Alternate Access Technologies:
A Guide for School-Based Teams

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Creating Student Opportunities

Alternate Access Technologies: A Guide for School-Based Teams
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Introduction

About SET-BC

Special Education Technology - British Columbia (SET-BC) is a provincial government initiative established to assist school districts and group 1 and 2 independent schools in educating students with physical disabilities, visual impairments or autism through the use of technology.

SET-BC's mandate is:

- to lend assistive technologies to facilitate students' access to educational programs, and
- to assist school districts in providing the necessary consultation and training for students and educators in the use of these technologies.

SET-BC services to school districts include:

- consultation, planning and follow-up for school based teams
- loan and maintenance of assistive technology
- training
- provision of resources and information

SET-BC consultants are based in seven Regional Centres around the province, providing community based services to all BC school districts. Each district has a SET-BC District Partner who can provide information on how services are provided for eligible students. For more information and resources on assistive technology, check SET-BC's web site at www.setbc.org.

Purpose of this Guide

The purpose of this guide is to provide an overview of alternate access technologies and to describe how students with disabilities can use them to participate and learn as independently as possible in the classroom. We hope that school-based teams, school and community therapists, and students and families will find this information to be informative and useful.

In this guide, we mention a number of specific products within the different categories of alternate access technologies. These are meant to be examples only, not recommendations. There are thousands of useful access technologies and we only have space to describe a representative sample. We have tried to focus on products that are commonly used in the British Columbia school system.

This guide will be used as the main resource for a series of workshops that SET-BC consultants will present in fifteen locations across British Columbia in 2005. The content for this workshop, including this guide, webcasts of the presentations, and software demonstrations, will be available on SET-BC's online Learning Centre (www.setbc.org) in mid-2005.

What are Alternate Access Technologies?

All computer users employ access technologies when using a computer. We can choose from a large (and sometimes confusing) array of keyboards, mice, trackballs and other input devices when setting up our computer systems. Alternate access technologies provide further options that make it easier for people with physical disabilities to use technology. These devices include software adaptations, mouse or keyboard alternatives, positioning devices, and switches.

Access can be divided into three component parts:

- **Input device** - The input device, or control interface, is the hardware required for the individual to access the technology; e.g. keyboard, joystick, or switch.

- **Selection Set** - The selection set is made up of the items from which an individual makes a choice; e.g. letters, words, symbols which are presented in a visual, tactile or auditory way.

- **Selection Method** - The selection method is the method by which the individual makes selections using the control interface. These are two general methods of selection, direct and indirect.
    - o **Direct** - Items are selected by direct contact using a hand, finger, light pointer, head pointer, or by eye pointing. This method requires good motor control. It is usually the quickest method and is cognitively less complex than indirect selection.
    - o **Indirect** - Indirect selection involves intermediary steps to make a selection. The most common form of indirect selection is scanning, but also includes encoding.
        - ▪ **Scanning** - An array of choices is presented and sequentially scanned by a cursor, light, pointing, or auditory output. The user selects a choice by making a signal to stop, or by pressing a switch.
        - ▪ **Encoding** – A pre-coded display is presented and the individual uses a sequence of selections to specify a target item. For example, the user may point to a number and then a colour to indicate a particular item in a communication book.

For example, a student may write with word processing software on a computer, using alternate access technologies such as a switch which controls a scanning on-screen keyboard. The input device is the switch, the selection set is the letters on the on-screen keyboard, and the selection method is scanning.

Adapted from "Accessing assistive technology assessment issues" (ACE Centre – North).

Team Roles

Decision making around a student's use of alternate access technologies needs to have the full involvement of the school team members. Gathering and sharing information from all members of the team, and combining knowledge and expertise through the process of planning, can lead to well informed and thoughtful decisions. These carefully made decisions will go a long way toward successful implementation of any access technologies.

Key members of the school team, for the process of designing and implementing an access system, may include:

- student and parents
- occupational and/or physical therapist
- classroom, school resource or district support teacher
- classroom assistant

It is important that this group of individuals create a collaborative working environment where all the facets of a student's access needs can be considered.

As with any group striving to make changes or implement programs, it is important to identify a team leader. It is often the case manager, but this person can be anyone who will take the responsibility for planning meetings, keeping records, setting goals, and ensuring action is taken. Without a team leader, the program for the student may not have a clear direction and the effort spent in planning may be wasted.

It may be desirable to choose a team leader who is directly involved with the student at the school level for more than one year at a time. Knowing and understanding the student's educational environments and how they change over time will be critical to the relevance and usefulness of the access system. The team leader can act as a facilitator for the group by bringing the combined knowledge and expertise of the team together, as well as by spearheading the development of the implementation plan.

The plan should include:

- assessment and selection of technology
- how the technology will be used
- technology use in a variety of situations
- who is responsible for the system maintenance and revisions
- how the team will share information and coordinate follow-up

Therapist's Role in Assessment Process

The school-based team attempting to match access technology to a student's strengths and needs may require consultation with therapists and clinicians who have experience with the "art and science" of alternative access. Most occupational and physical therapists working in BC school districts are an integral part of the school based team and have a good working knowledge of the SET-BC process.

School based teams rely on occupational and physical therapists to:

- Share information about the student's positioning and posture needs,

- Assess the student and inform the team about the student's motor abilities and requirements (i.e. hand function, reach, keyboarding skills, computer access, material storage),

- Provide information about the student's present mobility equipment (i.e. seating inserts, splints, standing frames, walkers, wheelchairs),

- Provide information regarding any pending medical procedures for the student (i.e. medical re-evaluations, orthopedic surgery),

- Share technical expertise regarding alternative access (i.e. recommended devices, ergonomic considerations, adaptations or modifications).

Community Partners for Assessment

If a student's school based team does not include an experienced therapist, there are consultation and outreach services available from a variety of agencies throughout the province. A partial list of these agencies includes:

- Sunny Hill Health Centre for Children is part of the Children's & Women's Health Centre of British Columbia. Sunny Hill's Assistive Technology Team provides assessment and support for children throughout the province related to technology for communication, learning, mobility, and environmental control.

- Queen Alexandra Centre for Children's Health is part of the Vancouver Island Health Authority. It provides in-school services, including physiotherapy, occupational therapy, seating, and special devices for children with disabilities.

- BC Child Development and Rehabilitation Association members include all child development centres (CDCs) in the province, including the Centre for Ability in Vancouver. Some of these centres provide services for school aged children with significant motor and speech impairments. Often these services are contracted through the school district.

- Community health units or hospitals – Occupational therapy and physiotherapy services are also delivered to children with disabilities and their parents through the health system. Depending on the region, some of these centres provide services for school aged children.

SET-BC Support for Selection and Use of Access Technologies

SET-BC consultants and school based teams collaborate throughout the process of matching student need to technology, planning, implementing, and following-up on student use of technology. The following provides an overview of each stage of the process.

Stage 1: School team identifies need for access technology.

- Team identifies that student needs technology to achieve goals in individual education plan.
- Team assesses student's strengths and needs and identifies most effective access method.
- Team addresses seating and positioning concerns for classroom activities.

Stage 2: Team plans for the use of technology.

- Team contacts SET-BC District Partner to initiate request for SET-BC service and follows district screening process for assistive technology.
- Team may field test technologies that might match the student's strengths and needs.
- School team and SET-BC consultant develop Collaborative Action Plan (CAP), including strategies for classroom implementation and request for technology loan.
- If necessary, team considers need for mounting of technology*.
- SET-BC loans technology to the school district and consultant provides training and resources to school team.

Stage 3: Team implements the technology.

- School team maintains system, including ongoing adjustments for changing student need and classroom activities.
- Technology use is reviewed as part of regular individual education planning (IEP) process.
- If the access technology doesn't appear to meet student need, the team reviews relevant items from Stage 1 and contacts SET-BC consultant for support.

Stage 4: Student moves to new setting.

