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Computers in Foreign Language Education: Teaching, Learning, and Language-Acquisition Research

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WHEN THE computer comes up for discussion among foreign language faculty members, there tends to be little disagreement about its value in word processing and in scholarly research that requires complex text manipulation. There is a great deal of disagreement, however, about its value in language teaching. Some foreign language teachers are enthusiastic, but many are skeptical or hostile (Olsen). At the very least, this disagreement provides unarguable evidence that language-teaching software, in contrast to word-processing software, is not yet sufficiently developed to persuade us immediately of its worth. Nonetheless, it is no more reasonable to dismiss the entire enterprise of computer-assisted language education because current software is inadequate than it would be to dismiss the efficacy of textbooks because some are bad.

My purpose here is not to rehearse the arguments either for or against computer use but, rather, to suggest that both the enthusiasm and the skepticism are based on faulty notions not only of what the computer can do but also, and more important, of what we as teachers ought to want it to do. In fact, I will go so far as to suggest that the need to think clearly about what the computer ought to be asked to do in foreign language education will have the highly salutory effect of causing us to think through our goals from important new perspectives.

Although I focus primarily on the use of the computer alone, its impact on many areas of language instruction will clearly be much greater when it is intelligently interfaced with audio and video. Nonetheless I cannot agree with those who argue that the computer in itself delivers a sterile and overly text-oriented representation of language, that only interactive audio and video can deliver dynamic, culturally authentic, well-rounded language instruction. In the first place, working with written text is a major part of foreign language education; at all but the most elementary levels, perhaps, reading and writing are an important part of a balanced program, and the computer can certainly address the learning of these abilities without audio or video support. Second, intelligently interactive audio and video cannot be achieved without a sophisticated understanding of how the computer can best manage the learning environment for the individual learner and for the particular learning task; the most wonderfully attractive and authentic video materials cannot of themselves work efficiently as a language lesson. Because the computer implements pedagogical principles that organize the audio and video materials, its intelligent use requires our most serious attention.

And that, of course, is the main point: what is the most intelligent use of the computer? What activities should it assist, and how? Until recently the most commonly used acronym for the endeavor has been the generic CAI, computer-assisted instruction, but we also find increasingly frequent references to CALL, computer-assisted language learning. Strictly speaking, CAI might refer to instructors' activities in which the learner does not directly participate, and here the computer's assistance can certainly be valuable. Computer grading programs save an enormous amount of time, and computer-generated materials that can be reproduced for class use are of crucial importance wherever the teacher wishes to supplement commercial materials with custom-made ones, especially in the teaching of languages for which few published materials exist.

The complementary strict interpretation of CALL would then refer to any application of the computer

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that directly engages the learners. In much of the literature, however, CAI and CALL seem to refer interchangeably to materials for student use (as for example in Dunkel), although some writers attempt to make principled distinctions between CAI and CALL along several different lines, as Underwood spells out. What is the difference between a computer program designed to assist instruction and one designed to assist language learning? (Ideally, we would like to think of them as two sides of the same coin.) One common way of drawing the line has CAI referring to computer activities that replicate and extend classroom explanations and drill, with CALL reserved for software that engages students in using the language for "interesting" purposes (i.e., those that avoid focusing the student's attention on the formal features of the language), such as simulations, problem solving, or content learning. In considering possible roles for the computer in their classes, many teachers argue for the desirability of CAI in this sense; they would like to be able to delegate the more "mechanical" and "tedious" and "noncommunicative" language-learning activities (i.e., work on grammar and vocabulary) to the computer, in order to free class time for spontaneous interpersonal language-using activities. Underwood, however, argues that explicit attention to grammar and vocabulary is unnecessary or even counterproductive, on the computer as well as in class, and insists that CALL materials represent the only theoretically sound use of the computer.

