# DOCUMENT RESUME

ED 360 770 EC 302 342

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TITLE Present Vision--Future Vision.
PUB DATE [May 93]
NOTE 6p.
PUB TYPE Information Analyses (070)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Accessibility (for Disabled); *Blindness; Braille; Computers; Futures (of Society); *Information Technology; Input Output Devices; *Technological Advancement; *Visual Impairments
IDENTIFIERS Florida

ABSTRACT

This paper addresses issues of current and future technology use for and by individuals with visual impairments and blindness in Florida. Present technology applications used in vision programs in Florida are individually described, including video enlarging, speech output, large inkprint, braille print, paperless braille, and tactual output devices. The future of technology for the visually impaired is then discussed, including three promising advances: voice recognition devices, ink-jet embossers, and optical character recognition devices. The combination of these new products is seen as potentially creating a fully interactive and intelligent information system completely accessible to individuals with visual impairments. (DB)

# Present Vision— Future Vision

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## Introduction

The present era is viewed by many educators as an inspiring period in the development and use of technology with the visually impaired (V.I.) and blind. Technology has been opening the world for the V.I. and Blind for more than a decade with video enlarging, speech output, large inkprint, braille print, paperless braille, and tactual output devices. Currently, manufacturers are producing innovative hardware and software applications that will open the world even further for the visually impaired. **Through access to technology, these individuals can become more productive in home, school and work environments.**

There are two major questions asked by educators and administrators. What are educators currently using in the State of Florida for these students and what does technology hold for them in the future?

## Present Technology Used in Vision Programs in Florida.

High tech will be defined as devices that may require a high level of expertise in research, development and use. For our purpose of looking at current technology used by educators in the State of Florida, the following is classified as high tech: video enlarging, speech output, large inkprint, braille print, paperless braille, and tactual output devices.

### Video Enlarging Devices

Video enlarging devices can be divided further into closed circuit televisions (CCTV), large print display processors (LPDP), and computer image-enlarging systems. Video enlarging devices are considered by educators to be low vision aids for students with residual vision. These students cannot access newspaper and book sized print without the aid of an enlarging system. These students may have macular degeneration, cataracts, diabetic retinopathy, glaucoma, detached retina or retinitis pigmentosa.

Closed circuit televisions (CCTVs) are the most popular classroom video enlarging device because of its high level of clarity, flexibility and ease of use. The basic components of a CCTV are a viewing table, video monitor (B&W or Color), TV camera (B&W or Color) and a control panel. Any printed or handwritten material placed on a viewing table can be magnified up to 60 times its original size by a CCTV. The user controls the CCTV's magnification, brightness and contrast to fit individual needs. Some features of the newer CCTVs include a color monitor, split screen, windowing for isolating specific text, two cameras for viewing multiple documents, tilting monitors, automated viewing table operated with foot pedal or joystick, and image reversal.

Large print display processors (LPDP) give low vision students access to computers. LPDP's enlarge the character display of a computer to a 5 to 6 inch height. Educators can introduce curriculum and application software that is 100% ASCII text/graphic characters. This is to say that an LPDP cannot enlarge computer bit-mapped text or graphics. LPDP's basic components are monitor, monitor stand, interface card and control unit. LPDPs are not dependent on specific software. LPDPs are totally composed of hardware and are transparent to software applications such as wordprocessors, databases and spreadsheets. LPDPs are made for computers found in work environments, allowing for easy transition from school to the work place.

Computer image-enlarging systems are empowering low vision students with the tools to use the total capabilities of state-of-the-art computers. Computer image-enlarging systems consist of software, an interface card, and control device (mouse). They generally will magnify the computer's screen from 2 to 20 times the normal output. Some systems will magnify bit-mapped graphics, giving the user total control of the computer's screen in a what-you-see-is-what-you-get format (WYSIWYG). Special features may include a computerized ruler magnifier, zooming, multiple views, cursor tracking of the application's cursor, scrolling, and a position locator. These systems generally support MS-DOS®/compatible computers.

## Speech Output

Speech output is probably the single most used computer enhancement device for the V.I. and the blind. Speech output is accepted as a viable part of the computerized educational process. As the price becomes more accessible and as the quality of speech output improves, students will have access to the computerized written word.

Speech output devices come in many makes and models that can be categorized as synthetic or digitized speech reproduction. Synthetic speech reproduction is described as "robot-like" sounding speech. These speech devices are generally inexpensive and require periods of acclimation for the user to understand. Digitized speech (waveform digitation) is the most expensive and has the highest quality speech. This technique generates waveforms based on the characteristics of human speech. It's actually a digital recording of a real human voice reprocessed to retain only the important points of the sound waves. The digital information stored can be played back through a digital-to-analog converter. These speech devices require no period of acclimation.