Prior to any student or staff transition:

- Team shares information on technology use in the classroom and describes technical and non-technical systems used by the student.
- Team provides overlays, technical tips, and training ideas and may also provide photos or a video of the student using the access technology, and a student information binder.

*Mounting of Equipment
Part of a team's assistive technology implementation plan may include the physical attachment, or mounting, of an access device or computer to a tabletop, wheelchair arm or tray. This provides stability and ensures that the device is in the optimum position for operation. An occupational therapist or physiotherapist should coordinate the selection, installation and maintenance of mounting systems. SET-BC provides a variety of commercial mounting devices and "universal arms" and also funds custom mounting of assistive technologies when needed.

Considerations for Alternate Access Technologies

Student Strengths and Needs

Assessment of a student's strengths and needs is not a single event that is over once the team has identified an appropriate access method. It is a process that needs to be updated and reassessed as the student, and his or her activities and environments, change. Clear documentation of assessment information is essential as it provides the team with baseline information for ongoing evaluation purposes.

In the sections of this guide that describe different categories of alternate access technologies, we use a feature matching model to demonstrate how teams can select technologies that are best suited for a specific student. This process can help to narrow down the range of possible access solutions, but systematic trials of the technology in a classroom setting are still useful.

- **Physical Considerations -** Accurate observation of a student's physical abilities will help to identify movements that he or she can use to access technology. An individual's physical abilities will affect both the selection method and choice of control interface. The physical assessment should consider the following issues when trying to identify the most effective access method for a student.
  - ➢ **Controlled voluntary movement** – To use any access device, the team needs to identify a controlled voluntary movement that the student can repeat frequently and within a specific time. Discovering whether the student has the best control of hands, head, feet or other body part can be a challenging, but essential, process.
  - ➢ **Fine motor control** – The student may have limited or slow fine motor skills, making it difficult to accurately target and activate the access device. This will influence the size, shape and position of items on a display or selection set, as well as keyboards, mice, trackballs, and switches.
  - ➢ **Range of motion** – The student may have a limited range of motion, making it challenging to physically reach the target. This will influence the position and choice of input devices. For example, mini keyboards and alternate keyboard layouts can be selected and positioned to match a student's range of motion.
  - ➢ **Strength** – The student may have decreased strength in his or her arms, wrists or fingers, which makes it important to provide access devices that require very little pressure for activation. Conversely, some students may use significant force when striking the device due to poor motor planning or control. They need to use sturdy products that are firmly mounted in the correct position.
  - ➢ **Fatigue** – The student may be able to physically access a device, but become very fatigued doing so. Selection of the most efficient access method, ergonomic design and proper positioning may address this need.
  - ➢ **Multiple movements** – Most people use multiple methods to access technology, using the keyboard to type and some type of pointing device to move the cursor and select on-screen items. For students with complex physical needs, it can be challenging to identify the best combination of movements. For example, a student may need to use a head movement to operate one switch and a hand movement for a second switch in order to control scanning.

- **Sensory Considerations**

  - ➢ **Visual impairments** – Visual impairments can affect a student's access to technology. If there is a visual impairment, keyboards or displays with large letters, different colours or greater contrast can be investigated. For students who have difficulty with visual complexity or processing, simple keyboards or displays should be considered.
  - ➢ **Auditory feedback** – The student may require auditory feedback to signal key selection or mouse clicks. Depending on his or her hearing ability, this feedback may need to be adjusted or changed to a visual signal.

- **Cognitive Considerations**

  - ➢ **Complexity of display** – Different displays and keyboard layouts place varying cognitive demands on the student. For example, displays with many items or keys may be too complex for some students and need to be simplified.
  - ➢ **Language and literacy** – Some students have limited language and literacy skills, which will affect the choice of items included in their selection sets. Graphic support for these students can be made available with keyboards that use customizable overlays, or displays and controls that include symbols.
  - ➢ **Memory and sequencing** – Some input methods, such as scanning or Morse code, require the student to plan, remember and follow a sequence of steps to make a selection.
  - ➢ **Student predisposition** – Students may have strong opinions about different devices or software and it is important to respect their perspective when selecting access technologies. Students who have a say in the decision-making process are often more enthusiastic about using the technology.

- **Environmental Considerations**

  - ➢ **Stable and supported position** - An occupational therapist or physiotherapist can design the best seating and positioning for a student using an alternate access method. The entire school team needs to follow these recommendations so the student has a functional position at all times.
  - ➢ **Technology placement** – Once the student is properly seated and positioned, the access device and computer need to be placed in the optimum location. The student should be able to touch, activate and see the device as easily as possible.
  - ➢ **Lighting** – Lighting considerations and glare minimizing are important to ensure that the student can see the input device and display as clearly as possible.
  - ➢ **Portability** – For students who are mobile and using a laptop computer, portability of the alternative access device is an important consideration.

- **Computer System and Software Compatibility Considerations**

  - ➢ **Operating system** – Not all access devices work with both Macintosh and Windows operating systems, or with older operating systems. This is especially true if the device requires specific software or drivers to function. Teams also need to consider compatibility with the computers/operating systems used in the school district.
  - ➢ **Software** – Some alternative access devices require specialized software to function, or to be programmed. For example, to create custom overlays for the IntelliKeys keyboard, you will use Overlay Maker software (both products from IntelliTools).

Assessment Tools

A variety of print and electronic resources are available to provide school teams with alternate access assessment frameworks and strategies. These planning tools can provide guidelines for the occupational therapist and physiotherapist, as well as an overview of the process of matching technology to a student's needs. In addition, these print resources could help prepare a team by suggesting questions or topics for consideration when meeting with the therapists.

- **Assistive Technology Solutions for IEP Teams** - This workbook presents a range of technology options which range from low-tech/no-tech to the use of complex electronic devices. The range of IEP goals that is presented emphasizes changes in basic instructional materials, strategies and modifications to curriculum.

- **Lifespace Access Profile** - This workbook provides a client-centered, team-based collection of observations that point to the next step in using technology for individuals with severe or multiple disabilities. It is also available as a computerized system. A technology plan, including device placement, positioning and communications is automatically prepared from the team members input into the program.

- **PCA (Physical Characteristics Assessment) Checklist for Computer Access** – This guidebook provides a range of considerations for alternate access assessment. It focuses on computer use and individual physical characteristics and offers ideas for input devices and placements.

- **Step-by-Step Guide to Assistive Technology: Switch Edition** – This CD was developed by Tash Inc. to help teams make decisions on the most appropriate switch for a student. Teams follow a decision making process that narrows down the choice of suitable switches that are available from this company.

- **WATI Assistive Technology Assessment Package** – The Wisconsin Assistive Technology Initiative (WATI) developed this process based, systematic approach to providing a functional evaluation of a student's need for assistive technology in their customary environment. It targets school-aged children with disabilities and presents a comprehensive assessment and planning process.

Therapists working at community and health agencies in British Columbia may also use locally developed protocols and tools when assessing the alternate access needs of students.

Computing Devices

Definition

Computing devices, with appropriate software, allow users to carry out a multitude of tasks, from writing, reading, learning, playing games, to chatting and shopping online. This device category includes desktop and laptop computers, tablet computers, dedicated word processors and handheld devices.

Key Features

- Physical Characteristics

  - Computing power – The device needs to have adequate processing power and memory for the tasks to be carried out.
  - Portability – Laptop computers, dedicated word processors and handheld devices are small and light enough to carry easily. Desktop computers usually remain in one place.
  - Battery – Batteries should allow use for a reasonable amount of usage (2 - 4 hours).
  - Wireless computers – Some devices can be operated without using wires or cables to connect to power sources or network connections.
  - Robustness – The device may need to be sturdy enough to withstand dropping, bending, and other physically rough handling.
  - Lighting – The display should be visible both indoors and outdoors.
  - Ergonomics or physical constraints – The keyboard placement and screen placement may need to be adjusted for optimal access.
  - Security – The device may need to be locked to a desk or other secure object

- Operation

  - Easy to turn on – The device on/off switch should be easy to access.
  - Startup time – The device should turn on as quickly as possible (from shutdown or sleep mode)
  - Adaptability
    - Software availability – The choice of computing device will depend on availability of software that the student needs to use.
    - Hardware availability – The choice of computing device will depend on availability of alternate access technologies that the student needs to use.

