quarterly*, 34(3), 585-591.

Meskill, C., & Mossop, J. (2000). Technologies use with ESL learners in New York State: Preliminary report. *Journal of Educational Computing Research*, 22(3), 265-284.

\*Meunier, L. E. (1994). Computer adaptive language tests (CALT) offer a great potential for functional testing. Yet, why don't they? *CALICO Journal*, 11(4), 23-40.

\*Meunier, L. E. (1995/1996). Human factors in a computer assisted foreign language environment: The effects of gender, personality and keyboard control. *CALICO Journal*, 13(2&3), 47-72.

Mills, D. (2000). Web-based technology as a resource for form-focused language learning. *TESOL Quarterly*, 34(3), 603-616.

Moore, Z. (1999). Technology and teaching culture in the L2 classroom: An introduction. *Journal of Educational Computing Research*, 20(1), 1-10.

Moore, Z. M., B. & Carel, S. (1998). Technology and teaching culture: Results of a state survey of foreign language teachers. *CALICO Journal*, 15(1-3), 19-128.

\*Motteram, G. (1990). Using a standard authoring package to teach effective reading skills. *System*, 18(1), 15-21.

\*Motteram, G. (1992). Authoring tools and teacher training for CALL. *System*, 20(2), 151-160.

Moulton, M. H., V. (2000). An ESL capstone course: Integrating research tools, techniques, and technology. *TESOL Journal*, 9(2), 23-29.

Murray, D. (2000). Protean communications: The language of computer-mediated communication. *TESOL Quarterly*, 34(3), 397-422.

Murray, G., & Kouritzin, S. (1997). Re-thinking second language instruction, autonomy, and technology: A manifesto. *System*, 25(2), 185-196.

Murray, L., & Barnes, A. (1998). Beyond the wow factor: Evaluating multimedia language learning software from a pedagogical viewpoint. *System*, 26(2), 249-259.

\*Nagata, N. (1996). Computer vs. workbook instruction in second language acquisition. *CALICO Journal*, 14(1), 53-75.

\*Nagata, N. (1997). The effectiveness of computer-assisted metalinguistic instruction: A case study in Japanese. *Foreign Language Annals*, 30(2), 187-200.

\*Nagata, N. (1998). Input vs. output practice in educational software for second language acquisition. *Language Learning and Technology*, 1(2), 23-40. Retrieved February 13, 2001 from the World Wide Web: <http://llt.msu.edu/vol1num2/article1/default.html>.

\*Nagata, N. (1999). The effectiveness of computer-assisted interactive glosses. *Foreign Language Annals*, 32(4), 469-479.

Nagata, N., & Swisher, M. V. (1995). A study of consciousness-raising by computer: The effect of metalinguistic feedback on second language learning. *Foreign Language Annals*, 28(3), 337-347.

Nakhimovsky, A. (1997). A multimedia authoring tool for language instruction. *Journal of Educational Computing Research*, 17(3), 263-276.

Nara, H. (1994). Improved delivery of lexical information in a computer assisted reading instruction program. *CALICO Journal*, 12(1), 19-36.

\*Nelson, T., & Oliver, W. (1999). Murder on the Internet. *CALICO Journal*, 17(1), 101-114.

\*Nicholas, M. A., & Toporski, N. (1993). Developing "the critic's corner:" Computer-assisted language learning for upper-level Russian students. *Foreign Language Annals*, 26(4), 469-478.

\*Noijons, J. (1994). Testing computer assisted language testing: Towards a checklist for CALT. *CALICO Journal*, 12(1), 37-58.

\*Nutta, J. (1998). Is computer-based grammar instruction as effective as teacher-directed grammar instruction for teaching L2 structures? *CALICO Journal*, 16(1), 49-62.

Nyns, R. (1990). An expert system in computer assisted language learning. *Computers and Education*, 15(1-3), 99-103.

\*Ogata, H., Feng, C., Hada, Y., & Yano, Y. (2000). Online markup based language learning environment. *Computers and Education*, 34(1), 51-66.

\*Oliva, M., & Pollastrini, Y. (1995). Internet resources and second language acquisition: An evaluation of virtual immersion. *Foreign Language Annals*, 28(4), 551-563.

\*Oller, J. W. (1996). Toward a theory of technologically assisted language learning/instruction. *CALICO Journal*, 13(4), 19-43.

Ortega, L. (1997). Process and outcomes in networked classroom interaction: Defining the research agenda for L2 computer-assisted classroom discussion. *Language Learning and Technology*, 1(1), 82-93. Retrieved February 13, 2001 from the World Wide Web: <http://lt.msu.edu/vol1num1/ortega/default.html>.

\*Osuna, M. (2000). Promoting foreign culture acquisition via the Internet in a sociocultural context. *Journal of Educational Computing Research*, 22(3), 323-346.

\*Osuna, M., & Meskill, C. (1998). Using the World Wide Web to integrate Spanish language and culture: A pilot study. *Language Learning and Technology*, 1(2), 71-92. Retrieved February 13, 2001 from the World Wide Web: <http://lt.msu.edu/vol1num2/article4/default.html>.

