USING TECHNOLOGY TO INDIVIDUALIZE LEARNING EXPERIENCES IN READING CURRICULA FOR DEAF CHILDREN

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Motivation

Development of English literacy skills is a pervasive challenge in education programs for deaf children in the United States. Literacy levels of deaf children are far lower than those of hearing children of the same age, and this continues into adulthood. Gallaudet University maintains records of literacy skills of 17-18 year olds who are deaf. The median reading comprehension score of this age group is at the 4th grade level (Stewart & Kluwin, 2001). This affects many aspects of adult life, including filling out an application form for a job, taking the written test for a driver's license, following written instructions or simply reading a newspaper.

Many recent approaches use fingerspelling in efforts to improve reading skills in deaf children. Fingerspelling is a system of representing symbols of a written alphabet as signs (Valli & Lucas 1995). Fingerspelling plays a significant role in diverse methods of deaf education. It appears in teaching approaches that use Total Communication (Lowenbraun, Appelman & Callahan 1980) and/or systems of Manually Coded English (Schick & Moeller 1992) as well as bilingual-bicultural ("bi-bi") approaches such as the Fairview method (Schimmel & Edwards 2003). Further, researchers have determined

that fingerspelling is an important bridge to comprehension of English print (Nover & Andrews 2000).

Although fingerspelling is generally recognized as a useful technique for supporting literacy acquisition, the barriers to using it effectively are myriad. Classroom management while using fingerspelling poses several challenges. It can be difficult to address the needs of all students in a class because they have a wide range of fingerspelling abilities. In some cases, a teacher will fingerspell a word, and then will ask an individual student for the sign. If the student is slow in answering, other students may jump in and answer instead.

In addition, teacher confidence in fingerspelling and fingerspelling fatigue can exacerbate the problem. For hearing people, fluency in fingerspelling is generally the last skill mastered when learning sign (Grushkin 1998). Fatigue can set in when a teacher needs to repeat the same fingerspelling over and over again.

Other barriers present themselves outside the classroom. Students need to practice at home. However, ninety percent of children born deaf have hearing parents (Mitchell 2004), and most hearing parents are not fluent in fingerspelling. In some cases, the parents are recent immigrants and are not fluent in English. These circumstances impede fingerspelling practice.

A new technology

To provide fingerspelling practice opportunities both in and outside the classroom, we have developed a software technology called "Fingerspelling Tutor" (Wolfe 2007) which combines the realism of videotape with the interactivity of computer software. As seen in Figure 1, Fingerspelling Tutor is an improvement over previous technologies because

it utilizes 3D-animation to produce true-to-life motions including transitions between the signs. This is superior to conventional "flash-card" technologies that only show a series of static images of the signs. In addition, Fingerspelling Tutor has the flexibility to spell any word of any length.

static images only

Fingerspelling Tutor

Figure 1: Comparing the realistic motion of Fingerspelling Tutor with conventional "flash-card" series of static images.

Initial features for individualization

The original intent of the designers was to accommodate a wide range of skill by providing a choice of four skill levels, and, if appropriate, a way to control the speed of the fingerspelling. The four levels are "Alphabet," for students learning the manual alphabet, "My First Fingerspeller", "Intermediate" and "Advanced".

At the Intermediate level, students can choose among "Demonstration," "Practice" and "Quiz".   In "Demonstration", students can type any word and see it fingerspelled.

Figure 2 shows the first screen of "Practice." Students can choose from multiple categories (animals, first names, last names, and more). Each category contains a list of related vocabulary words. Figure 3 shows a practice session in action. Students see the fingerspelled word and then select an answer from one of the four possibilities, or they can press "Repeat" to see the fingerspelling again. Students can repeat a word as often as they like, and they can use the slider to increase or decrease the speed of fingerspelling. When the student presses "Enter", feedback appears immediately on the screen. At any

time, students can click "How am I doing" to see the number of words they identified correctly and a list of words that they misidentified. Figure 4 shows an example of this screen.

The difference between "Practice" and "Quiz" is that a quiz has a specific number of questions and offers a maximum of one repetition.

The biggest difference between the Intermediate and Advanced levels is the way students supply their answers. In the Intermediate level, students select the answer from a list of possibilities, while in the Advanced level, students type in the answers, as seen in Figure 5.
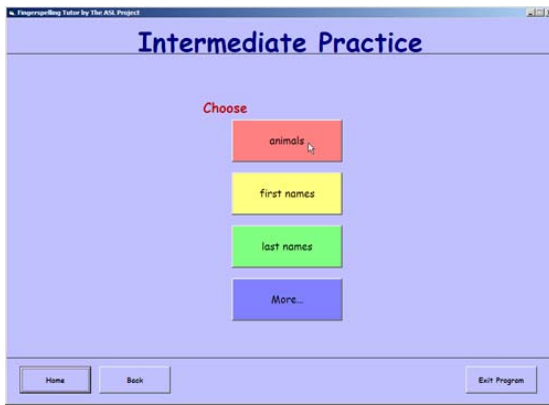

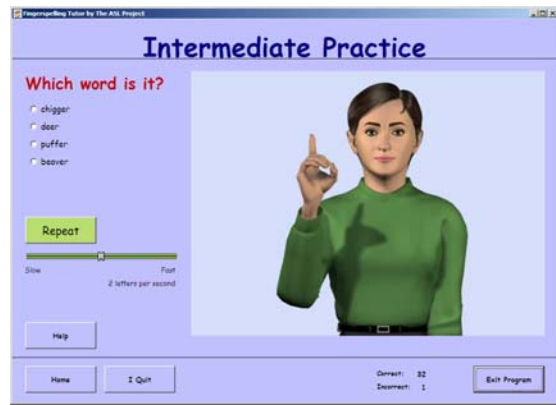**Figure 2: Starting a Practice session at the Intermediate level.**

Figure 3: A word is fingerspelled during a Practice session.

