

# DEVELOPMENT OF A TECHNOLOGY FOR LANGUAGE INSTRUCTION USING MULTIMEDIA PCs

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This paper describes the Language Technology Project which is now four years old, at the University of Central Florida's Institute for Simulation and Training (IST). The goal of this project has been to develop, evaluate, and commercially produce language courseware and training techniques for personal computers (PCs), including MS DOS (IBM-compatible) and Macintosh PCs equipped with voice interfaces. The project uses hypermedia software shells augmented by specially developed software for authoring the courseware. Researchers in the project are developing applications for computer-based language training and translation. These applications include language education for public school and university students, the "Forms Translator Assistant," "Dispatch" for rapidly teaching survival Spanish to 911 dispatchers, and "Survival Somali" developed for the U.S. Marine Corps for use in Somalia. Survival Somali was developed in five weeks from the initial identification of its need to delivery to the Marine Corps and is more fully described in another paper in this *Proceedings* (Mullally, Kincaid and Kishek). The ability to respond this rapidly was the result of resources and expertise already in place.

## AUTHOR'S BIOGRAPHICAL SKETCH

### **J. Peter Kincaid**

Dr. Kincaid is a Senior Scientist at IST. He earned his Ph.D. at Ohio State University and has over 25 years of human factors research experience including 15 years of university teaching experience. From 1979-1985 he was one of the Navy's lead scientist for developing English as a second language training courses. He developed the Department of Defense's readability standard. He has served as a NATO lecturer, and has worked for the Naval Training Systems Center, the Air Force Human Resources Laboratory, and the Army Research Institute. Dr. Kincaid has published over 70 journal research articles and technical reports. His current research activities include cost and training effectiveness, language technology, and human factors design of training devices with emphasis on computer-user interface.

### **Daniel E. Mullally Jr.**

Mr. Mullally, a Research Associate at IST, has 20 years of military experience. As a training systems expert, he has served as a training consultant in industry, a war-games designer, and on several projects applying high technology to military training. Mr. Mullally is currently part of an R&D team designing semi-automated forces for a U.S. Army networked simulator. His research activities include the conceptual design and development of the Forms Translator Assistant for the U.S. Customs Service using a computer-assisted test and speech presentation methodology.

### **Catherine Meyer**

Ms. Meyer has nine years of college and university teaching experience in French, Spanish and English as a second language. She is currently teaching foreign languages at the University of Central Florida, and is also an expert in instructional development, serving as the lead author and coordinator of production for the computer-based Spanish instructional aid "Pedro and Friends" (created at IST). Ms. Meyer is currently enrolled in the doctoral program in instructional technology, specializing in multicultural education, at UCF and is a Research Assistant at IST.

### **William J. Bramble Jr.**

Mr. Bramble is a graduate of the University of Central Florida. He is currently enrolled in the human factors doctoral program at UCF and is also a Research Assistant at IST. He has been involved in the evaluation of computer-based language training aids and has presented his work at several national conferences. Mr. Bramble is also part of a research team developing human-computer interface for virtual environments.

## INTRODUCTION

There are many potential benefits for developing computer assisted language learning (CALL) — (Kincaid, Mullally, and Kincaid, 1992), Interactive courseware which simulates an instructor who is a native speaker of the target language allows students more intensive individual practice.

The Language Technology project at the Institute for Simulation and Training (IST) has three areas of emphasis, to: (1) develop demonstration courseware, (2) evaluate the more promising demonstrations and conduct studies to establish effective learning strategies, and (3) commercially produce language courseware and training techniques.

Americans (including our military personnel) typically do not easily master fluency in foreign languages. Language books and audio tapes, used in schools, by industry and by the military Services are useful but have a number of shortcomings. The most important problem is that audio tapes make it awkward for the student to hear himself and then compare pronunciation against the recorded voice of the instructor. Students learning to speak a foreign language need extensive practice in pronouncing the language and receiving feedback. Ideally, this intense practice and feedback is provided by a native speaking instructor working with a single student. This is frequently not feasible and it certainly is expensive.

## BASIC TECHNIQUE

Our computer-assisted language training software is based on simulating how a student is taught by a native speaker. For instance, an English speaker wanting to learn Spanish, listens to a native speaker pronounce words, phrases and sentences, which are also displayed. The student speaks into the computer's microphone, and the sounds are digitized and played back. The student's pronunciation can then be compared with the native speaker's. This cycle can be repeated as often as necessary. In another variation, conversations are simulated (e.g.,

the student converses with a bank teller) and two hours of intensive one-on-one instruction with the computer can be critiqued by an instructor in just a few minutes.