\*Padilla, R. (1990). HyperCard: A tool for dual language instruction. *Computers in the Schools*, 7(1/2), 211-226.

Paramskas, D. (1995). Meanwhile, up north: The beginnings of CALL in Canada. *CALICO Journal*, 12(4), 97-105.

\*Peng, Y.-J. J. (1993). Answer markup on computer-assisted language learning. *CALICO Journal*, 10(3), 31-49.

\*Pertusa-Seva, I., & Stewart, M. A. (2000). Virtual study abroad 101: Expanding the horizons of the Spanish curriculum. *Foreign Language Annals*, 33(4), 438-442.

Peterson, M. (1997). Language teaching and networking. *System*, 25(1), 29-37.

\*Plass, J. L., Chun, D. C., Mayer, R. E., & Leutner, D. (1998). Supporting visual and verbal learning preferences in a second-language multimedia learning environment. *Educational Psychology*, 90(1), 25-36.

\*Pusack, J. P., & Otto, S. K. (1990). Applying Instructional technologies. *Foreign Language Annals*, 23(5), 409-417.

Rankin, W. (1997). Increasing the communicative competence of foreign language students through the FL chat room. *Foreign Language Annals*, 30(4), 542-546.

Rendall, H. (1993). Using the microcomputer to bridge the language gap. *CALICO Journal*, 10(3), 77-95.

\*Ritter, M. (1993). "That's us! A book about ourselves" An EFL project with intermediate learners, incorporating the computer as a tool. *CALICO Journal*, 10(4), 57-69.

Robinson-Stuart, G. L. (1998). New directions in CALL: Getting to the heart of it. *CALICO Journal*, 16(1), 11-24.

Roe, P. (1994). User modeling in CALL: some fundamental issues. *Computers and Education*, 23(1/2), 27-34.

Rollinghoff, A. (1993). Implementing word learning strategies into an interactive learning environment. *CALICO Journal*, 11(2), 21-44.

\*Ruschoff, B. (1993). Language learning and information technology: State of the art. *CALICO Journal*, 10(3), 5-18.

\*Salaberry, M. R. (1996). A theoretical foundation for the development of pedagogical tasks in computer mediated communication. *CALICO Journal*, 14(1), 5-36.

Salaberry, M. R. (2000). Pedagogical design of computer mediated communication tasks: Learning objectives and technological capabilities. *Modern Language Journal*, 84(1), 28-37.

Sanders, R. H. (1995). Thirty years of computer assisted language instruction: Introduction. *CALICO Journal*, 12(4), 7-14.

Sanne, S. M. (1993). Hypermedia in the teaching of Italian. *CALICO Journal*, 10(4), 76-82.

Santiago, R., Nakata, M., Einwaechter, N., Marschmeier, R., & Shimada, R. (1996). Integrating technology in the writing curriculum of Japanese learners of English as a foreign language. *Educational Technology Research and Development*, 44(3), 103-108.

Sayers, D. (1993). Distance team teaching and computer learning networks. *TESOL Journal*, 3(1), 19-23.

Scholnik, M., & Rubin, H. (1991). The computer lesson as an integrated element in the academic EFL reading curriculum. *CALICO Journal*, 8(3), 81-94.

Schmitt, L., & Christianson, K. (1998). Pedagogical aspects of a UNIX-based network management system for English instruction. *System*, 26(4), 567-589.

\*Schwartz, M. (1995). Computers and the language laboratory: Learning from history. *Foreign Language Annals*, 28(4), 527-535.

\*Sciarone, A., & Meijer, P. (1993). How free should students be? A case from CALL: computer-assisted language learning. *Computers and Education*, 21(1/2), 95-102.

\*Scott, V. M., & New, E. (1994). Computer aided analysis of foreign language writing process. *CALICO Journal*, 11(3), 5-18.

Selwyn, N. (2000). Researching computers and education-glimpses of the wider picture. *Computers and Education*, 34(2), 93-102.

Shelley, J. O. (1997). Post-Institute connections: Implementation and outcomes of a diffusion-based electronic mail and instructional model. *Foreign Language Annals*, 30(1), 124-139.

Sherry, L., Tavilin, F., & Billig, S. (2000). Good online conversation: Building on research to inform practice. *Journal of Interactive Learning Research*, 11(1), 85-127.

Silva, A. A. (1991). A tool for language teachers: A spread (use of the) sheet. *Journal of Educational Technology Systems*, 20(1), 3-10.

Sinyor, R. (1997). An analysis of student behavior and error sources in an Italian CALL context. *CALICO Journal*, 14(2-4), 51-65.

\*Soo, K.-S., & Ngeow, Y.-H. (1998). Effective English as a second language instruction with interactive multimedia: The MCALL project. *Journal of Educational Multimedia and Hypermedia*, 7(1), 71-89.

\*Sotillo, S. (2000). Discourse functions and syntactic complexity in synchronous and asynchronous communication. *Language Learning and Technology*, 4(1), 82-119. Retrieved February 13, 2001 from the World Wide Web: <http://llt.msu.edu/vol4num1/sotillo/default.html>.

