content or focus of the activities for which students were using the computer. More importantly, the results should not be considered in summary form to indicate an overall high level of computer familiarity worldwide because access to technology is not equal for subgroups. For example, although the survey respondent in most of the test centers reported increased use in computer use in just a 30-month period, the use and the amount of increase were markedly less for African respondents. This difference may be attributed to a lack of technological infrastructure and trained teachers (Jegede & Okebukola, 1992; Lubbe, Heney, & Swank, 1997; Van der Weij & Piennar, 1996, 1997). Whatever the case, the survey illustrates that one quarter to one half of the students from most regions of the world will likely need help learning how to use English-processing programs and the Internet once they arrive at North American colleges and universities.

The data reported in this study are already dated. The situation today can only be extrapolated; although it seems safe to assume that computer use among international students has increased, teachers in EAP programs should continue to assess, rather than assume, the computer familiarity of their students.

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of first-class language professionals to teach English language learners have suffered in the rush to acquire hardware and software.

Exactly what are the promises of technology for children of limited English proficiency in U.S. schools? This study first set out to gain a broad view of the practices of ESOL professionals with regard to technology and their assessment of its value. We then examined in close detail contexts where electronic texts (e-texts)1 were being used effectively to support the L2 and literacy development of children in kindergarten through eighth-grade classrooms. Both research activities have produced informative findings that we briefly outline in this report. (For a full report of the findings, see Meskill & Mossop, 2000; Meskill, Mossop, & Barn, 1999.)

BACKGROUND

The short history of e-text in language education has been replete with acclaim for certain of its characteristics, most notably speed and efficiency, patience, convenience, motivational aspects, and, more recently, the many possibilities of communications connectivity for teaching and learning. The research community in turn has examined these and other features of computer technology to understand their influence on reading, writing, syntax, comprehension, speaking, listening, and other skills in an L2 (see Meskill & Mossop, 2000, for a summary). Even though research in L2 literacy development consistently underscores the importance of the mentored, event-rich literacy environment and of instructional practices and behaviors that provide concomitant support for learners en route to L2 literacy (Augus & Halpin, 1998; Kessler, 1996; Huss, 1995; Johnson, 1995; Rigg & Allen, 1989; Toohey, 1998), parallel research that examines such environmental characteristics with e-texts is notably absent in the literature. The few earlier studies of technologies in classrooms suggest fear computers do not simply affect individual learning but tend to reshape classroom processes overall (Cazden, Michaels, & Wan-on-Gege, 1987; Meskill & Swan, 1999). This study is concerned with the day-to-day practices of ESOL teachers in their classrooms: what they do with technologies and how their actions shape L2 and literacy instruction. It is responsive to the current need to extend inquiry beyond the attributes of the machine to study how the use of technology-based tools can change—in many cases for the better—the contexts and processes of a given instructional environment (Warschauer, 1998, 1999).

METHOD

Initially, we queried E-12 practitioners regarding if and how they used e-texts with their ESL learners. Data from our statewide survey and follow-up telephone interviews revealed a great deal of activity in ESOL that was supported in a variety of ways by e-texts (see Meskill & Mossop, 2000). From this initial data collection activity, two reporting teachers from the same district became the focus of an intensive, 2-year study of the dynamics of ESOL classrooms when e-texts were integrated into L2 and literacy learning. To select these teachers from the more than 150 reporting language educators, we applied the criteria of (a) length of time a technology component had been in place, and (b) training and expertise in instructional technology and TESOL. In addition to substantial expertise in both areas, these two teachers enjoyed unusually positive support from their districts for their work with ESOL learners.

Data concerning these environments and their participants consisted of videotaped classes (30): interviews with teachers, students, and administrators; video talk-back sessions2 and student products. To capture the dynamic of the learning and activity around e-texts, we transcribed the videotaped data using a two-step, audio-then-visual process. Data were coded and analyzed using the qualitative research tool, QSR NUDIST (1997).

SUMMARY OF FINDINGS

Our surveys and interviews of ESOL practitioners regarding technology in their work, and the long-term study of two technology-using ESOL classrooms, have yielded a number of instructive findings.

• A good portion of ESOL professionals reported using technologies as part of their L2 and literacy instruction.

• Teachers reported that learners were motivated by doing tasks with the computer (though not by self-study drills).

• In exemplary uses of technologies, teachers designed and implemented precomputer and postcomputer tasks that optimize focus on and use of L2 and literacy skills.

• The role of the instructor tended to shift from being central to being a sideline support.

• Evidence of learner achievements with e-texts was continual.

• Mastery of the computer translated into higher status.