- Support

  - Team knowledge – The school team needs to have specific skills and knowledge to support the student use of technology and maintain the device in the classroom.

- 'Cool' factor

  - Attitude – The student needs to be willing and motivated to use the device.

  .

Matching Student Need to Technology

Technology can often be used as a tool to promote the educational goal of student independence. Consider the following questions when trying to select a computing device that will foster student independence and support the achievement of educational goals.

Student Needs, Abilities & Expectations	Technology Features
Mobility of user – Will it always be used in the same way in the same location? Is the user capable of setting it up and starting it?	Portability
Speed of use – Is time critical for the user? Does the device have to be up and running instantly?	Startup Time
Location – Is the device to be mounted on a wheelchair? Table? Lap? A variety of positions?	Ergonomics
Can the student access the device in the way it was intended or are there to be hardware adaptations?	Adaptability
Is the team familiar with the hardware for technical troubleshooting?	Support
Will the student be willing to use the device? Does it make them look 'cool'?	'Cool' factor
Does the student have good motor control and strength? Are they liable to drop the equipment?	Robustness

Student Scenario

Robert is a Grade 10 student who has spinal muscular atrophy. He is small in size and has severely limited range of motion. He fatigues quickly when asked to do any physical exertion. He uses a joystick to drive a motorized wheelchair. He needs a stick to hit the on/off switch of his computer because he is not strong enough to push it down.

The school district has a lab full of Windows XP desktop computers with appropriate educational software, but Robert is not able to use them due to his physical constraints.

Robert is unable to use a regular keyboard because he could not reach both ends of it due to his limited range of motion and strength. He has similar difficulties with a laptop, as he is unable to reach all of the keys, move the laptop, or reach the screen to tilt it.

Robert tried out a handheld personal digital assistant (PDA) with a full keyboard in a 15 cm. layout below a small screen. He was able to touch type with this device. He was also able to move it and tilt the screen. His support worker needs to connect the device to the stationary Windows computer in the school lab, but the PDA allows Robert to be more independent.

Product Examples

- Desktop computers are usually attached to the electrical system and are therefore not portable. Their large size allows for greater expandability and adaptability. These systems can be multi-part and may require a large amount of desk or table space.

- Laptop computers provide portability as they are lighter than desktops and battery operated. Their smaller size may not allow for as many external modifications as desktop computers. Too many add-ons can defeat the purpose of portability.

- Tablet computers allow the user to enter text by writing directly on a touch sensitive screen using a stylus. The user must have good fine motor control to use the stylus and be able to write legibly for the system to recognize and convert the writing into text. Tablet computers can also be used with a keyboard. Tablet computers are similar in weight to laptop computers.

Tablet PC, by ViewSonic

- Dedicated word processors are lightweight, battery-operated devices with full-size keyboards and narrow monochrome LCD screens. They are used for writing and can be easily carried from class to class. They can connect to regular computers for uploading and downloading files and can send files to printers. Some word processors incorporate access features such as word prediction.

Dana, by AlphaSmart

- Handheld device or personal digital assistant (PDA) – These are the smallest and lightest of the computing devices. They can be easily carried and are commonly used as note-takers and organizers. They may have more limited power and options, and often require add-ons such as a keyboard, memory card, external hard drive, link to desktop computer, or access to printer. Some may include features such as word completion to increase ease of input.

Axim PDA, by Dell

	Desktop Computer	Laptop Computer	Word Processor	Handheld Device (PDA)
Portability		➤	➤➤	➤➤
Startup time			➤➤	➤➤
Ergonomics	➤➤	➤		
Outdoor Use		➤	➤➤	➤➤
Accessibility	➤➤	➤➤		
Support	➤➤	➤➤		
Cool factor		➤➤	➤➤	➤➤
Security	➤➤	➤		➤➤

Additional Options

Some of the key products that work in combination with computing devices include:

- Software
  - ➢ A wide range of software can provide accessibility features for desktop, laptop and tablet computers. A smaller number of applications, such as word predication or word completion programs, can be used with dedicated word processors and personal digital assistants.

- Alternate keyboards
  - ➢ Keyboards for handheld devices or personal digital assistants (PDAs) may be on-screen or physical. The on-screen keyboards are usually add-on software that allows the programming of the keyboard. Solutions such as the Fitaly one -finger keyboard design use letter frequencies to reduce the time and distance needed to activate each key. Physical keyboards usually fold up into a package roughly the size of the PDA and tend to be specific to the particular brand of PDA.

- Alternate pointing devices
  - ➢ PDAs may require use of a stylus to draw on the screen. These require good fine motor control and can be easily lost.
  - ➢ Desktops and laptops can be equipped with a touch screen for direct user input.

- Mounting systems
  - ➢ Laptops, tablet computers, dedicated word processors and PDAs can be mounted on wheelchairs and other surfaces for easy access.

Operating Systems

Definition

Computing devices require operating system software to allow them to compute and carry out all functions. Both Macintosh and Windows operating systems have built-in features that allow adaptations for users with special needs or preferences. These adaptations can be set permanently so that they are always available for the student.

Key Features

- Keyboard input

    - Sticky keys – allows user to type commands that require combined keystrokes ('Shift' plus a letter) by typing single sequential keys
    - Filter keys - ignores brief or repeated keystrokes
    - Key repeat – can be on / off and set for different rates to avoid inadvertent key strokes
    - Serial device input - allows input from serial devices
    - Alternate layouts - allows use of alternate keyboard layouts, including Dvorak Left / Right
    - Auditory feedback - adds sound when a key is successfully pressed

- Pointing device input

    - Cursor controls
        - size and shape can be changed to allow for easier targeting
        - tracks can be added to make following the mouse (visual tracking) easier
        - color can enhance visual tracking
    - Movement controls
        - initial delay refers to the duration before the mouse cursor moves
        - speed adjustment changes the rate that the mouse cursor moves for a corresponding movement of the mouse
        - acceleration means the speed of cursor movement increases the further it is moved
        - touch / stylus use may allow control of mouse cursor movements
        - keyboard keys can be used to control cursor movements

- Voice input

    - Command - controls the user interface with voice
    - Data entry - enter text using voice

- Target size

    - Screen resolution control – using a lower screen resolution makes objects appear larger and the cursor appears to move faster
    - Icon size - increased size make a larger target

- Security - Passwords for each user

- Robustness – stability and reliability of the software

- Connectivity - ability to connect to networks, printers and other devices

- Support - ability of team to provide technical support and training

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Matching Student Need to Technology

The selection of an appropriate operating system is foundational to the student's use of technology. The two most critical features of operating systems are:
- availability of technical support – preferably within the school
- availability of software appropriate to the student's educational program.

Student Needs, Abilities & Expectations	Technology Features
Is the user able to hit small targets reliably?	Cursor modifications
Does the user have sufficient fine motor control to use the pointing device without modification?	Mouse modifications
Does the user have sufficient motor control and range of movement to use the full keyboard?	Keyboard modifications
Are the user's files secured with password protection?	Security
Is the student able to troubleshoot simple problems independently?	Robustness
Is the user able to connect to the internet, other computers and hardware as needed?	Connectivity
Is the team able to support the user?	Support

Student Scenario

Sascha is a Grade 6 student with post encephalitis syndrome. She has had a nearly complete recovery from encephalitis. The only remnant of her illness is an intention tremor in both hands when she uses a pen, pencil or keyboard. Her neurologist has indicated that her tremors are permanent.

Her penmanship pre encephalitis was excellent. A recent sample shows that her writing is now largely illegible and she fatigues after 3 minutes. She tried using a regular keyboard but this caused her to inadvertently type many repeated letters within words. Correcting her errors was very time consuming and often resulted in over correction, with too many letters being deleted. By simply slowing the keyboard repeat rate, many of her typing errors were prevented.