Speech output devices consist of a combination of software and hardware. Speech output devices purchased as software still require the purchase of a separate speech synthesizer that connects to the serial (communication) port of the computer. An advantage to this system is that the user can purchase from a multitude of low-cost synthesizers and later upgrade to a high-quality/cost synthesizer. Speech output devices purchased as a software and hardware (interface card) combination add greater control and flexibility. A user may control different sounding voices, rate, volume, punctuation, letter, word, sentence or whole screen review, and update the synthesizer's pronunciation dictionary to correct the mispronounced word.

Speech output devices, when coupled with computerized image-enlarging systems, can add sensory reinforcement for the low vision students. This is achieved by supporting his/her visual discrimination with his/her auditory discrimination. Speech output devices can only interpret purely ASCII text-based programs. Programs that have a combination of text and graphics or have letters that are bit-mapped cannot be interpreted by the synthesizer.

## Large Inkprint

For low vision students, large inkprint documents are more accessible and the easiest to produce. Large inkprint generally is 2 to 3 times larger (18-24 pt.) than standard size print (10-12 pt.). The hardware and software used to produce large inkprint are found in most schools within our state. The necessary equipment includes wordprocessors that allow for changes to font size and/or font, and inkprint printers that can support these fonts and font sizes. Most inkprint printers (dot-matrix, inkjet, thermal, thermal transfer, and laser) easily support font and font size changes. Daisy-Wheel printers require the change of a print wheel, called a daisy, to change a font and font size. Daisy-Wheel printer's font wheels do not come in the size necessary to print large inkprint (18-24 pt.). They print at very slow speeds (10-40 characters per second or c.p.s.).

The producer of the large inkprint must consider not only the size of the font but the font style, capitalization, leading, kerning and pagination. Fonts are usually Serif or Sans-Serif in type style. Serif fonts are harder to read because of the short cross lines after unconnected lines of the letter. Sans-Serif fonts do not have the crosslines giving the reader a more plain and recognizable format. Mixed capitalization is more readable because of the different heights of letters allowing the eye to recognize easier the next letter in the sequence. Leading is defined as the spacing between the lines and kerning is the space between the letters. For some students, enlarging the space between the lines and the distance between the letters can improve the quality of the large inkprint. Pagination is defined as the formatting of text, such as the top, bottom, left, right margins and the justification (even) or non-justification (ragged) of text. By turning the right justification off within the wordprocessor, the text will be printed with ragged edges. Ragged edged text can also aid low vision students by enabling them to distinguish the end of consecutive lines.

**Braille Print**

Braille was created and improved upon by a blind student, Louis Braille, in the early 19th century at the Royal Institute in France. Braille's purpose for creating braille was to make his school instruction easier. Braille print is composed of raised-dot combinations within the framework of a six dot cell. Each cell can stand for a letter, number or punctuation mark (grade 1), or a cell or combination of cells can stand for a word (grade 2). Braille print is produced and used by those students who cannot benefit from enlarged inkprint. Braille is read by the user using his/her tactual sense of touch.

For many years, braille printers have been expensive for students and/or schools to purchase. The only educational facilities to own braille printers were state or regional braille production centers. In recent years, braille printers have become economically feasible for schools but were still beyond the reach of individual students. Not until last year was the first quality and low-cost personal braille printer introduced.

Braille printers, used for individual school use, print on one side of the braille paper rather than both sides (inter-point). Braille paper is usually thicker (100#) than regular paper (20#) so that the raised dots created on the paper are more permanent. There is another type of braille printer that prints both the braille line and the inkprint equivalent. Since **some teachers servicing the blind have classes with students of varying exceptionalities, it becomes necessary for these teacher to have braille printers that print in both braille and inkprint.**

School based braille printers generally print on 100 weight braille paper, up to 13 inches in width, at speeds between 10-40 c.p.s. Some added features are horizontal, sideways and graphic printing, buffered memory, parallel and serial interfaces, built in speech output, and international braille language translators.

**Paperless Braille**

When we think of printed braille paper we think of thick paper with a series of raised dots. When we think of paperless braille devices, let's think of a computer at the central core, a seven key braille style keyboard for input, a speech synthesizer and an optional refreshable braille display (see Tactual Output Devices) as the output.

Most paperless braille devices are highly portable, weighing approximately 1-12 pounds. Of course, there is no need for a visual display. Subsequently, portable paperless braille devices run on a rechargeable battery or AC adapter/charger. This portability allows the blind student versatility in taking the computer anywhere he/she goes during the school day.