1The term electronic text (e-text) refers to any information displayed on a computer, including audio, video, graphics, and the written word.

2In short sessions, teachers reviewed videotapes of their classes and were prompted to comment on their student's and their own thoughts and actions.
Use of computer technology. Forty-nine percent of the nearly 800 survey respondents reported using some form of computer technology with their students. They saw tools such as word-processing software and context-rich applications such as simulations as especially supportive of their goals and practices. Like the majority of the survey respondents, our two focal teachers chiefly used two genres of software: enhanced text-processing tools and context-rich simulations. Use of the former in the elementary context consisted of children creating their own stories with the software Once Upon a Time (1995)—a multimedia product that allows children to hear and use semantically grouped vocabulary items and manipulate accompanying illustrations to build stories. Use of context-rich simulations such as MEGO's Oregon Trail series and the Sim-series published by Maxx was frequent in both classrooms. Teachers pointed to the generative aspects of these software genres, for example, the amount and quality of literacy opportunities, the content richness and relevance, and the degree to which the software could be exploited for opportunities to practice the language and literacy needed for school.

The computer as motivator. For questions regarding use, survey and interview responses consistently cited the motivational feature of technology. Teachers observed that children were especially responsive when they were able to control products of their learning to share with others. "Enthusiastic for learning with exerts provided the class sessions observed and interviews with students. One of the focal teachers in the longitudinal study noted the degree to which this excitement for learning extended into the classroom beyond:

It excites them. I just think it's fun when I hear 'Oh my God! Wow! Cool!' ... you don't really hear a lot of excitement like that over some of the assignments you give in class. It definitely works as a motivating tool. They motivate each other because one person will do something and another person will build on that idea and say, 'Oh, I think I can do it even better.' (interview, focal middle school teacher, spring 1999)

Task design. Activities most often described in the survey/interview portion of the study, as well as those observed in the two focal classrooms, shared a common overall structure characterized by a smooth stream of offline, to on-line, to offline activity. Before working on the computer, language professionals spent a focused period of time ranging from 5 to 15 minutes doing offline preparatory work. Both focal teachers felt this component was essential to the successful integration of exerts. The focal elementary school teacher told us, "For every time we use the computer we prepare [offline], do our work, then review what we did

[offline]." (interview, fall 1997). Children were first coached to awareness of the forms and ideas they would be working with on the computer. In some cases this coaching consisted of preparing a print (hand-written or drawn) language guide or a paper-based task for the learners to complete during their on-line work.

Teacher's role. In all of the videotaped classroom sessions, we observed e-texts being used as tools through which and around which language use was supported by carefully crafted sociocollaborative contexts. With moment-to-moment teacher support, learners took the bulk of responsibility for initiating and following through on the computer-supported tasks they had been assigned. Guidance in the way of genuine, un-oriented questions (with agendas of language and literacy acquisition consistently underlying them) was continual. The locus of thought, action, and talk was learners and their learning. Teachers provided ongoing, moment-to-moment supportive talk and behavior while the children worked through on-line tasks and materials.

Learner achievement. Because of the public nature of e-text activity, children could share their minute-by-minute successes with teachers and peers: "Look, look, Ms. E! I made it!" (newly arrived ESL learner in 4th-grade classroom, spring 1998). Their finished work, whether a word-processed, desktop-published document, an animated story, a multimedia presentation, or a fully functioning city of their own design, was consistently a source of great pride and, among peers and family members, admiration. In one telephone interview, an ESOL teacher reported that a student she had designed and had a hand in producing a two-page, illustrated supplement to the local newspaper. That supplement presented aspects of the students' home culture and their adjustment to life in the United States. Learners' achievements extended from moment-to-moment successes in editing their own work or making decisions to demonstrating to the larger school and community what they could do with technology.

The computer as status builder. Throughout the study, many anecdotal accounts connected status and ability with computers. Children who had received a great deal of hands-on computer experience as part of their ESOL classes were frequently called upon by adults and peers in their schools for assistance in setting up hardware and software, troubleshooting, and teaching others. The ESOL children became experts in their classes and school. The district technology specialist told us,

One of the students in Calculus did her report that she did, each of the ESOL children in fourth grade did a report and the slide show feature again. They

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scanned pictures from their home country. Where they live. This one little girl was from Thailand and she had a picture of her house. It was made of sticks, that's the type of house they had. And she had scanned pictures of moneys, costumes, whatever she had taken from her own stuff at home. She put it in the slide show to explain what it was like in her home country and then the ESOL teacher had her do a presentation for all the other fourth-grade kids in her classroom. The fourth-grade kids watched the slide show, and they were like, "Did you do this?" And she explained. They asked her all these questions about, well, how did you get the picture of your mother onto the computer. And so the little girl explained how she did it and how it worked, and the ESOL teacher said that the kids were very jealous of the fact that she could do this, and they wanted to learn. It really elevated her among her peers. (interview, spring 1998)

In addition to excellent teachers, the two focal ESOL classrooms enjoyed a great deal of support from the immediate and extended school community. The central district office was very active in procuring state funds to support the acquisition and maintenance of computer products and to provide training for the ESOL program. Moreover, the district strongly encouraged the use of technologies as tools to support thinking, talking, and writing across the content areas.