Sascha's school is in a district that exclusively uses the Windows XP operating system. She received a laptop computer with the same operating system. Her operating system was personalized for her use, with modifications of the repeat rate and the delay time before a key press was accepted. These simple modifications allow her to use the computer with fewer errors and less frustration and fatigue.

Product Examples

- Mac OS X – Apple's new operating system has many built in features to support disabled users.

- Windows XP – Microsoft supports keyboard controls for all mouse actions. They continue to support disabled users. The range of software available to support different users is larger that for any other system.

- Palm OS – The stripped down operating systems that are used in PDAs are not designed for a wide range of adaptations, but they are still useful in many situations.

- PocketPC – Similar to Palm OS.

	Mac OSX	Mac OS9	Win XP	Pocket PC	Palm	Alpha Smart	Dana
Cursor Modification							
• Size	➤	➤	➤				
• Shape	➤	➤	➤				
• Tracks	➤	➤	➤				
• Colour	➤	➤	➤				
Mouse Modification							
• Keyboard Access	➤	➤	➤				
• Initial delay	➤	➤	➤				
• acceleration	➤	➤	➤				
• Speed adjust	➤	➤	➤				
Keyboard Modification							
• Sticky Keys	➤	➤	➤			➤	➤
• Slow Keys	➤	➤	➤			➤	➤
• Alternate Layouts	➤	➤	➤	1		➤	2
• Serial Keys	➤	➤	➤				
• Rate	➤	➤	➤				
• Repeat	➤	➤	➤				
• Auditory Feedback	➤	➤	➤	➤	➤		
Other							
• Voice Command & Control	3		4	5			
• Voice data entry	6	6	6				

1. On-screen Keyboard activated by stylus. Various external keyboards from full sized to thumb boards. Look for on-screen keyboards that are optimized for single digit (stylus) input. See www.fitaly.com .
2. DVORAK right and left handed
3. Small speaker independent command and control
4. Only available within some application with embedded speech capabilities
5. Small speaker independent vocabulary in Windows Mobile (upgrade from pocket PC)
6. Capable only with after market products. www.scansoft.com www.macspeech.com

Software Access Options

There are many software programs that incorporate features that can assist users who need alternate access options. Much like the operating system options described in the previous pages, standard software products also provide a range of access features, from adjustable font size, to techniques for speeding up editing and formatting. There are also software programs that are specifically designed to support people who need to use alternate access methods. These programs include a wide range of tools for supporting the writing process, such as word prediction, speech feedback and voice recognition. And finally, many educational or instructional programs that focus on teaching different curriculum topics also include access options for students with alternate access needs.

Rate Enhancement

Rate enhancement features provide options for speeding up keyboard entry for students with physical disabilities. Some rate enhancement options are features of standard software:

- **Macros** – A macro is a series of commands and instructions that you group and save as a single command to accomplish a task automatically. Some typical uses for macros include:
  - ➢ speeding up routine editing and formatting
  - ➢ combining multiple commands
  - ➢ making options in a dialog box more accessible
  - ➢ automating a complex series of tasks
  - ➢ launching programs and opening files

- **Abbreviations & codes** - Users can store repeated phrases and sentences as abbreviations or codes. They can then be used to make it easier to type frequently used text selections. For example, a student might want to store abbreviations for:
  - ➢ His or her name   js = Jenny Smith
  - ➢ An address   ad = 404 Elm Street, Richmond, BC V5P 2D1

- **Templates** - You can design a standard layout for a document and save it as a template for any number of writing activities that take place regularly in different subject areas. This allows students to avoid the time-consuming task of typing headings or setting up the page and allows them focus on content of activity. Commonly used programs like Microsoft Word provide libraries of pre-made templates that can be used as is, or adapted for specific tasks and students.

Homework for [Your Name] Week of [Date]

Period	Monday	Tuesday	Wednesday	Thursday	Friday
1st					
2nd					
3rd					

Homework schedule template from MSWord

Word Prediction

Word prediction was originally developed as a tool to make the physical act of keyboarding faster and easier, but is now widely used to assist with the writing process (spelling and grammar). With word prediction software, the user types the initial letter(s) of a word and then selects the desired word from a predicted list.

Word prediction may prevent fatigue by reducing the number of keystrokes needed to complete words and phrases and by automatically inserting spaces and capitals. It assists with spelling and grammar by providing a choice of correctly spelled words and by predicting words based on grammatical rules. Different word prediction programs offer different options for customizing how word lists are predicted for a specific student, or for a specific writing task.

Features of word prediction

- Prediction may be based on:
  - ➢ Spelling / alphabet
  - ➢ Frequency of use
  - ➢ Phonetics and grammar
  - ➢ Custom vocabulary or dictionaries

- Vocabulary / Dictionaries
  - ➢ Can automatically learn new words
  - ➢ Can delete custom words
  - ➢ Can use pre-stored phrases or sentences, as well as words
  - ➢ Different sizes of vocabulary can be matched to literacy level
  - ➢ Specialized vocabulary can be used for different topics

- Appearance of lists can be customized
  - ➢ size and colour of font and background colour
  - ➢ number of words in list
  - ➢ arrangement in columns
  - ➢ position on screen
  - ➢ fixed or dynamic arrangement

- Selection method can be customized
  - ➢ point and click on word
  - ➢ type number of word
  - ➢ automatically scan through words and click to select

- Auditory and visual feedback can be adjusted
  - ➢ speaks word, list and/or sentence
  - ➢ highlights words as spoken

- Transparency – Most word prediction programs work transparently with other software. The word lists "float" above the software and as words are selected, they appear next to the cursor in the application. Some programs incorporate word prediction which only works within that application.

Considerations

- Consider using word prediction if your student has difficulty writing and:
  - ➢ Can initiate spelling words
  - ➢ Can recognize words in list or can search word list using visual or audible scan
  - ➢ Uses strategies to find correct word
  - ➢ Can switch between word list and document
  - ➢ Can maintain focus on own ideas

Product Examples

There are many different word prediction programs, each with different combinations of features that may be appropriate for students with alternate access needs.

- Co:Writer, by Don Johnston – adds linguistic word prediction to any word processing or e-mail program with vocabulary, spelling, composition and revision supports to build writing skills for struggling writers.

- Read & Write, by Texthelp Systems - designed as a floating toolbar that will help improve reading & writing skills, with features such as speech feedback, phonetic spell checking, word prediction & homophone support.

- Word Q, Bloorview MacMillan Children's Centre – has a range of prediction options, text-to-speech reading capabilities, as well as Canadian English and French dictionaries

Voice Recognition

Voice or speech recognition software allows users to speak to input text into computer applications. Significant improvements in this software now allow many users to achieve a high rate of speed and accuracy within an hour of starting to use the software. The ideal user is a literate adult male American who speaks with little or no accent or dialect. The more the user varies from this ideal, the more difficult accurate speech recognition becomes.

Voice recognition takes your speech as a series of syllables and tries to organize it into words, based on their acoustic form and the rules of English grammar. By speaking the phrase "It's hard to recognize speech.", voice recognition software may organize it as "It's hard to wreck a nice beach," or, " It's hard to recognize speech." Effective training helps minimize these recognition errors.

Benefits
- May increase writing rate
- May reduce fatigue as it takes less physical energy than writing

Considerations
- Literacy - The user needs to be able to continuously monitor the transcription of speech into text for errors in order to prevent inaccuracies.
- Situational awareness - In early use, it is important to build and maintain the accuracy of voice files. Failure to correct and delete errors and unintended input will lead to poor accuracy levels and possible abandonment of this technology
- Intact speech and language system and mature speech model - People with speech and language differences or difficulties often fail to master this software.
- May cause vocal strain for some users.
- Computer requirements – This requires a computer with up-to-date operating system, significant RAM and hard drive space
- Environment – Voice recognition requires a relatively quiet environment. Classroom and open office settings are not suitable for speech recognition use.