This kind of debate about the appropriate role of the computer in the classroom is fundamentally misconceived, because it is based on, and serves to perpetuate, a problematic split that affects all foreign language education, a conceptual split between *knowledge of language*, some understanding of its linguistic rules, and *the ability to put that knowledge to use*. We operate today on the assumption that knowledge of language can be "taught," while the ability to use that knowledge is a set of complex skills—skills such as comprehending spoken discourse, speaking, reading, and writing—that students must acquire. We know that "teaching" a complex skill is not the same as teaching a body of knowledge; in fact, a complex skill cannot be taught but can only be practiced until it has been learned. All the teacher can do to assist in the learning of skills is to structure the class environment to encourage practice, continually adjusting the demands of the environment to allow learning to proceed at an optimal pace. The problem is that in today's ideology this conceptual split automatically devalues knowledge in relation to the ability to use it, and the entire field of foreign language education is bedeviled by doubts about how (or even whether) knowledge actually contributes to that ability.

I have argued elsewhere ("Problem") that the assumption of this split turns into a self-fulfilling prophecy. As long as we think of a knowledge of grammar as distinct from the ability to use language (a belief commonly expressed as "teaching them grammar doesn't help them use language appropriately"), the materials we design to teach grammar will have little relation to students' language-using activities. We cannot solve the problem, however, by focusing exclusively on CALL materials. For one thing, materials that encourage students not to pay conscious attention to the form of language but to use language "to do something interesting" often seem uneasy about the degree of accuracy that should be required of the students' language production. If the materials hold up the allegedly interesting activity until certain formal criteria are met (regardless of whether explicitly grammar-oriented feedback is provided), students will certainly learn very quickly what the real point of the computer interaction is. At the same time, teachers—even those who are not "hung up" on grammar—tend to be anxious about letting students use programs that disregard the formal aspects of language production. What is more, to assign beginners materials that require problem solving, game playing, or content learning is to overlook completely that these students have not yet learned the language skills needed for such activities—the skills of reading and writing. Finally, I can't help finding it odd that language teachers should regard a language program as necessarily more interesting if it focuses on something other than language.

In this discussion, therefore, I adhere to the most obvious and literal distinction between the acronyms and use CAI to refer to software designed to carry out the traditional pedagogical assumption that the subject matter is to be presented and worked over until it is "mastered" in some abstract sense quite independent of communicative language use. Lessons designed from this perspective tend to be "computerized" versions of workbook materials, and even though they can be more effective than paper-and-pencil exercises in helping students acquire that abstract mastery, they still fall far short of the CALL ideal. CALL should be reserved, I believe, for computer materials based on the best current theories and research on how the complex skills that constitute "knowing a language" (which, of course, includes the ability to use it) are learned; in this sense all computer programs that engage the learner should be CALL materials. Since in order to program the computer to carry out a task one must first analyze the task in painstakingly logical detail, a serious effort to develop CALL will depend crucially on our detailed understanding of the language-using abilities we want our learners to develop.

When we define what we want our students to be

able to do, we conventionally refer to spoken and written goals and speak of four skills—speaking, listening, writing, reading. Thinking first in those terms, however, makes us overlook the primary skill that underlies all of them, the ability to use the language's underlying principles of grammaticality. In the most general terms, knowing a language means being able to express one's meaning in that language and to understand the meaning that others express; and meaning is carried both by lexicon and by grammatical form. The point is that we urgently need CALL materials that help students learn grammaticality, not CAI materials that teach them grammar. (Most grammar lessons, both on the computer and on paper, focus exclusively on teaching what the forms are and how they relate to one another in the formal system, i.e., "if there's an X in the sentence you need to use a Y," or "you get structure B by doing these operations on structure A.") CALL grammar materials both explain grammatical forms and structure opportunities for the learner to practice them, not in relation to an abstract linguistic system but in connection with what meaning they convey, with what words, how they are constrained by communicative factors, that is, the sociolinguistic, pragmatic, or discourse context. (At times the presentation and the practice will show that in certain usages some forms are merely surface requirements, having no discernible meaning.) As yet there are no CALL grammar materials on the market that incorporate this perspective, but I have elsewhere suggested some possible designs ("Psycholinguistic").