The voice interface is probably the most important element of integrated CALL. The voice interface allows the student to do more than simply listen and repeat. Until computer diagnosis (e.g. voice recognition) and feedback is developed to be effective and affordable to public schools, the built-in listen-record-and-compare feature is the best non-human phonetic production tutoring device available. There are at least two important applications for voice interface: training students to understand phonetic production (spoken language) and training them in phonetic production.

## STRATEGY FOR THE R&D PROJECT

In our four year project, we have developed a number of strategies.

### **1. Make use of available low cost multimedia PCs and authoring languages.**

Our courseware runs on both Macintosh and IBM-compatible PCs. Either of which, fully equipped to run our courseware, can be bought for under \$1,000. For the Macintosh PC, our courseware runs on most old Macintosh PCs (such as the SE model) as well as all current models. The lowest priced of the current models costs less than \$900. Macintosh PCs have a built in voice interface for their newest models which use the version 7.0 operating system. On older models, a voice interface, the MacRecorder (cost \$75), plugs in.

The courseware works on IBM PC compatibles, models 286, 386 and 486. The lowest priced of the 386 computers equipped with a VGA color monitor, an 80 megabyte hard drive and a mouse can now be bought for about \$700 and the price is still dropping. The voice interface we are using is the DigiSpeech unit (cost \$150).

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This research has been supported by grants from the Florida High Technology and Industry Council and the Florida Technological Research and Development Authority, through a contract with Rei America, Inc., and through cooperation with the U.S. Marine Corps and Apple Computer Corporation. The authors wish to acknowledge the contributions of the following individuals: Col. Bruce Schwanda, Roger Huder, George Kishek, Patrick Kelly, German Calderon, David Arnold, Xavier Calderon, Denise Kostic, Ana Aboudoj, Kim Telish, John Kincaid, Sheri Murtaugh, Susan Lanham and AbdiRizak-Salah.

We are using standard authoring software for producing our courseware. For the Macintosh, we are using either HyperCard or SuperCard. For the IBM PC courseware, we are using Linkway. We produce additional software modules, which we find necessary for all of our application programs, in C and C++.

## **2. Capability for Rapid Development.**

Project personnel have followed a practice of quickly producing demonstration software, demonstrating a concept of computer-assisted language instruction in one to two weeks of concentrated effort. Demonstration courseware need not be a complete package; however, it should make apparent the value of full development.

One fully developed product, HELPS (Survival Somali) was developed in five weeks of concentrated effort (Mullally, et al., this volume). Given the extent of this project and the fact that it required the use of a language that the project team had no experience with, this was extremely rapid development. It was only possible, because the resources and personnel were already in place (and because of the availability of a Somali linguist).

## **3. Total Production Capabilities On-site.**

One must have all resources in place for production of courseware including computers, authoring software, voice interface equipment, a complete graphics department, audio recording capabilities and the right mix of expertise. Key personnel on the project are expert in instructional design, language education and computer programming. Several are cross-trained, for example in language instruction and instructional design. This is a key to our capability for rapid development.

## **4. Formative and Summative Testing.**

Testing, both to develop courseware and to formally evaluate the final version, is a routine part of the developmental process. Formative testing begins as soon as the earliest story boards have been implemented and provides continual feedback in the development process. Summative testing is conducted for courseware in the environment for which the courseware was developed. For example, "Pedro and Friends" was formally evaluated in elementary schools in Orlando, "Dispatch" in Orlando area fire departments and HELPS in Somali. The extent of

the evaluation varies somewhat according to circumstances. For example, "Pedro and Friends" was subjected to a rigorous experimental evaluation comparing the performance of a control group against that of an experimental group. HELPS was evaluated using a questionnaire. Several of these evaluations are described in detail below.

## **5. Concentration on Specialized Applications.**

The object is not to comprehensively teach a foreign language, but rather to concentrate on rapidly teaching limited (but useful) functional oral skills for particular applications. For example, HELPS is intended to provide the minimal survival language skills necessary for U.S. Marines to communicate relating to limited military and humanitarian topics. "Pedro" is a more comprehensive package, but it is designed to teach speaking and listening and does not stress reading and writing. "Pedro" is intended to supplement a traditional curriculum based on books and audio tapes.