Product Examples

There are many different voice recognition programs, each with different combinations of features that may be appropriate for students with alternate access needs.

- Dragon Naturally Speaking, from ScanSoft - is considered by many to be a good product with a short initial training period (Win)
- IBM ViaVoice, from ScanSoft – is available in multiple editions for Windows and Macintosh computers

Alternative Keyboards

Alternative keyboards and other keyboard enhancements allow individuals who have difficulty with conventional keyboards to access the computer. Alternative keyboards offer a variety of ways to provide computer input through options in size, layout, and complexity.

Ergonomic Keyboards & Accessories

Many "standard" keyboards are now designed using ergonomic principles. These keyboards and accessories can reduce hand, wrist and arm difficulties such as repetitive stress injuries. Individual preferences and physical needs will determine which of the many keyboards is most suitable for a user.

- Split keyboards are designed to straighten the user's wrists and improve the alignment of the user's forearms, by increasing the distance between sides of the keyboard, or by rotating the keyboard. Tented keyboards are tilted variations of split keyboards.

- Keyboards with a negative slope (sloped down / away from the user) can prevent the user's hands from bending up in an awkward position.

- Curved keyboards have concave "wells" that adjust the height of the keys to match the lengths of the fingers. Some users may find this more relaxing for their fingers.

- Built-in wrist rests or palm rests help keep the user's hands in a good position by straightening the wrists.

- Keyboard trays can be mounted to a desk or table to ensure that the keyboard is at the correct height for the user.

Large Key

Some individuals require large keys due to physical limitations or visual impairments. They might benefit from using a Large Key keyboard. These keyboards have a simplified keyboard layout with physically larger keys.

- Big Keys, by the BigKeys Company - standard sized keyboards with very large (1") keys in a QWERTY or ABC layout. They do not require special software and can be used like a regular keyboard.

Small Key

On the opposite end of the spectrum, some individuals require physically smaller keys spaced closer together. These keyboards not only have a smaller footprint, but also have a shorter distance between the actual keys and a smaller key pitch or distance from the center of one key to the next.

- Little Fingers, by Datadesk Technologies - specifically designed for children or for adults with smaller hands. It is a full function keyboard with a built in trackball that can be used with both Macintosh and Windows computers.

Miniature or One-handed Keyboards

Not to be confused with small keyboards, miniature keyboards are designed with the keys very close together and usually in an alternate layout to allow an individual with a small range of motion access all the keys. They are typically lightweight and very small in size. Users often access these keyboards with only one hand.

- iGesture Mini Keyboard by FingerWorks - very flat keyboard with a conventional QWERTY layout. It requires very little pressure to activate the keys and provides the user with keyboard, mouse, and gesture input in a very small area. It has a USB connection and can be used with both Macintosh and Windows computers.

- Tash Mini Keyboard, by Tash International - small QWERTY keyboard with a sensitive membrane surface with keys that are less than 0.5" square. It has a Mouse Mode key to control the mouse and gives auditory feedback when keys are pressed.

- Half Keyboard, by Matias - a one-handed version of the standard keyboard. Only one half of the keyboard is visible (the QWERTY side). By holding down the space bar, the missing half is virtually activated and accessed. It does not have specific mouse features and users must activate it with their left hand only

- Maltron Single-Handed Keyboard, by Maltron - a full sized keyboard that has been ergonomically designed so that key placement minimizes strain and fatigue. There is a right- and left-handed version of the keyboard which has all the functions of a regular keyboard and can be plugged right into the computer for immediate use.

- BAT Keyboard, by Hallogram - ergonomically designed input device that uses a chordset to replicate all the functions of a traditional QWERTY keyboard. There are no mouse functions on the keyboard, but the use of chords greatly reduces the number of keys that need to be accessed to type

Programmable Keyboards

Programmable keyboards are very versatile and can often be programmed so characters, words, or phrases can be entered by selecting keys. They are often larger in size than standard keyboards, allowing for larger key target areas. Standard overlays on the keyboards can be used without special software, while custom overlays can be created to suit individual users' layout needs.

- IntelliKeys USB - a large format programmable keyboard with a membrane surface. It comes with standard overlays including QWERTY, ABC, and mouse keys. The keyboard can be programmed in a number of ways to suit an individual's physical limitations.
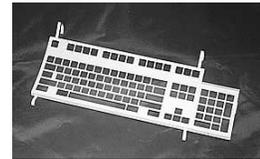
- DiscoverBoard, by Madentec - comes with a permanent overlay with large, widely spaced keys. It has four additional overlays that provide access to most typical software programs. Software that comes with the keyboard allows control of the mouse as well as speech and overlay customization

Keyboard Accessories

There are a number of keyboard accessories which can be added to alternative keyboards to further meet the user's need.

- Keyguards - Keyguards are hard plastic covers that fit over the keyboard with holes for each key. Individuals who have difficulty targeting keys or who frequently hit unwanted keys benefit from having a keyguard. The keyguard layout must match the key locations on the keyboard.

- Moisture Guards- Moisture guards are thin plastic "skins" that fit tightly over the keyboard to protect it from liquid spills and drooling. Moisture guards must match the keyboard layout to be effective.

- Alternative Labels - A variety of key labels are available for adding clarity or tactile information to the keys. Labels can enlarge the print, colour code the keys or make more frequently used keys more obvious.

Keyboard Feature Matching Grid

Student Need	Consider
Can access a standard keyboard but…	
…often strikes the wrong key	‣ Adjust seating and positioning of keyboard ‣ Use adaptations for visual impairment ‣ Keyguard ‣ Adjust keyboard input time ‣ Large key keyboard ‣ Keyboard with large keys overlay
…cannot see the keys clearly	‣ Adjust seating and positioning of keyboard ‣ Investigate lighting options ‣ Use high-contrast or large print key labels ‣ Keyboard with large keys ‣ Chordic keyboard

Student Need	Consider
…repeats letters by mistake	▸ Turn off key repeat ▸ Adjust key repeat time or delay release time
…hits the key several times or has difficulty releasing the key	▸ Adjust the key post-acceptance delay
…cannot hold down two keys at once	▸ Use the "Sticky Keys" feature in operating system
…has difficulty knowing when a key has been selected	▸ Adjust auditory feedback for key selection
…suffers pain or fatigue when typing	▸ Adjust seating and positioning of keyboard ▸ Ergonomically designed keyboard ▸ Keyboard with alternative layout like Dvorak or frequency of use ▸ Keyboard with word/sentence overlays to reduce keystrokes ▸ Mini keyboards to reduce range of motion
…cannot reach across entire keyboard	▸ Adjust seating and positioning of keyboard ▸ Use arm and wrist supports ▸ Small key keyboard ▸ Mini keyboard
…has the use of only one hand	▸ One-handed keyboard ▸ Chordic keyboard ▸ On-screen keyboard with mouse
…is not literate	▸ Keyboard with ABC layout ▸ Keyboard with picture / symbol overlay ▸ On-screen keyboard with pictures / symbols
Cannot access or operate a standard keyboard…	
... with fingers	▸ Hand held pointer ▸ Head or chin pointer ▸ Keyboard with overlay accessed by knuckle, fist, or foot ▸ On-screen keyboard accessed with alternative pointing device ▸ On-screen keyboard scanned and selected with switch

Adapted from Keyboard Assessment Guide, CALL Centre

Student Scenario

Kenny is a 12-year old with Ruvalcaba-Reichert-Smith syndrome, which is a congenital skeletal disorder that affects his stature and motor planning. He has difficulty with many aspects of school life and requires one-on-one support for much of his school day. He has balance problems and is unable to climb stairs unassisted. He also has difficulty with his pincer grasp, but his fine motor skills are emerging. Kenny is cognitively delayed and follows a modified Individualized Education Plan based on functional life skills.