Vocabulary is the other major component of all four skills. What kind of ability is expected of our students when they "learn vocabulary"? To teach it conventionally is to convey some sense of a word's meaning, whether through an English equivalent, a foreign language paraphrase, or a picture or demonstration. CAI lessons teach vocabulary by drilling students in attaching a word to one or another of these. But surely the desired result of learning vocabulary is the ability to use the words to express one's own meaning appropriately, which does not mean merely being able to plug the word into the appropriate form-class slot in a semantically vague sentence. So CALL vocabulary materials will have to provide authentic, interesting discourse contexts for using vocabulary, and there are a few lessons on the market that approach this. (Video too has great potential for presenting vocabulary in context, but as I said earlier, mere visual presentation does not of itself make an effective lesson.)

Of the four standard skills, speaking is the one most heavily emphasized in current methodological discussions, and listening is its complement. One can hardly imagine being able (or wanting) to carry on humanlike, spontaneous, open-ended conversations with a computer, but we should not underestimate the potential value of a computer-manager environment for practicing certain aspects of speech, such as pronunciation, intonation, rhythm, and fluency. To permit this practice, a computer must obviously have some audio capability, which at present is lacking in most microcomputer configurations. However, enough work has already been done with various random-access audio devices (audiodisc, videodisc, CD ROM, digitized sound, etc.) to make clear the enormous potential of computer-interactive audio as an environment for practicing speaking and listening comprehension.

When we consider reading, the computer's ability to manipulate text makes its potential seem obvious, but very little currently available commercial software for foreign language reading comes close to realizing even a fraction of that potential. Many reading-comprehension materials, both on the computer and in print, are nothing but vocabulary lessons, and others only train students to identify phrases in the text that supply certain pieces of information. What does it really mean to be able to read in a foreign language? Recent research on the relation between top-down and bottom-up processing, among world knowledge, word knowledge, and grammatical knowledge, between the reading strategies of native speakers and those of foreign language learners contributes to the growing awareness that reading is a far more complex skill than most current materials address.

Unfortunately, basic language courses are hard-pressed to "cover" even all the basics of sentence syntax; yet, to read successfully, students need to discover and work with text grammar, the principles by which simplex sentences in the pragmatic mode of conversational discourse are combined and compacted into the complex syntactic structures of written discourse. Software design is already more than sophisticated enough to allow dynamic screen representation of these principles and to support lessons in which students can practice applying them, as well as lessons demonstrating the principles of paragraph cohesion and coherence, the use of anaphora, and topic-comment structures and lessons exploring the particular characteristics of various stylistic features or different kinds of text—for example, narrative, explication, and argument.

Such reading exercises could help students bridge the gap between predigested or specially written textbook passages and authentic published materials. We have all had the frustration of assigning a "real" text to be read outside class, hoping to spend class time discussing its literary or cultural significance, only to bog down dealing with students who have "looked up all the words but don't know what it means." Computer programs make it possible for teachers to create a graded reading passage from any attractive bit of text, to add vocabulary or grammar or cultural notes at pre-

cisely the appropriate level (so students are not distracted by unnecessary glosses or frustrated by missing ones), to make available the idiomatic translation of a word or phrase to contrast with the literal translation—and to do all this without knowing anything about programming. These goals are not futuristic fantasies; computer materials along these lines have already been developed and are being pilot-tested at the University of Minnesota, and similar projects are in progress at the Universities of Iowa and Illinois.

It is obvious that working on the computer will not in itself enable students to think better about what they read, to achieve critical insights, or to grasp cultural implications. But the ability to read is the sine qua non both of literary study and of the mastery of language for special purposes. (There is a rapidly increasing need for language courses that focus on business, agriculture, engineering, computer science, etc.) The development of that ability constitutes the bridge between "language courses" and all subsequent courses in the language that focus on other content.

