



UNIVERSITY OF  
MARYLAND



# **Introduction to Computers and Computer Access**

EDUC 477/6890

Devices Part IV-A



# Barriers:

- When you are operating a computer, you must integrate a variety of skills and abilities.
- Each interaction with your computer requires you to:
  - **Use your vision**
  - **Use your motor skills**
  - **Use your thinking and reasoning (cognitive) skills**



# Use Your Vision To:

- Locate and read keys on a keyboard
- Observe the reactions (output) of the computer
- Locate disk drives and other peripherals such as printers.



# Use Your Motor Skills To:



- Touch individual keys
- Point to and click areas of the screen using the mouse
- Turn on/off switches
- Insert or remove disks
- Press multiple keys concurrently (shift + b)



# Use your thinking and reasoning (cognitive) skills to:



- Read keyboard symbols and words
- Read screen prompts or instructions
- Understand the computer reactions to your input
- Remember series of sequential instructions (e.g., to load a program into memory)
- Remembering where you are when multiple documents or windows are open.



# Benefits



- There are many benefits that persons with disabilities experience when they are provided with accessible computer technology



# Virginia's Comments



- I have a basic IBM-compatible computer with a screen reading program that turn all the information on the screen into speech so I can hear what is up there.
- I also have a display that sits below the keyboard that will turn all the screen information into Braille so I can read it with my fingers.
- I can't begin to tell you about how much an accessible computer station means to me.



# Virginia's Comments Cont.



- I am able to read and write what other people are able to read and write. I can compete with other students and co-workers with tasks. If I needed to depend on producing all my work in Braille with a typewriter (Perkins Brailier) I would not be able to keep up. With my computer I am able to write information, edit that information, and print it out in one easy motion. I can go onto the internet and search for information, read a book (if it is in electronic format), and write my papers and letters.
- I feel much more confident in being able to handle college and the world of work now that I have a computer that works with me and lets me use my strengths.

# Mel's Comments



- I use a computer that magnifies the image so that I can see what is on the screen.
- For me, having a computer that magnifies the image has been great. I can read almost anything now.
- Before, I was limited to what I could see with my hand held magnifier or blow up on a copying machine. Now I can see everything on the computer screen.



# Mel's Comments Cont.

- I use my computer in school and at work. Right now I am taking classes and I can enter my notes from class into the computer, edit them, and print them out in a size that I can easily read.
- I also can search the internet for information that I need to know for research papers and class projects.
- I write all my papers on the computer and pretty much use it for all my writing.
- At work the computer helps me enter information into a database, my assigned task.
- Without this computer, I would not be able to do this job.



# Mel's Comments Cont.

- Around the house, I use a computer to keep track of my checkbook, store addresses and phone numbers, and do things like that. Before I had the computer, I needed to put these on a tape. This took forever to find the right address for someone. Now, I can find it much easier and faster
- I guess if I had to boil it down, the computer makes me more independent, allows me to be effective at work and makes me feel better about myself because I see that I can do these tasks.

# Ruth's Comments



Click on the image to see the program that Ruth uses

- I have a lot of trouble reading. I cannot understand the words that are on the page or computer because I have mental retardation. All the words look jumbled up and confusing. Sometimes I know the word; other times I don't. The computer helps me to read.



# Ruth's Comments Cont.

- My computer at school has a voice that talks to me. I can listen to it as it reads the page. The voice is funny and took some time to understand, but now I do just fine. I just tell it to talk and it puts a colored block around the word then says it. This way I don't need to read. I just listen.
- I also have a program that they put on the computer that allows me to write with pictures. I don't spell very well so this helps me to write without worrying about what it looks like. I used to be really scared to write because I always got the word wrong and the paper had lots of red marks all over it. Now I don't worry too much about writing because I can use the pictures to help.



# Ruth's Comments Cont.

- I use my computer in school to do all my work. I sit there and do my worksheets, read my assignments - my teachers type them out, and I write my journal every day. Before I had my computer, I couldn't read what the other students could and my writing was terrible. I hated school - now I just don't like it.
- I think with my computer, I can do what everyone else can do. That makes me feel real good. My mom will even ask me to do some things for her now.



# Other Profiles

- Read the stories of two other students
- Rebeka's Story
- Angie's Story

Stories from the *NCIP* Library Collection



# Computer Access Options

- What options do I have?



# Computer Access Options

- The process of providing computer adaptations for persons with disabilities is based upon a **matching process**.
- The goal of this matching process is to match the residual abilities of the individual with a disability with the features of assistive devices, hoping that a good match will help the person overcome the impacts of their disability.