Kenny's school based team was interested in providing him with a method of developing functional life skills. They want him to be able to rely on visual prompts and clues to complete tasks more independently. They also wanted him to begin developing more sustained attention and to have a way to practice concepts and skills repeatedly for reinforcement.

His team requested the IntelliTalk II and IntelliKeys USB software / hardware combination to meet his physical and cognitive needs. His special education assistant trained on the use of IntelliTalk II by attending school based team training and by completing an online course. She has created a number of activities for Kenny designed to teach him item and people recognition, task planning, and coin recognition. Kenny enjoys using the computer and IntelliTalk II to learn and his team reports that he is able to generalize the skills he develops on the computer to "real life" situations.

Because of his physical limitations, Kenny has difficulty targeting the small keys of a regular keyboard. Cognitively, he is not literate and requires graphic or symbol support to identify words. The IntelliKeys USB alternate keyboard has been an excellent choice for Kenny – the overlays provide him with larger keys, symbol support, and the ability to completely customize activities to suit his specific needs. The IntelliTalk II program provides motivating and attention sustaining auditory feedback.

On-Screen Keyboards

There are a number of on screen keyboard programs for those who have difficulty accessing a regular or adapted keyboard. These programs display a picture of a keyboard on the computer screen and letters or commands are sent to the underlying program by clicking the keys. On screen keyboards can be accessed by mouse or alternative pointing device, by touchscreen, or by switch scanning. They often have various features including built in word prediction or abbreviation expansion, alternate layouts or program specific custom setups.

On-Screen Keyboards of Operating Systems

- **Windows XP -** The Windows operating system has a built in on screen keyboard as one of its accessibility features. It is very basic but can accommodate mouse, joystick and switch access. It has a standard or enhanced QWERTY layout with only minor adjustments in the number of keys possible.

Dedicated On-Screen Keyboards

- **WiViK Onscreen Keyboard**, by WiViK- is accessible with any pointing device or up to six switches. It can be set for point and click or dwell selection and has a unique expanding quadrant selection feature. It also has built in word prediction and abbreviation expansion as well as speech output. (Win)

- **Screen Doors** 2000, by Madentec - has foreign language support, self-learning word prediction and both alphabetical and frequency keyboard layout options. Both the keyboard and the keys are resizable. (Win/Mac)

- **DiscoverScreen**, by Madentec - This talking on-screen keyboard is accessible by all access methods. It is fully customizable, allowing the user to create program specific custom setups. It has integrated speech for auditory cuing and feedback with multiple options for matching settings to access needs. **(**Win/Mac)
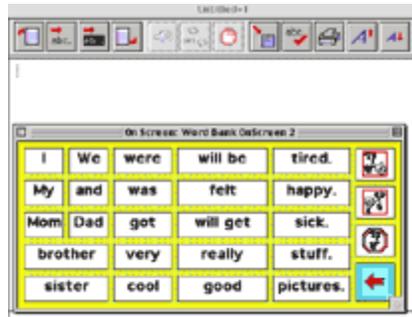

- **Keystrokes 3.1** by AssistiveWare – has an extensive list of features including multilingual word prediction and speak-as-you-type auditory feedback. It floats above and works with any MacOS9 or OSX application and has all of the standard input, dwell, and customization features of other dedicated on-screen keyboards. (Mac)

Integrated On-Screen Keyboards

- **IntelliTalk III**, by IntelliTools - has three standard keyboards built into its toolbar: QWERTY, frequency of use (designed for scanning switch users) and ABC (letters arranged in alphabetical order). The program can be accessed a variety of ways including pointing device and scanning with a switch. The keyboard sends directly to the word processing area of the program so does not require another word processor to function. The keyboards cannot be customized per se, but the many features of the program allows you to create custom on-screen keyboards with whatever content (letters, words, phrases, commands) and in whatever configuration the user needs. (Win/Mac)
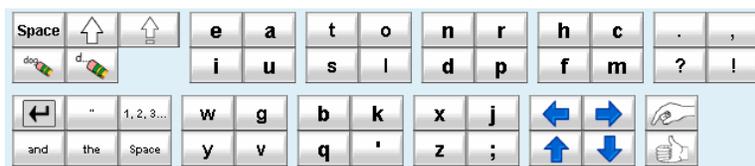
Frequency Keyboard

- **Clicker 4**, by Crick Software - has an on screen keyboard grid that can be accessed with pointing devices or scanned with a switch. The keyboard grid sends text, with auditory cuing and feedback to ClickerWriter, the integrated word processor. Also like IntelliTalk III, Clicker can be used to create custom keyboard grids that send letters, words, or phrases depending on the needs of the user.
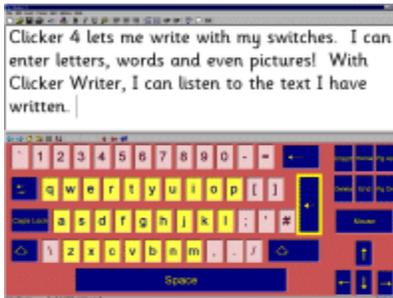
Considerations When Choosing an On-Screen Keyboard

Many of the considerations described when choosing an alternative keyboard apply to choosing an on screen keyboard as well. The Occupational Therapist plays a key role in determining the exact needs of the student and matching them to the available on screen keyboards.

On screen keyboards may be a good choice for those who cannot physically access a regular or alternative keyboard due to a limited range of motion or motor control or because they have limited strength in their hands and/or fingers. An on screen keyboard that can be customized for layout (alphabetical) or to send words or phrases may be a good choice for developing or struggling readers. Some additional considerations include:
- Access method – how will the on screen keyboard be accessed (mouse, alternative pointing device, joystick, touchscreen, switch)?
- Access options – what access options does it provide to more closely match the needs of the user (scanning features, dwell to select, mouse emulation, etc.)?
- Feedback options – what click or auditory feedback does the on screen keyboard provide?
- Mouse options – does the on screen keyboard offer mouse emulation features?
- Layout customization – can the on screen keyboard layout be customized if needed (keyboard size, key size, number and location, specific program commands, mouse emulation, etc.)

Since on-screen keyboards are a type of alternative keyboard, you may also want to refer to many of the considerations listed in the previous section.

Student Scenario

Justin is a high school student who suffered a serious accident while skiing. As a result of breaking his third and fourth vertebrae, he is now confined to a wheelchair as a quadriplegic. He has retained good head and trunk control and can move his right arm minimally from the shoulder. He has good movement in his thumb, index finger and second finger of his right hand. Justin is very bright and his accident has not limited his intellectual abilities in any way.

After recovering from his accident, Justin indicated he was very motivated to complete his regular high school program and graduate on time with his classmates. The goal is to have him access technology which will give him the ability to take some notes in class, start and complete written assignments, and conduct research on the internet. He has full time support in school, but his team wants him to develop as many independent skills as possible to increase the likelihood of successfully transitioning to a vocational situation when he leaves school.

Justin was provided with a laptop computer, an alternative mouse, and an on-screen keyboard (WiViK). The laptop was needed for portability as Justin moves from class to class throughout the day. The team tried a number of alternative mice before Justin settled on a small trackball mouse that allowed him to move the mouse with his right index finger and click with his thumb. The hand held mouse required very little pressure to mouse or click and could be held in his lap comfortably. His on-screen keyboard was adjusted for dwell selection with the dwell time being reduced as he became more proficient with its use. Justin used his on-screen keyboard to write assignments and to do internet searches for his various courses. After three years, and a great deal of motivation and hard work on his part, Justin graduated with his class on time.

Alternate Pointing Devices

Definition – Pointing Devices

Alternate pointing devices provide options for computer users who cannot control the movement of a standard mouse due to fine motor problems, fatigue, visual impairments, or learning difficulties.

Key Features of Pointing Devices

Standard computer mice are available in many different sizes and shapes. Left-handed people can use left-handed mice, children can use small mice, or people can choose a mouse that just feels more comfortable (or looks more attractive) to them. Mouse users need to be able to accurately control the movement of the on-screen pointer, click and double-click mouse buttons, and hold down mouse buttons while dragging the pointer to highlight or move items on-screen.