The fourth skill, writing, demands a major investment of time by both teacher and student. Unfortunately, teachers of basic language courses, especially with today's emphasis on the development of speaking proficiency, cannot possibly make the time very often to assign even minor papers if they try to do conscientious corrections. The power of word processing as a tool for teaching composition, editing, and revision is quickly gaining respect in English departments around the country, and competent foreign language word-processing packages are now available for comparable use. Noblitt, Solá, and Pet have designed an extraordinarily efficient word-processing program in French that has a built-in lexicon and full reference grammar, so that students are minimally distracted by the need to consult such aids.

Ideally, of course, all language learning materials, not only those for the computer, can and should be based on a detailed analysis of the skill to be learned. The point of using the computer lies in its unique ability to deliver materials that meet the needs of the individual learner. "Individualization" has always been touted as one of the computer's important advantages, but in fact it has so far been achieved only in superficial ways: it seldom means anything but allowing students to proceed at their own pace or, in some software, to choose a desired lesson segment from a menu. Such options are certainly of benefit, but CAI, based on standard conceptions of the subject matter, presents the same material in the same way to every student. True CALL lessons, in contrast, are based on the learning process, which varies for every learner, and therefore must be structured to allow individual students to get access to the particular explanations and practice opportunities they need. Such lessons should be able, for example, to analyze the current level of ability and suggest the appropriate path through the materials. They should also be able to analyze student language so that they can not only give feedback about a specific error but even suggest why the student might have made it. Similarly, a range of options geared to individual learning styles should be available: some students approach language-learning tasks analytically, others holistically; some want to use all possible helps to avoid making errors, others prefer to guess and learn from their errors, and so on. (This feature does entail training students to understand their needs and their learning styles, as well as suggesting efficient learning techniques; students are used to being taught rather than taking the responsibility for their own learning.) All these variations and more are eminently possible with intelligently designed CALL.

Certainly there is still an enormous amount to be done in working out the principles of natural language processing on the computer, and the astonishing rate at which entirely new technologies appear on the scene shows that we cannot hope to arrive at definitive answers to questions of what might be done with technology in foreign language education. But the hardware and the programming are already far more advanced than our capacity for making sophisticated pedagogical use of them. The real hindrance to the implementation of CALL materials, as I have defined them here, is our inadequate understanding of the language-learning process—and that brings us to the third topic indicated in my title, language-acquisition research.

A good deal of ambiguity commonly attends discussions of foreign language research in connection with the computer, and it might be well to spell out first the kinds of research that are not at issue here. Among the literature faculty in the foreign language departments of research-oriented institutions, the use of the computer is usually linked to scholarly textual research, in which the computer performs text manipulations such as collocations. In foreign language education, research projects are usually methodological, and research on the computer is often assumed to focus on the computer's efficacy in delivering foreign language instruction. In addition, the computer can collect the same kind of student language output as do paper-and-pencil exercises; it can be programmed to recognize correct and incorrect language and to supply scores on which to base conclusions about various methodological treatments. And finally, of course, research in language education, like that in any other discipline, can use the computer to organize quantified data and perform statistical analyses. The following discussion concerns none of these.

Of interest to this exploration of the computer's

potential is the research that directly informs the effort to develop true CALL materials, that is, research on the language-learning process, investigation into the ways learners develop their own idiosyncratic hypotheses about how the foreign language encodes meaning. Such "basic" research is essentially psycholinguistic and may be strongly influenced by linguistic theory, or by theory and research in first language acquisition or nonclassroom second language acquisition. This kind of research is well recognized in the field of English as a second language, less so in foreign language, but almost none of it has made use of the computer except for handling statistics.