# Computer Access Options Must Consider:



- computer input (keyboard and mouse)
- output (computer monitor and printer)



# Monitor Adaptations

- Persons who have difficulty interpreting text (vision impairment, learning disabilities, and sometimes persons with a hearing impairment) will often have problems using standard monitors.
- There are a number of options for modifying the visual output from monitors



# Monitor Adaptations

- Convert to Auditory Output
- Enhancing Existing Images
- Convert to Tactile Output
- Convert to Symbols
- Convert Auditory to Visual Output



# Monitor Adaptations

## Monitor output to Speech output

- One way to alter the output of a computer is to convert the information presented on the screen into speech.
- Speech output (sometimes referred to as "**screen reading**") is a common method of access for persons with vision impairment.
- Persons with learning disabilities, who have difficulties reading text, can also use speech output to access print materials.



# Monitor Adaptations



- Susan is using a screen reading program to listen to the text she is entering into the computer. This modification allows Susan to catch incorrect keystrokes, edit, and preview her work before sending it to the printer)

**Click on image to learn more about Assistive Devices for Auditory Output (Screen Reading Software)**



# Monitor Adaptations

## Enhanced Monitor Image

- A second means of altering computer output is to enhance the image presented on the monitor.
  - magnifying the image,
  - heightening the contrast between foreground and background elements,
  - and highlighting important keys so that they can be found with a minimum amount of searching



# Monitor Adaptations

- This person is using a magnification program to increase the size of the information presented on the monitor.
- By multiplying the screen magnification, they are able to read and understand the information on the monitor

## Enhanced Monitor Image





# Monitor Adaptations

## Enhanced Monitor Image

- Check out these  
Screen Magnification  
Applications
- Software-based Screen  
Magnification
- Screen Magnification  
with Speech
  - MAGic



# Monitor Adaptations

## Monitor Output to Tactile Output

- Here you convert all screen information to a tactile form.
- The most common tactile output is Braille.
- In addition to converting text, Braille output devices can also display graphic images and can be paired with screen reading programs to increase the number of access options for persons who are blind or who have severe vision impairment.
- Find out more about Braille Output **Braille Output**

More information about Braille can be found in readings



# Monitor Adaptations

## Text Output to Symbolic Output

- Convert information that is presented in text into symbols.
- An example of this kind of conversion is readily available - the Windows operating system.
- In an effort to make **computers easier to use for the general public**, Microsoft designed a graphical user interface (GUI) that uses symbols (for example, a picture of a disk represents saving a file to disk) to minimize the need to learn abstract strings of characters.
- For persons with reading difficulties (learning disabilities, mental retardation), the ability to convert information to symbols allows them to access and effectively use the computer.

# Monitor Adaptations



## Text Output to Symbolic Output

- Here a symbol-based word processing program is being used to compose a written document.



# Monitor Adaptations

## Auditory Output to Visual Output

- Converts auditory output (beeps to indicate that an incorrect keystroke has been entered) into visual information.
- This is particularly important for a person with a significant hearing impairment who may miss many, if not all, auditory signals.



# Keyboard Adaptations

- Persons with disabilities often cite problems with the standard keyboard.
- Standard keyboards can be modified by any of the methods listed below. Typically these methods are attempted in order from least to most adapted (i.e., from top of the list to the bottom).
  - **Modified Existing Keyboards**
  - **Altering Keyboard Contrast**
  - **Alternative Keyboards**
  - **Emulating Keyboards**



# Keyboard Adaptations

## Assisted Keyboard

- One of the least difficult computer adaptations is to change some of the features of the standard keyboard.
- These modified keyboards are called **"assisted keyboards."**



# Keyboard Adaptations

- An **assisted keyboard** is
- one where the standard keyboard is used, but the operations or features are changed to meet the user's needs.
- Attractive, more typical, and hence typically the first option in modifying a computer to be accessible.
- Assisted keyboards may be preferable because they require little in the way of specialized software or hardware, look most normal, and avoid many of the compatibility problems when one attempts to mix hardware or software from many vendors.

# Keyboard Adaptations



## Assisted Keyboard

- Here a person is using a **keyguard** that modifies the standard keyboard so that the person does not produce multiple, undesirable keystrokes.



# Visual Adaptations

## High Contrast Images

- For some individuals with vision impairment, it is difficult to separate foreground and background information.
- A way to assist this person would be to alter the contrast value of the material.
- The most typical contrast change is **inverse imaging**.
- Other variations involve using **different colored paper and text**.
- Another strategy for altering contrast values is to **provide additional lighting** for the subject matter.