Optical Mouse, by Kensington

- Standard Mouse Adaptations

    There are a number of adaptations that can make it easier for people to use a standard mouse.
    - ➢ Proper positioning of the keyboard and mouse and appropriate seating are essential for all computer users.
    - ➢ Wrist or arm rests can provide support and stability, reducing strain or fatigue.
    - ➢ Computer operating systems offer a number of accessibility options that can make it easier to control mouse movements.
        - o The speed and acceleration of mouse movements can be adjusted. People with poor fine motor control may find it easier to control pointer movements at a slower speed or rate of acceleration.
        - o Users can adjust settings so that two slow clicks will be recognized as a double-click, or the "+ key" can be used to double-click.
        - o People who have difficulty with holding down a button while dragging can use button latching features.
        - o The "dwell" feature allows a user to click a button simply by allowing the pointer to rest on the desired on-screen object for a defined time.
        - o Pointer size can be increased, the colour can be changed, or the pointer can flash to make it more visible on-screen
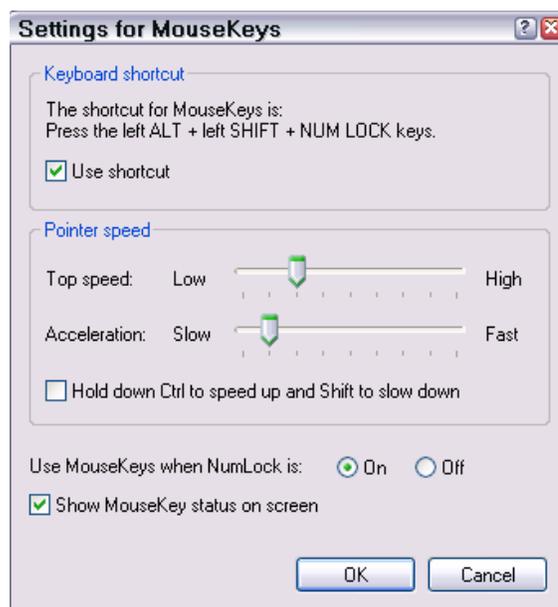
MouseKeys feature in Windows XP

- Keyboard Control

  People who can use a keyboard, but have difficulty controlling a pointing device, can use the keyboard to control mouse functions. They can use key combinations to select menu commands, use the arrows or numeric keypad to move around in documents, and use defined shortcuts or macros to enter mouse functions.

- Trackballs

  Trackballs are upside down mice that stay in one spot while the user rolls the ball to control pointer movements. They come in many sizes and shapes, with balls that can be moved using individual fingers, hands, or feet. Many people prefer to use trackballs instead of mice because they are more stable and don't take up much desk space. People who cannot use a mouse due to problems with fine motor control, or with pain or fatigue, may find it easier to use a trackball because this requires less hand and arm movement.

  Logitech Cordless TrackMan Wheel

- Joysticks

  Joysticks have a moveable bar that the user grasps or pushes with a hand or other body part to control pointer movements. There are many types of joysticks available in different shapes and sizes, as they are frequently used for playing computer games. Some people who have difficulty controlling a mouse or trackball find it easier to use a joystick.

  USB Point It Joystick by Tash

- Touch Sensitive Pads

  Many laptop computers have built-in touch pads that use finger or stylus movements to control an on-screen pointer. Touch pads are also available as separate devices that plug into a computer. Users can click by tapping the pad or by using the buttons next to the pad. Touch pads are useful for people who have good finger dexterity, but have difficulty with the larger movement needed to use a mouse or trackball.

  Smart Cat by Cirque

- Touch Screens

  Touch screens are built-in or mounted in front of the computer screen so the user can touch on-screen objects directly. Users can tap the screen with a finger or stylus, or use built-in buttons to click and drag. People who cannot grasp or control a mouse or other pointing device, but can reach out to touch the screen, may find this easier to use. This type of direct control is also useful for people who may not understand how to use a mouse or keyboard to operate the software.

  Touch Screen by Magic Touch

- Switches to Control Mouse Movements

  Some special mice and trackballs can be used in combination with switches for users who can control mouse movement but can't control mouse buttons or keyboard commands. Switches can be plugged into the pointing device and the user hits them to click and drag the pointer.

  Switch Adapted Mouse by Infogrip

- Head Pointing Systems

  People with good head control, but limited control of hands, arms, or other body parts, can control pointer movements using head mounted systems. A control device is mounted on the user's forehead, eyeglasses, or a headband. The user's head movements send an ultrasonic or infra-red signal to a receiver. Switches or a "dwell" function are used in combination with these systems to control mouse clicks.

Headmouse Extreme, by Origin Instruments

Matching Student Need to Technology

Student Needs, Abilities & Expectations	Technology Features to Consider
Mouse use causes wrist, arm or hand strain	Wrist rests or other supports
Can use a mouse, but has very small hands	Smaller size of mouse
Can move a mouse and click mouse buttons, but is not accurate	Operating system accessibility options to slow down mouse speed, or adjust "click and drag"
Needs to scroll through documents or websites	Mouse with a scroll wheel to make it easier to move up and down in a document
Cannot use mouse buttons	Switches instead of the buttons to "click" and "drag"
Fine motor problems make it difficult to move mouse, or mouse use causes fatigue	Trackball or joystick may provide more stability
Good fine motor control of fingers	Trackpad may require less hand movement
Poor control of hands and arms, but accurate head movements	Head pointing system
Does not understand connection between mouse movement and action on the screen	Touch screen mounted directly over computer screen with appropriate software

Student Scenario

Ryan is a 10 year old boy with Muscular Dystrophy. He has an average build, but is growing physically weaker and fatigues easily. He is starting to lose his ability to walk and has begun to use an electric wheelchair at school and a standard wheelchair at home.

He takes part in a full academic program and has an average, to slightly above average, achievement level. Fatigue is starting to limit his ability to demonstrate the extent of his knowledge in curriculum tasks. He is having increased difficulty grasping and moving objects and is unable to hold a pen for any length of time. It is difficult for him to write at end of the school day and he is asking for more scribe time in class.

Ryan now uses a laptop computer to write, which is mounted on his wheelchair tray. He uses a broad range of Windows applications, including word processing, web browsers, organizational tools, and games. Ryan can touch type slowly, but regular mouse use is very debilitating for him. Ryan finds that using a laptop with a built-in trackpad and good wrist supports allows him the best access at this time. He also uses word prediction software to reduce keystokes and fatigue. His team will monitor his condition closely to ensure that his access technologies change to meet his physical needs.

Switch & Scanning Options

Definition - Switches

A switch acts as an interface between the user and a computer, toy, environmental control unit or other device. It allows the user to indicate a choice by the use of one or two motor responses. Switches provide access to:

- Environmental control for work, play or participation (toys or machines)

- Communication devices

- Computing devices - with switch activated software, or as key or mouse function

Switches are used by students who have limited motor output. Switch use is commonly confined to a limited number of body "sites" over which the person has motor control, including the hands, head, or foot. Switches may be the preferred access for students who:

- Cannot access a regular keyboard

- Cannot control the mouse

- Cannot click or drag

- Have fatigue issues when using any of the above methods

Key Features of Switches

Switches may be single, double, multiple or joystick types. A particular user or student may need specific levels of:
- Sensitivity

- Adjustability

- Degree of surface area

- Height

- Amount of travel

MicroLite Switch

Cordless Big Red

- Sensory feedback - The user must have some signal that the switch has been activated. This can be in a visual, auditory or tactile form.

- Mounting - The switch may need to be positioned or mounted to a specific site to allow easy access for the user.

- Interface - A switch is almost always attached to an interface box in order to allow any given switch to function in a variety of ways. A switch can be set to close or open an electrical circuit (on/off) or can be programmed to function as a key on a computer keyboard.