The computer can play two roles in research projects investigating the nature of language learning. First, since it can track many details at once and analyze the relations among them, it can deal with far larger and more complex amounts of data than can human researchers, and this ability is crucial to the investigation of anything as complex as the underlying reasons for language learners' errors. Experienced teachers have well-founded hunches about why students have certain problems, but even a very good teacher with a very small class cannot constantly keep track of the details of each student's every language production under minutely specified linguistic and communicative conditions, all of which are needed to diagnose why individual problems occur. The computer can keep track of everything it can be programmed to recognize, so if the researcher can specify the conditions under which a certain error is caused by one misunderstanding and can specify other conditions under which "the same error" has different causes, the computer's tabulation of these conditions can be read with considerable certainty as an analysis of an individual learner's underlying processing problems.

For example, second-semester university students were given a number of sentences to translate from English into German, sentences including a large number of indirect objects in a variety of contexts (Garrett, "In Search"). (The students had no idea that any particular grammar structure was of interest in the study, though obviously they recognized the general focus on grammar.) Some students translated noun indirect objects correctly but consistently made errors on pronoun indirect objects. This is a surface-level morphological problem; the pronoun paradigms in German are highly irregular. Some students tended to translate animate indirect objects correctly more often than they did inanimate ones; such a pattern betrays a semantic problem, the use of a semantic feature to control a grammatical form that is in fact independent (at least in English and German). One student produced all indirect objects correctly except those in sentences like "he told his mother what had happened," where the whole second clause constitutes the direct object; her errors showed that a syntactic feature that should have been irrelevant controlled her production. Many students were able to translate indirect objects correctly if the English stimulus sentence was of the type "he gave my brother the money" but routinely did so incorrectly in sentences like "he gave the money to my brother," where they translated the preposition *to* literally instead of omitting it and using the dative case: their error could be attributed (superficially at least) to "interference" from the English. In fact, the unavoidable conclusion from the aggregated performance of these students (who were highly motivated learners with A's and B's for their previous semester's work, which had included the indirect object) was that an extraordinary proportion were translating the indirect object on the basis of some linguistically irrelevant clue instead of using the one unambiguous and obligatory semantic feature—the recipient of the direct object—because they had no clear sense of what the grammatical form conveys.

In compiling and analyzing such complex data the computer is certainly performing a task that human researchers will seldom have the time for (and it therefore enables research that would not otherwise be undertaken), but it is not one that is, strictly speaking, impossible for the teacher-researcher. The second and more intriguing role open to the computer in basic research, however, depends on the uniqueness of computer-learner interaction and provides teachers with an opportunity to develop an entirely new approach to basic research on classroom foreign language acquisition. I refer here to the computer's ability to interact with the learner in the act of producing language, to respond instantly, consistently, and objectively to "online" learner language production. This procedure may sometimes be nothing more than standard feedback, where the computer's response ends each interaction by confirming or denying the correctness of the learner's production. Even this kind of program would allow studies on the working hypotheses of individual learners and on the effect of various kinds of feedback on these hypotheses.

For example, in the study of indirect objects discussed above, the computer responded to the student's sentence translation by indicating the location of errors, which the student had to attempt to correct. If the first correction attempt still contained errors, selected grammar explanations could be called to the screen for the student to refer to before attempting further corrections. These features allowed a number of significant insights. One was the pervasiveness of the "binary correction strategy" used by students to correct errors: "If it isn't X it must be Y." Use of this strategy gives the impression that the student actually knows the correct form but had momentarily forgotten it, but a routine repetition of precisely the same

error and same correction throughout a task shows not only that the error occurs regularly but also that the student is actually learning nothing from the feedback. Another conclusion allowed by the tabulation of the help sought and the attempted corrections is that even among students who had done well on their classroom grammar tests many had no idea at all why a certain grammatical form was correct or incorrect (e.g., why the dative case should or should not be used for the indirect object); they routinely "looked up" points of reference grammar that had nothing to do with the errors they were trying to correct. (This conclusion is corroborated by the frequency with which they used irrelevant semantic or syntactic features to control their production of the indirect object.)

