Making Apple computers accessible to blind children

by SUSAN H. PHILLIPS, ANDREW G. RENOUF, and ROBERT A. BOWERS

Sensory Aids Foundation
Palo Alto, California

ABSTRACT

Sensory Aids Foundation engaged in a study examining computer-aided instruction (CAI) with 15 visually impaired students. Off-the-shelf educational software was adapted for use with a speech synthesizer. Students were tutored in typing, spelling, and language skills. The study was conducted for approximately 6 months, and the results were analyzed and are discussed in this paper.
A revolution has occurred that is dramatically changing the way we live. Even those of us with few or no technical skills are being affected by the advent of computers in our society. Today children are learning through computer-assisted instruction (CAI) and gaining computer literacy as early as preschool age. In 1983, Market Data Retrieval estimated that there were 200,000 computers in educational settings throughout the United States and that 600,000 could be expected by 1985. While many children are preparing for success in our computer world, blind and visually handicapped children have been denied this experience of CAI and computer literacy. If continued, their lack of experience will widen the gap between them and their sighted counterparts, needlessly compounding their handicap.

A review of the current literature indicates that the Apple computer has been made to “talk” with a limited amount of software. Phillip Schwartz, president of Computer System Resources in Florida, has adapted some software for the blind professional, as has David Holladay of the Raised Dot Computer Company, Madison, Wisconsin. In addition, Peter Maggs at the University of Illinois has developed software that enables the Apple to talk for specific uses by blind college students. There are also several voice synthesizers on the market that enable an Apple computer to speak whatever text is on the screen.

This work is primarily limited to use by visually impaired professionals and college students rather than by the general visually impaired populace or, specifically, visually impaired school children. Even the voice synthesizer peripherals now available for Apple computers are of limited use because of the lack of compatible software. Thus, it was with this backdrop of issues that the present project was undertaken. The project endeavored to test the feasibility of adapting off-the-shelf educational software to a speech synthesizer unit that was compatible with the Apple II, II+, and IIe personal computers and would be within the financial reach of most school districts. The project was to then make any necessary adaptations to the selected software and to test the efficacy of the speech synthesizer and adapted software in teaching children specific skills. The project was also concerned with the effect of CAI in motivating the participating children to do further computer work and how it might affect their feelings about computers in general.

To do this study, Sensory Aids Foundation received a grant from the United States Department of Education* for the period of August 1, 1983, to July 31, 1984. SAF, a nonprofit corporation, emphasizes the use of technological aids to assist visually or hearing impaired persons to achieve their greatest potential for independent and productive employment and education.

OBJECTIVES

Project objectives were as follows:

1. To develop the ability to use a variety of preprogrammed computer applications in an academic context. This included the ability to understand the purpose of, and discriminate between, the different software used.
2. To foster awareness by the students of the growing role of computers in our society and of their ability to function, vocationally or personally, in such a society.
3. To use the Apple II computer to develop special software that would provide access to off-the-shelf educational software. The Apple IIe was chosen for this project because there were more than 187,000 Apple computers in educational settings in the fall of 1983.
4. To use the Echo II speech synthesizer (because of its relatively low cost, high quality, and ease of installation).
5. To enable the students enrolled in the project to use the software developed by SAF. This includes the ability to use a keyboard and to run the software with supervision, but unaided.
6. To encourage the students in the project to consider vocational computer training just as they might consider other present vocational opportunities. Currently more than one million workers find employment in the computer industry, and this number will continue to increase.

SUBJECTS

The subjects for this project were 15 visually impaired students (7 boys and 8 girls) recruited from the San Francisco Bay Area. The children selected were in third through sixth grades. Because of the small number of visually impaired students in the area, and the fact that the study was a pilot project, criteria for selecting subjects were extremely flexible. However, extensive background data were collected to aid in interpreting the study data. This information included age, sex, degree and stability of vision, type of school program (mainstreamed or special education classes), reading level, and previous exposure to computers. The children had varying degrees of visual impairment but no other disabilities.

MATERIALS

The educational software packages used were a version of Master Type by Lightning Software (approval was received
The Efficacy of the Speech Synthesizer

One of the concerns of the project was that the selected speech synthesizer, although possessing many other desirable attributes, would not produce speech sufficiently clear to be of use to students. This could be especially problematic with software such as the Echotype program, which required students to identify accurately single words—as opposed to words in a sentence, which can be better understood by using sentence structure and context as a guide. Our concerns about this matter were justified by the results of the Wepman Auditory Discrimination pretest given to the subjects. When two words (as spoken by the speech synthesizer) were the same, students correctly identified them as such 94% of the time within a range of 80% to 100%. However, when the two words were different, students responded correctly an average of only 44% of the time within a range of 33% to 53%. These scores were clearly due to the synthesizer’s lack of fidelity, which made distinguishing similar-sounding words extremely difficult. Our hope was that with repeated exposure to the synthesizer, students would become accustomed to the rather mechanical speech produced by the synthesizer. Indeed, this proved to be the case, although not to as great an extent as we had expected. In the Wepman posttest, students averaged 97% correct responses to the same word pairs within a range of 80% to 100% and 56% correct responses to the different word pairs within a range of 47% to 70%. However, the students worked with the computer and speech synthesizer for a maximum of only 45 minutes each week. This small amount of exposure may have limited the extent to which the students could become adjusted to the synthesized speech. The experience of the two researchers who conducted the CAI, and who subsequently had a more prolonged exposure to the synthesized speech, was that with more exposure one becomes more accustomed to the speech. This finding was supported by the Wepman posttests, although the question remains to what extent students would adjust to the synthesized speech with more computer time. The difficulty of unclear speech can also be compensated for to some degree by adjustments in the actual software, which would change the pronunciations of words that are not consistent with the phonetic rules used in programming the synthesizer.