## **6. Easy-to-Use Computer-User Interface**

Each courseware project has been designed to be easy to use. For example, "Pedro" was tested with first grade elementary students, and without exception, they have been able to begin using the program in no more than five minutes. For a variety of our projects, a mouse and a windows-like environment are typically used to provide an easy to use interface. Ease of use is evaluated in the earliest phases of development and throughout the development process. In fact, a significant amount of development time and resources is devoted to developing an easy to use computer interface.

### **COURSEWARE DEVELOPED TO DATE**

Courseware which has already been developed includes:

#### **1. *Pedro and Friends/Pedro y sus Amigos.***

"Pedro and Friends" (shown in figure 1) was developed to assist second language learning at an elementary level. Versions are available for Macintosh, IBM compatible and Apple II PCs. The courseware consists of "talking" cartoon characters who take the student through various comic-book style "adventures."



Figure 1. Screen From "Pedro y sus Amigos."

Also included in the software are drills and tests. The software is supplemented by a number of workbooks. This instruction is intended primarily for English as a second language instruction, but is equally applicable for foreign language instruction. Both English and Spanish voice tracks are incorporated into the program. The package is intended to supplement more traditional paper-based instructional material published by the same publisher, Rei America. The courseware has been evaluated in five elementary and middle schools in the Orange County (Florida) Public Schools.

**2. Advanced Conversational German** is an adaptation of conventional oral language instruction (consisting of a book and audio tapes) which is published by the German government. It was converted to interactive computer-based instruction and it was field tested in an advanced German class taught in an Orlando high school. Altogether, about 20 hours of intensive oral instruction were created. One interesting aspect of this project is that we are simply providing assistance to the high school which is doing most of most of the conversion work. Several talented high school seniors required only minimal training to do this work. Cost for this project is very low and it serves as a model for projects in other schools which tend to have limited funds.

**3. The Forms Translation Assistant (FTA)** (shown in figure 2) - was developed as a way to help non-English speakers fill out the various customs forms presented in their native language and provide additional information in their language.

The same technique is applicable for initial screening for military interrogations and for providing assistance to non-English speakers seeking emergency medical aid (for example in an emergency room).

The FTA resides on a standard IBM-PC (or compatible) computer with voice interface and a key pad. The computer is installed in a kiosk. Given the innovative nature of the approach employed in developing the FTA, many human-computer interface problems have had to be solved. For example, intuitive on-screen visual graphics and animation which match the associated oral instructions were developed. The FTA is currently implemented in English and Spanish. Training for use of the FTA has also been an important issue given that users: (1) speak a variety of native languages, and (2) may not be familiar with similar devices such as automated teller machines.

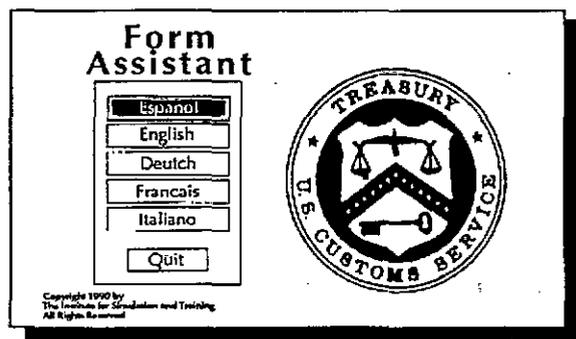


Figure 2. Opening Screen From "Forms Translator Assistant."

**4. Survival Somali** (also called HELPS) teaches the speaking of functional phrases and short sentences for U. S. military troops engaged in humanitarian support in Somalia. The program is hosted on a Macintosh PowerBook, which is a small portable PC with a built in voice interface. HELPS rapidly teaches key phrases to those who must have a functional grasp of the language in order to communicate orally. It also has a function to play pre-selected phrases through a public address system or through the computer itself. HELPS is described in detail in another paper of this proceedings (Mullally, et al.).

**5. Dispatch** teaches the minimal Spanish that an emergency, fire or police dispatcher needs to send the proper help. For example, the proper response for a domestic dispute is quite different than for a fire or a medical emergency. Also, the response for a child is frequently different than a response for an adult. Given the large number of immigrants who speak only Spanish, dispatchers frequently encounter this situation. The language data base for "Dispatch" is arranged as a hierarchy covering four different situations. The first statement in Spanish is

"I don't speak much Spanish, please answer yes or no." The typical dispatch can be made after four or five questions.