### DISCUSSION

The goal for nonnative-English-speaking children in U.S. schools is to become full participants in the academic or mainstream discourses. Principally, they need to be able to read, write, and understand English sufficiently to master the content of their regular classes and, like their native speaker counterparts, do well in school and succeed on tests. Both our survey data and the results of our 2-year classroom study indicate that many ESOL professionals are using technologies well in supporting these goals and processes. The L2 and literacy activities reported and observed take advantage of specific features of c-texts in ways that optimize learners’ engagement in the spoken and written work. The results are not only local, moment-by-moment achievements but also the attainment of the skills students need to achieve in the larger context of school (Mestek et al., 1999). A consistent aspect of this process is that c-texts are viewed not as primary curricula that drive learning, rather, they are viewed as tools that can be called into the service of learners’ immediate needs through careful task design and continuous exploitation of teachable moments.

This study provides some evidence that examining what teachers do with technologies yields insights on the realities and potential of the medium. Studies from outside the discipline also support this notion (see Cohen, Levin, & Souviney, 1986; Carter & Gillingham, 1998; Mergendoller, 1996). As Edelsky (1996) aptly points out, what good teachers do “requires perceptiveness and courage but no unusual materials” (p. 78). Turning to the courageous and perceptive teachers who are using technologies to support their L2 and literacy instruction, researchers can begin to learn what works best for c-texts in TESOL.

### ACKNOWLEDGMENTS

This research was supported by the U.S. Department of Education’s Office of Educational Research and Improvement (Award No. R305A00008). The views expressed herein are those of the authors and do not necessarily represent the views of the department.

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Does Popular Speech Recognition Software Work With ESL Speech?

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Recent research (Lyster & Ranta, 1997; Spada & Lighthoon, 1993) suggests that L2 learners can benefit from explicit error correction under at least some circumstances. If computers are to play an effective role in providing corrective feedback on errors in learners’ spoken language, automatic speech recognition (ASR) software must be able to (a) recognize nonnative language and (b) identify errors similar to those identified by human listeners. This study used these two criteria to evaluate the effectiveness of a popular ASR package for ESL speech.

ASR FOR ESL

Although several software packages include an ASR component designed specifically for use within the language classroom, little relevant information is available about the suitability of general-use, commercial ASR packages for ESL speakers. Also, despite the recent attention given to automatic recognition of foreign-accented speech (e.g., Price, 1998), little work has directly compared computer speech recognition with the comprehension of human listeners. In the most pertinent study dealing with this issue, Coniam (1999) evaluated the accuracy of Dragón Systems’ Naturally Speaking for 10 Cantonese speakers by having them read a passage of about 1,000 words aloud into the computer. He assessed the software’s ability to recognize Cantonese-accented speech by counting the number of words, clauses, and other units correctly printed out by the computer. The software was considerably less effective at recognizing the Cantonese-accented speech than at recognizing native English speech, an issue that has important implications for pedagogical uses of the software. Although Coniam concluded that the software was not yet usable by ESL learners, he suggested that it might have future pedagogical value as a means of giving corrective feedback. In particular, he proposed that when a more highly developed version of the software incorrectly recognized a word, students might view the computer’s error as an indication of a mispronunciation needing correction.

The software used in Coniam’s (1999) research is a readily available ASR package. The user dictates the desired text into a microphone connected to the computer, which then transcribes the oral input. Upon completion of the task, the speaker manually edits any errors produced by the program. Obviously, the more errors the software makes, the more onerous the editing task. Although this package was not designed specifically for ESL speakers, ESL students sometimes purchase it for their own use, hoping it will help them with writing assignments and general word-processing needs. Moreover, it is not unusual for those responsible for purchasing software for computer labs to be tempted to try ASR software whether or not it was designed with the classroom in mind—a temptation that is likely to occur more often as technology becomes even more prominent in classrooms. In the current climate, careful attention needs to be given to the methods and results of ASR software evaluation.

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