The student may use his paperless braille device as a braille to print transcriber to print his lessons for his sighted teachers. He also may use it as a note taker/organizer, calculator, calendar, computer terminal (Braille Interface Terminal B.I.T.), telephone directory and full—function wordprocessor.

The optional refreshable braille display is generally 20 braille characters in length. This allows the student not only to listen to what he/she has composed but also gives it a tactile quality. Refreshable braille displays are usually quick, quiet and require low power consumption. The student uses the display similarly to the way he/she uses a printed braille page.

**Tactual Output Devices**

Tactual output devices have allowed blind students access to the printed word for the last 20 years. This technology uses a tactual array of vibrating rods (refreshable braille display) that directly relate to the photo sensitive areas of a scanning device. When the scanning device moves along a page of light and dark images, the dark images are translated into the activation of the corresponding rods of the tactual array. The white images remain non-active. Tactual output devices can display any informational source (text and graphics) that is represented by dark and light images. This display quality lends the device to use with graphic displayed computer operating systems.

The basic tactual output device is composed of a scanner, a control unit with the tactual array of vibrating rods, and an alternate power supply for portability. These devices may be configured for access to computer monitors, small type styles, and typewriters.

In the past few years, these devices have been modified with an RS-232 serial interface. This development has given the student access to electronic data from local and remote computerized databases. A wide range of information can be accessed, including newspapers, magazines, research abstracts, entertainment, and personal finance.

**Future of Technology for the Visually Impaired**

For those of us working on the education of students with visual handicaps, the future is looked toward with great anticipation. Empowerment will be the watch word of these students in the 90's. Computer devices will empower these students to perform better in school by lessening the degree of their handicaps and giving them access to the latest information. Computer devices, now being tested and those not yet developed, will empower students with the necessary skills to make the transition to the work force smoother.

However, there is a nemesis looming for the visually impaired in the development of new operating systems for computers. This nemesis is the graphic user interface used in computers of today and tomorrow. These operating systems preclude that the user must be able to view the monitor to operate the computer. Since this is not possible for the blind or severely visually impaired, an alternative must be sought. A screen navigator utility has been developed that allows the blind access to the graphic interface by using a speech synthesizer. Another access product uses the tactual output device to create a tactual image of the graphic display.

For those students who can function with an enlarged view, the computers using graphic interfaces have the opposite effect. Graphic interfaces are easier for the user to control magnification. The enlarging capabilities are usually a function of the graphic interface and require no additional cost.

Two problems have occurred by enlarging the monitor's output. The first concern is the shape of the graphics or fonts as the output is magnified. The output begins to look as if it was created with children's building blocks. This low resolution effect makes the decoding of graphics and fonts more difficult as the output is magnified. The second problem concerns the creation of a strobing effect. As the output is magnified, the computer cannot recreate the new graphic screen fast enough to make movement from one place to another fluid. This problem creates a jumping or strobing effect. This strobing has been known to cause seizures in students with some neurological conditions.

Three promising advances for the visually impaired are voice recognition devices, ink-jet embossers, and optical character recognition devices. Controlling the computer through voice recognition could alleviate most of the problems associated with graphic interfaces. By using the voice recognition device to preform most of the complex navigation, the user could concentrate on the normal operation of application programs.

Ink-jet printers are now being used to a greater extent because of the ability of many to print in color. When the print was produced using a ink-jet printer, users noticed that the printed areas were raised and differences in color could be felt as width and height changes. These printers are now being marketed as possible alternatives to common braille embossers.

Optical character recognition (OCR) systems have major implications as transcribers and readers for the blind and severely visually impaired. OCR systems are being used to transcribe text for students into braille books at a fraction of the time necessary to transcribe them manually and with a higher level of accuracy. Today's transcriber will not be obsolete in the future but transformed into an editor. This editor will be responsible for modifying the document into the correct format for braille documents. OCRs also double as personal readers for the blind and severely visually impaired. A student in a few years will carry a briefcase-size OCR to class. The student will only have to place the page(s) of a book on the scanner to have the document read out loud or transferred into a disk file for later access.

The combination of these new products can create a fully interactive and intelligent computer that will be able to read, recognize voice commands, and print out in inkprint or braille. If business and education together can share in the cost of the research and development of such a product, the price will become more economic for end users.

While technology will empower the visually impaired with a higher quality of education and work, technology should only be thought of as a tool. It is not the ultimate cure, but a support mechanism for the educational advancement of all.