## EVALUATIONS

### Classroom Evaluation of "Pedro"

The most thorough evaluation we have conducted was for "Pedro" which was conducted at an Orange County (Florida) elementary school. The experiment compared the interactive computer version of "Pedro" with the same content presented as a comic book and audio tape.

Forty-six elementary school children were tested from fifth and sixth grade classes at Aloma Elementary School. They had no experience with Spanish. All subjects were native English speaking, and were proficient in reading and writing. Apple Macintosh computers were used to train the experimental subjects with the courseware. The recordings were made by native Spanish speakers.

Subjects were tested for their pronunciation of words and phrases with a definite "Spanish" sound. Native Spanish speaking judges scored each word for pronunciation accuracy and rating it on a seven point scale ranging from "unintelligible" to "native" quality.

Results suggest a strong positive learning effect for students utilizing the computerized practice method with voice recorder as opposed to the traditional technique. A t-test performed on the differences between overall pre-test and post-test scores for the two groups yielded a highly significant statistical result [ $t(44) = 3.132, p = 0.003$ ]. From a practical standpoint, the experimental group using the computer presentation had an improvement 2.5 times greater than did the control group using the audio tape and book presentation. Moreover, the computer group displayed significant improvement after training ( $p < 0.05$ ) for each of the 25 target words used to evaluate pronunciation performance. The control group, on the other hand, only showed significant improvement on 17 out of the 25 target words.

**Forms Translator Assistant.** Testing of the FTA was conducted in two parts including a pilot test using foreign students enrolled in the intensive English language program at the University of Central Florida, and a formal evaluation conducted at the Orlando International Airport.

Testing provided a successful proof-of-concept. Every subject tested at both UCF and the Orlando International Airport had an overall positive response to the FTA. Several revisions to the interface were made as a result of this testing. For example, the form was originally shown on two screens. This was necessary to be able to read the small print. Subjects had significant trouble in calling up the second screen (the bottom questions on the form) so a design change was made to enable users to navigate the entire form displayed on a single screen. Once the user selects an individual question, it is enlarged so that every word can be read.

Other results are: (1) the ergonomics design of the kiosk, which was based on military specifications, worked well with users having a full range of sizes, (2) the key pad worked well in accessing the program on screen (we used a "calculator," not a "telephone" key pad design), (3) the hierarchical arrangement of information (achieved by using a hypertext authoring system, Linkway) proved to be user-friendly, (4) a "286" IBM-compatible computer with a VGA monitor (either color or monochrome) is the minimum equipment configuration to host the FTA.

The FTA is clearly a viable concept which has been shown to do what it was designed for. The intuitive design features of the FTA interface lead to a rapid learning curve in achieving operator understanding the relationship between the key pad numbers and the on-screen superimposed numbering system. After a lengthy trip in an airplane the average non-English speaker arrives in the U. S. to the confusion and uncertainty of a confrontation with unfamiliar forms written in a strange language. The FTA can defuse a portion of that anxiety by providing personalized, interactive instruction with the rate of delivery determined by the user.

**Dispatch.** Testing of "Dispatch" is ongoing at the Orlando Fire Department, the Seminole County Fire Department and the University of Central Florida. Fifteen dispatchers at the Orlando Fire Department learned the required phrases in an average of six hours. An additional 15 dispatchers are being tested at Seminole County Fire Department. College students at the University of Central Florida are serving in a control group to compare learning using the computer presentation with learning using the same information presented in print and on an audio tape.

## CONCLUSIONS AND DISCUSSION

What is the explanation for the consistent finding favoring the computer-based presentation over the conventional presentation of print materials and an audio tape? The answer is most likely the interactive nature of the computer program, and/or the computer's fast record-and-compare capability which sped up the practice process, and allowed the users to more objectively compare their own phonetic production with that of the computer's "native-speaker" voice. Further studies might isolate these factors to see how influential they are. Researchers might also like to examine the influence of this type of training on the learning of language comprehension. In any case, interactive listen-record-and-compare computer-based language training aids seem to give an increased effectiveness for oral language for the several applications we have tested so far.

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