The computer's ability to generate this kind of information makes it a research tool of unprecedented power. Results of such research about the psycholinguistics of classroom foreign language learning can be immediately used in several valuable ways. First, information about an individual learner's own hypotheses can be fed back into the operation of the computer lesson itself (if, of course, the program is designed to collect and use the information), enriching the feedback and directing the student's path through the available lesson material and helps. Second, analysis of this information can contribute to the improvement of lesson design in future materials development. Third, teachers who can access this information by checking either student disks or printouts can use it as a basis for helping individuals with problems or for assessing the needs and the progress of whole classes.

But such studies on foreign language learning can also contribute significantly to the development of language-acquisition theory. In the fields of linguistics, applied linguistics, psycholinguistics, and English as a second language, important efforts are being made to understand how the human mind acquires and processes language. Such studies are as yet rather an anomaly in foreign language education—neither methodological nor literary, nor for that matter linguistic in the conventional sense—and because of disciplinary traditions, foreign language teachers have until recently neither contributed much to them nor reaped much benefit.

This kind of research offers an extremely important opportunity to faculty members in foreign language departments; it not only relates directly to teaching but has theoretical substance and intellectual rigor—the effort, in short, merits the researcher's promotion and tenure. The computer is essential to such research, partly because the data required are necessarily complex but also—and more important—because they can only be collected in the moment-to-moment language processing of the individual. Developing the research materials themselves will not be difficult; any sophisticated CALL package that allows for the collection and compilation of the student's input can generate such data.

But as things stand now, the development of software is not recognized as research by most major research universities, any more than is the writing of textbooks. Furthermore, the computer-equipped "language lab" is almost universally thought of as a service unit, a place for the most mechanical, most tedious aspects of language instruction, not as the locus for substantive promotable research. For both these reasons, junior faculty members who are interested in the use of the computer are often warned that such activities will not count toward tenure. This is a serious problem, resulting in the waste of significant opportunities for the advancement not only of these faculty members but also of the field of foreign language education itself.

The solution depends on complementary changes in two arenas. On the one hand, foreign language faculty members and administrators above the department level must understand what distinguishes this kind of research from "pedagogical" studies and what its value is. (This is no easy matter—established notions of what constitutes the proper research for a discipline seem sometimes to be set in concrete.)

But to accomplish that change in perception we need also to enhance the visible status of the research, and one factor in that status is the attitude toward the research locus itself. As long as the "language lab" is thought of as nothing more than a roomful of machinery where students slog through dreary impersonal drills, faculty efforts in that arena will have no prestige. I have done a certain amount of consulting at universities around the country where the foreign language departments are planning to set up computer sites, usually in conjunction with language labs, sometimes freestanding. I am deeply concerned that a great many such plans do not include any planning for research, and that as a consequence the extraordinary potential of the computer in this regard will not be realized.

Setting up a computer site to accommodate language-acquisition research by faculty members as well as language-learning activities by students is not a matter of extra hardware or even of much extra expense. The real essential is the staffing. To have validity as a research facility, the center must be an academic unit directed by someone with research credentials in the field. I am distressed by job listings in the *Chronicle of Higher Education* that describe managerial positions in language labs as requiring the ability to undertake minor repairs and as responsible primarily for scheduling. It is abundantly clear that faculty members wishing to undertake research that will make them promotable will not see any advantage in working with such a unit. Even if it has to be "managed" by a

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nonacademic staff member, it should be directed by faculty members committed to language-acquisition research. The director might have a joint appointment, part-time in the research center and part-time in a language department, and there could be other part-time or even zero-time joint appointments to form a nucleus of faculty members who can develop research projects, write grant proposals, and so on. Such a staff can of course also support materials development, teacher training, and all the other service functions of the more traditional language lab.

In sum, I believe that the most important potential of the computer lies in its ability to provide a richly supportive language-learning environment in which students are helped individually to develop, expand, and refine their own expressive and communicative abilities in a new language as well as to understand what language and language learning are all about—surely important parts of a liberal education. Computer-assisted learning must be the focus of our efforts, but our development of its potential will significantly affect our teaching and our research as well.

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