Figure 4: the "How Am I Doing" screen shows student performance during the Practice session.

Figure 5: A Practice session at the Advanced level, where students type in the answer.

Feedback from Classroom Testing

Classroom testing took place in grades K through 8 in a deaf program situated in a large metropolitan area. Fingerspelling Tutor was used to support the Fairview method.

Overall, the feedback was positive. Fingerspelling Tutor did effectively provide practice opportunities. It served as a motivator, and students spent more time practicing than with any previous technology.

Fingerspelling Tutor did prove useful for classroom management because each student could practice independently without interference from other students. In addition, teachers could provide more individualized instruction by dividing students into smaller groups, and assign selected groups to practice with Fingerspelling Tutor while the teachers worked with the other groups.

Instructors made two suggestions for improvement. Both involved adding features to facilitate more individualized instruction. The first was to provide a method to print the "How Am I Doing" page so it could become part of a student's portfolio and provide data for long-term student assessments. The second suggestion involved adding a feature to change the categories and the corresponding vocabulary word lists. While the first suggestion was a straightforward change, the second suggestion required the development of a second software product called "Word List Manager".

Facilitating additional individualization

Instructors wanted Word List Manager so they could present new words as part of a teaching module. For example when studying the Civil War, they wanted to use Fingerspelling Tutor to practice and review vocabulary related to the Civil War. Another

use for Word List Manager would be to create or edit vocabulary lists for individual students, for further practice either in the classroom or at home.

However, unless the new Word List Manager was extremely fast and easy to use, instructors said that they probably would not use it. Teachers are extremely busy and have very little time to learn new software. For this reason, our primary goal was to create an interface for Word List Manager that required a minimal learning curve. We wanted to make it quick and easy to create or edit a vocabulary word list. Further, we needed to make it easy and fast to transfer vocabulary word lists from one computer to another, because in many classrooms, computers are not networked.

Result: the new Word List Manager

Word List Manager works in cooperation with Fingerspelling Tutor. Instructors can use Word List Manager to create a new category of vocabulary words, and the new category will automatically appear in Fingerspelling Tutor.

Features of Word List Manager

To make the software easy to use, each screen displays the directions for the next step. Figure 6 shows the opening screen for Word List Manager with instructions for getting started. At this point, an instructor can choose to create a new vocabulary list or edit an existing one. When creating a new list, an instructor supplies a category name, as shown in Figure 7, and proceeds to the editing screen, as shown in Figure 8, where s/he can type the vocabulary words. All of the standard Microsoft editing conventions (copy/paste, delete) are available.

In addition to creating or editing individual vocabulary lists, instructors have the option of exporting one, some or all of the lists for easy transfer to another computer.
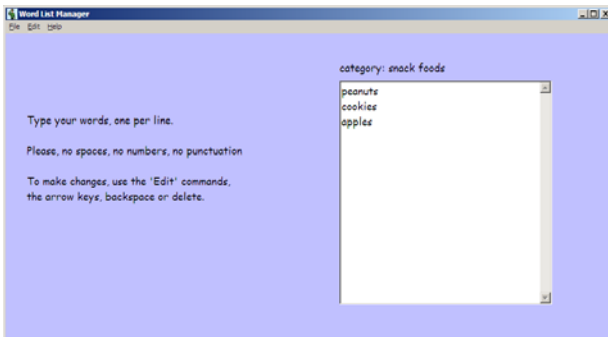
Figure 9 shows the export screen. The instructor has chosen "calendar", "cartoons", "dogs" and "fruits and veggies" to export. Importing the vocabulary lists to another computer is a four-click process.
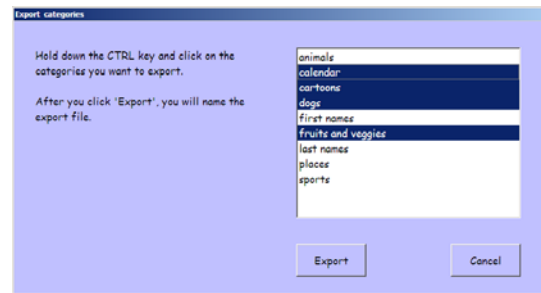

Figure 6: Opening Screen of Word List Manager.
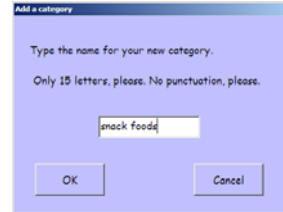
Figure 7: Naming a new category.

Figure 8: Adding vocabulary words to the category.

Figure 9: Exporting vocabulary lists.

Conclusions

Fingerspelling Tutor provides the visual realism and interaction to make it appealing to students who need to practice their fingerspelling. With the addition of Word List Manager, instructors now have a quick and easy-to-use means to tailor vocabulary lists for individual teaching modules or even individual students. For more information, and demo software, visit www.fingerspellingtutor.com

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