The Wepman posttest results, coupled with the clinical observations of the two researchers involved in monitoring the CAI, leads us to believe that the Echo II produces speech sufficiently clear for it to be effective in CAI. However, it is a recommendation of this project that when programmers are adapting software for use with the Echo II, one concern will be to insure that all the spoken text is pronounced correctly in order to facilitate students’ understanding.

Software

The original intention of the project had been to take off-the-shelf educational software and to use it with little or no adaptation with the Echo II. We soon discovered, however, that almost without exception, educational software is very heavily graphics-oriented—many programs to the extent that

from Bruce Zweig prior to the sale of Lightning to Scarborough Systems, a spelling program, and a language arts program created by Sensory Aids Foundation. All three packages needed to be designed specifically for use with the Echo II.

PROCEDURE

All subjects were administered a battery of pre- and posttests: the Wepman Auditory Discrimination Test with the synthesizer speaking the words, a shortened version of the Minnesota Computer Literacy Questionnaire, a standard typing test (for the appropriate grade level) and the Stanford Achievement Tests for spelling and language (given at the appropriate grade level for each child).

Because of the large numbers of Apple II computers in the local school systems (due to the Apple Educational Program), the Apple II was chosen as the microcomputer for the study. It was felt that if the students in the study were to have further exposure to computers, it would probably be the Apple II. Therefore, using the same microcomputer would be consistent with probable future opportunities.

The speech synthesizer used in the study was the Echo II by Street Electronics. After a review of the available speech synthesizers, the Echo II was chosen because of its compatibility with the Apple II, its ease of use, and its cost, which was the least of all the synthesizers reviewed in October 1983.

Subjects were administered the pretests for auditory discrimination, computer literacy, keyboard proficiency, spelling, and language. The Project Director scheduled each student for 30 minutes per week of hands-on experience with the computer and voice synthesizer. Each student was taught to use both the hardware and the software. Basic information was given to each student on how a computer works. Students were allowed to explore the inside of the computer and actually feel the circuit boards. The students then received tutoring with an Apple II computer for 30 to 45 minutes each week for as many as 15 weeks. All 15 students received instruction with the Echotype program, 10 subjects received instruction with the spelling program, and 5 received instruction with the language program. At the end of the instruction period, posttests were administered.

ASSESSMENT

Because of the small number of subjects and the exploratory nature of the study, statistical analysis of data would not have yielded meaningful results. Thus, each case was looked at individually with the goal of identifying possible trends that would suggest further research questions.

RESULTS AND DISCUSSION

Because of the method of assessment and the nature of the results, the Results and Discussion sections will be combined so as to present the material more clearly. Thus, the project will be broken down by component and each will be assessed and discussed.
they follow a video game format. Thus, software selection for the project became not just simply choosing appropriate software according to its instructional content, but also according to the format of that content. The only software that readily lent itself to adaptation was older, public-domain educational software, which was judged inadequate in terms of instructional content. Consequently, the Project Programmer made extensive revisions of the software finally selected. This was made possible by obtaining releases from the copyright holders for one piece of software so that the changes could be made. The remaining two programs were developed by SAF, because off-the-shelf software was unsuitable for adaptation.

Most software on the market today is protected so that a programmer may not enter the program in order to “look” at how it was written without knowing the entry code for the particular piece. The negotiating time needed to obtain permission from the software publishers to make the necessary adaptations is often six months or more. It would therefore be useful if writers of educational software could make available to special educators unprotected copies of their software.

Since this project was completed, the authors are now aware of two people actively engaged in reviewing public-domain software to be used with the Echo II speech synthesizer and therefore of use to blind people.*

CONCLUSION

As a result of this project, 15 visually impaired students in the San Francisco Bay Area have the same opportunity as their sighted peers to use a computer. Our society is moving with increasing speed into the computer era, and with the aid of projects like the present one, the visually impaired will be able to share in the new technology. Early exposure to computers is an important factor in motivating children to do further work with computers and to consider computer-related careers. For the visually impaired or blind child this also means another opportunity to participate in mainstream society.

As one student in the fourth grade said, “I feel more a part of the kids in my regular classroom because I can do the same stuff they can with a computer using the voice synthesizer.”

SUGGESTED READINGS


* Questions on the availability of the software should be directed to Susan Phillips, Sensory Aids Foundation, 399 Sherman Avenue, Palo Alto, California, 415/329-0430.