# Visual Adaptations

- Examples of altering contrast:
  - High contrast lighting
  - LS & S Group



# Keyboard Adaptations

## Alternative Keyboards

- For some persons, assisted keyboards do not allow them to adequately access and use a computer.
- Use "alternative keyboards."
- An alternative keyboard is a different keyboard. Here the keyboard matrix may be placed on a larger keyboard, smaller or mini keyboard, or on a simplified keyboard.
- The key element is that the keyboard is physically different.
- Alternative keyboards are meant to either supplement or replace the standard keyboard.

# Keyboard Adaptations



## Alternative Keyboards

- In order to type, this individual needs a keyboard with larger keys. Having this larger keyboard reduces the number of unwanted keystrokes this person produces when attempting to press smaller keys.



# Keyboard Adaptations

## Emulated/Virtual Keyboards

- Persons with very limited upper extremity control often require a direct interface with the computer.
- An emulated or virtual keyboard is needed.
- There is no keyboard.
- A representation of a keyboard is presented to the person and they simply signal the computer when they locate their choice.



# Keyboard Adaptations



## Emulated/Virtual Keyboards

- Here a person is using a scanning program that presents them with choices for typing letters or words.
- When the choice that she wants is highlighted, she presses a switch to enter that letter or word





# Mouse Adaptations

## The Mouse

- Many persons, both with and without disabilities, have difficulty using the mouse.
- To effectively use this input device, the user needs to have good fine motor control, excellent visual-motor coordination, directionality, and sufficient vision to monitor the cursor movements.
- This severely limits many persons with cognitive, motor, or sensory impairments. Fortunately, there are several ways these limitations can be overcome.



# Mouse Adaptations

- **Two ways mouse limitations can be overcome:**
  - **Modifying the existing functions of the mouse**
  - **Emulate the functions of the mouse**



# Mouse Adaptations

## Modify Mouse Operations

- As with keyboards, your least intrusive option would be to modify the way the typical mouse operates.
- May be as simple as changing the tracking speed or altering the click-double click speed.
- Many of these are features available in newer Windows or Macintosh operating systems.



# Mouse Adaptations

## Modify Mouse Operations

- Another alternative - becoming widely accepted - is the **trackball**.
- Trackballs allow the user to set the parameters that govern speed of movement and click speed.
- In addition, these devices allow the person to set up button presses to initiate mouse commands (one button press = a double click or a click and hold command).



# Mouse Adaptations



## Modify Mouse Operations

- **TrackBall**
- To compensate for slow button click speeds, this individual is using a trackball to replace a standard mouse.





# Mouse Adaptations

## Emulated Mouse

- When a person is unable to use a trackball or a standard mouse that has been modified, the next step would be to look at mouse emulation.
- A device or an alternative access option is used to mimic the movement and functions of a mouse (Church & Glennen, 1991).
- Mouse emulation can take several forms, but in each instance the standard mouse is replaced with a more accessible option.



# Mouse Adaptations



## Emulated Mouse

- This person has converted their numeric keypad to issue mouse movement and function commands



# Printer Adaptations

- Printers present their own unique set of access barriers from difficulties removing the paper once the print task is completed to an inability to read print output.
- In some instances, the access barriers can be overcome by scheduling tasks differently. If a person has difficulty removing paper from a printer, they could schedule print tasks when assistance is available.



# Printer Adaptations

- Text output that has traditionally been produced as print can be redirected to electronic form through e-mail.
- In this situation, the person with a disability sends the document (be that a memo, a report, or a bill) to another person electronically, eliminating the need to produce a print copy.



# Printer Adaptations

- When electronic forms are not sufficient, the following options are available:
  - **Convert to auditory output**
  - **Convert to tactile output**

# Printer Adaptations

## Printer Output to Auditory Output



- The same technology that is used to alter monitor output - that is, a screen reader - can be used to overcome the barriers presented by printer output.
- A person who is blind or visually impaired is able to review text documents by having them read aloud in synthesized speech.
- This same technology is appropriate for a person with a learning disability who is not able to effectively read text documents.



# Printer Adaptations

## Printer output to Braille output

- For persons who have severely limited vision or who are blind, print output can be translated into Braille using a combination of software and hardware.

More about Braille in other readings



# Storage Adaptations

- With the advent of hard drives, saving and storing information is less of a problem than it used to be.
- Most of the time the user can simply store their files on the hard drive and transfer them to a floppy disk whenever someone is available to help.



# Storage Adaptations

- For those cases when a person must handle floppy disks, homemade disk guides and disk handles are often used.
- Disk guides are small platforms that assist a person with physical impairments insert the disk into the disk drive.
- Disk guides can be constructed with dowels and a small piece of thin wood.
- The person places the disk on the wood ramp and, using an extension device, pushes the disk into the drive.
- Disk handles are thin, rigid metal extensions that are placed on the top edge of the disk to help the person guide the disk into the drive.