Stenson, N., Downing, B., Smith, J., & Smith, K. (1992). The effectiveness of computer-assisted pronunciation training. *CALICO Journal*, 9(4), 5-20.

Stiers, W. (1993). A new approach to authoring. *CALICO Journal*, 10(4), 83-93.

Stoks, G. (1993). Integrating new technologies into the modern languages curriculum. *CALICO Journal*, 11(1), 76-93.

Stone, L. A. (1990). Reaction: Applying instructional technologies. *Foreign Language Annals*, 23(5), 421-422.

\*Sullivan, N., & Pratt, E. (1996). A comparative study of two ESL writing environment: a computer-assisted classroom and a traditional oral classroom. *System*, 24(4), 491-501.

\*Sussex, R. (1991). Author languages, authoring systems and their relation to the changing focus of computer-aided language learning. *System*, 19(1/2), 15-27.

Svenconis, D. J., & Kerst, S. (1995). Investigating the teaching of second-language vocabulary through semantic mapping in a hypertext environment. *CALICO Journal*, 12(2&3), 33-58.

Tamburini, F. (1999). A multimedia framework for second language teaching in self-access environments. *Computers and Education*, 32(2), 137-150.

Taylor, C., Jamieson, J., & Eignor, D. (2000). Trends in computer use among international students. *TESOL Quarterly*, 34(3), 575-584.

Thompson, J., & Chesters, G. (1992). CALL for all. *Computers and Education*, 19(1/2), 163-172.

\*Thorson, H. (2000). Using the computer to compare foreign and native language writing processes: A statistical and case study approach. *Modern Language Journal*, 84(2), 155-170.

Torres-Guzmán, M. (1990). Voy a leer escribiendo in the context of bilingual/bicultural education. *Computers in the Schools*, 7(1/2), 145-172.

Tucker, G. R. (1999). The applied linguist, school reform, and technology: Challenges and opportunities for the coming decade. *CALICO Journal*, 17(2), 197-221.

Tuman, W. V. (1990). Computer-enhanced beginning Russian. *Foreign Language Annals*, 23(1), 23-32.

\*Ulitsky, H. (2000). Language learner strategies with technology. *Journal of Educational Computing Research*, 22(3), 285-322.

\*Van Bussel, F. (1994). Design rules for computer aided learning of vocabulary items in a second language. *Computers in Human Behavior*, 10(1), 63-76.

\*Van der Linden, E. (1993). Does feedback enhance computer-assisted language learning? *Computers and Education*, 21(1/2), 61-66.

Van Elsen, E., Van Deun, K., & Decoo, W. (1991). Wordchip: The application of external versatility to an English lexical CALL program. *System*, 19(4), 401-417.

\*Van Handle, D., & Corl, K. (1998). Extending the dialogue: Using electronic mail and the Internet to promote conversation and writing in intermediate level German language courses. *CALICO Journal*, 15(1-3), 129-143.

Vilmi, R., & Malmi, L. (1996). Learning English, creating, writing and playing WWW adventure games. *Educational Technology Research and Development*, 44(3), 09-118.

Walker de Felix, J., Johnson, R. T., & Schick, J. E. (1990). Socio-and psycholinguistic considerations in interactive video instruction for limited English proficient students. *Computers in the Schools*, 7(1/2), 173-190.

Walz, J. (1998). Meeting Standards for Foreign Language Learning with World Wide Web activities. *Foreign Language Annals*, 31(1), 103-114.

\*Warschauer, M. (1995/1996). Comparing face to face and electronic discussion in the second language classroom. *CALICO Journal*, 13(2&3), 7-26.

\*Warschauer, M. (1997). Computer-mediated collaborative Learning: Theory and Practice. *Modern Language Journal*, 81(4), 470-481.

\*\*Warschauer, M. (2000). Online learning in second language classrooms: An ethnographic study. In M. Warschauer & R. Kern (Eds.), *Network-based language teaching: Concepts and practice* (pp. 41-58). Cambridge: Cambridge University Press.

\*Warschauer, M., Turbee, L., & Roberts, B. (1996). Computer learning networks and student empowerment. *System*, 24(1), 1-14.

\*Watts, N. (1997). A learner-based design model for interactive multimedia language learning packages. *System*, 25(1), 1-8.

Wilson, E. (1994). Using corpora as a resource in language teaching. *Computers and Education*, 23(1/2), 41-52.

\*Wolach, A. H. (1994). Developing a computer program to facilitate language training. *Computers in Human Behavior*, 10(4), 541-557.

Yang, P. J. (1998). Networked multimedia and foreign language education. *CALICO Journal*, 15(1-3), 75-88.

\*Young, R., Shermis, M., Brutten, S., & Perkins, K. (1996). From conventional to computer-adaptive testing of ESL reading comprehension. *System*, 24(1), 23-40.

Zahner, C., Gupta, G., & Olohan, M. (1994). Lexical resources in CALL. *Computers and Education*, 23(1/2), 75-80.

\*Zhao, Y. (1996). Language learning on the World Wide Web: Toward a framework of network based CALL. *CALICO Journal*, 14(1), 37-52.