Switch Activation Methods

Switches can be made to respond to a variety of user responses. These include:

- Pressure differences

- Use of a puffer reed

- Motion detection (mercury)

- Pneumatic

Pneumatic Switch

- Light sensitivity
- Sound sensitivity
- Myoelectric (muscle)
- Proximity
- Brain activity

Grasp Switch

Matching student need to technology

Feature matching / Factors that influence the selection of switches:

- Range of motion
- Strength of motion - use of gravity or lift action, adjust required pressure
- Size of target area - accuracy of motion
- Steadiness and endurance of motion
- Reliability of access site
- Mounting and positioning relative to all of the above factors
- Training of scanning - Development of motor skills and cognitive task

Critical questions for single switch evaluation are offered by Cook and Hussey in *Assistive Technologies: Principles and Practice*.

- Can the student activate the switch?
- Can the student wait for the appropriate selection?
- Can the student activate the switch at the right time?
- Can the student maintain switch activation (hold)?
- Can the student release on command?
- Can the student repeatedly carry out the steps necessary for selection?

Ways to Utilize Switches

- Direct selection. The student must be able to navigate independently
- Scanning
  - ➢ Visual scanning
  - ➢ Auditory scanning
- Morse code

Definition - Scanning

Scanning is an indirect selection method.   An array of choices is presented and sequentially scanned by a cursor or light. The user selects a choice by pressing a switch. Scanning is employed when the user is unable to navigate a pointing device on a screen through direct motor control. Scanning is generally slower and less desirable than direct selection.

Scanning or indirect selection reduces the user's output to a binary decision of:
This one – SELECT with switch   or   Not this one- pass over and move to next item.
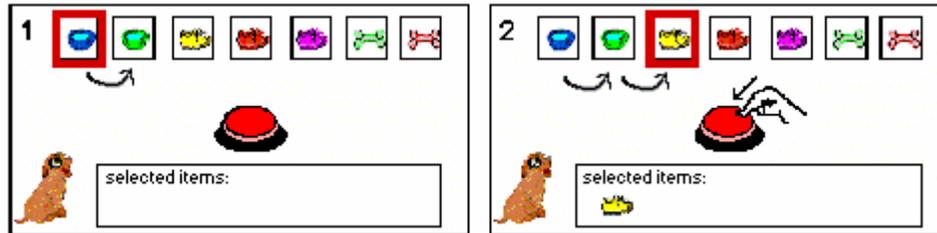
Visual Scanning Techniques

- **Automatic** - the array of choices is offered automatically and the user presses the switch to indicate a choice when the desired choice is offered.

- **Continuous/ongoing** - This is a form of automatic scanning where the scan continues on along the array from the last point of selection or switch hit. The scan does not automatically return to the beginning of the array after the selection has been made.

- **Step** -The user advances the cursor or scanning indicator one item at a time. Choice selection is then by a second switch or by a different acceptance dwell time.

- **Inverse** - This is a selection method whereby the user must hold the switch to keep the cursor moving. Selection of choice is indicated by releasing the switch.

Auditory Scanning

In auditory scanning, the items in an array are offered in an auditory mode rather than visual mode. The automatic, step and inverse methods of selection can be employed.

Scanning Formats

In order to increase efficiency of the scanning method, consideration must be made for the array and frequency of item use.

- Dependent on number of switches in use

- Scan presentation

  ➢ one item at a time
    o in linear, circular or snake sequence
  ➢ sets or groups in
    o row/column
    o column/row
    o group/block
    ⇒ quadrant
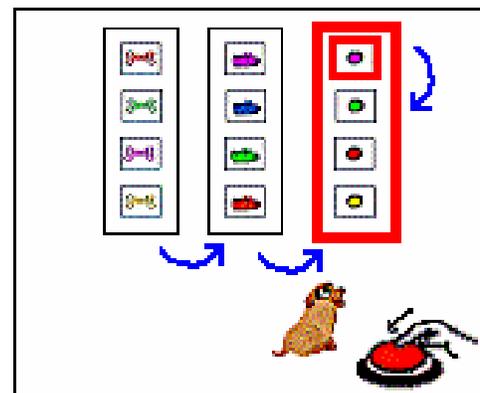
Scanning Factors

- Scan Displays - Targets can be offered by:
  - ➢ Light panels
  - ➢ Highlight box
  - ➢ On screen
  - ➢ Dynamic or branching – when a target is hit, the screen changes to another array

- Scanning Arrays - Arrays will depend on what the user is required to do for a given task. It may vary depending on:
  - ➢ Letters, number, keyboard function, mouse keys for navigation, icons
  - ➢ Customized to user's need
  - ➢ Frequency of use
  - ➢ Auditory or visual feedback
  - ➢ Scripts and macros
  - ➢ Built in word prediction
  - ➢ Pre-defined messages
  - ➢ Mouse – movements , functions and screen locator

Switch Skill Progression

1. Cause and effect

   - Beginning - large graphics, bold movements, blank screen between activation

   - Intermediate - medium sized graphics, less movement, no blanking between activations

   - Advanced - small graphics/movement, no blanking.

2. Maintaining switch activation

   - Holding switch continues actions

3. Switch release – activation does not begin until switch is released

4. Timed (locking) activation - user must activate or deactivate switch to achieve response

5. Two switch use – user has 2 switches, each providing a specific action. For example, hitting switch 1 advances you through options and hitting switch 2 selects the current option.

(Adapted from Caroline Musselwhite)

Software for Switch Use with Scanning

- **Graphic word processors that provide "universal access"** - Writing with Symbols 2000, Clicker 4, IntelliTalk II and III

- **Co:Writer** - Word prediction software which enables the user to use fewer keystrokes by offering word or phrase predictions based on the preceding spelling and grammar.

- **DiscoverScreen** - is a talking on-screen keyboard. It can provide access using any pointing device to a standard on-screen keyboard. Program provides files to match common learning software

- **Cross Scanner** - can be overlaid on any computer program to allow user to do mouse functions. It targets a point on the screen by intersecting horizontal and vertical coordinates.

- **On-screen keyboards** - Keyboards which are accessed on the computer screen using a pointing or scanning device

Morse Code

Morse code is a faster input method than scanning, but requires precise switch control and ability to memorize the code.

- ➢ 1, 2 or 3 switch input
- ➢ Tonal or timing changes
- ➢ Training mode
- ➢ Programmable
- ➢ Letter, number and function keys
- ➢ Click or speech feedback
- ➢ Scripts, macros, and pre-programmed messages
- ➢ Screen locators

Connecting to a Computer

Switches cannot be plugged directly into a computer. An interface is needed to pass on the switch "instructions" for the software.

- ➢ Switch Interface
  - o USB, PS/2, ADB (Macintosh) connections
  - o Software will specify
- ➢ Appropriate number and type of switches

Student Scenario

Mary is a 9 year old girl with severe physical challenges who follows a regular grade 3 curriculum. Mary uses a wheelchair and is unable to speak. She has limited head and bilateral arm control and is completely physically dependent on her caregivers. She communicates using gross arm signals to indicate yes and no. Eye gaze is also used with an E Tran board, PCS symbols with text, and text only. It is evident that Mary is cognitively capable, but she is unable to generate her own spontaneous communication.

Due to Mary's complex physical and health needs, little time was available to provide training for choice making and selection strategies. In addition, Mary was often fatigued or frustrated and refused to continue with the training tasks. Success had to be measured based on the first 3 to 5 responses during any given training session.

Mary was trained to use a head switch and scanning to operate Speaking Dynamically Pro software. Cross Scanner software was also used to allow her to access games and educational software which did not provide universal access. Although Mary had no learning difficulties per se, training was still required to teach her to scan. Training began using a 3 choice display laid out in a horizontal pattern. The scan was set on a "repeating circular scan" until the selection was made. Familiar and well established cognitive tasks were chosen such as matching of simple spelling words. Due to the problem of motivation, another training task involved having Mary tell "knock, knock" jokes using Speaking Dynamically Pro. Over several weeks, scanning arrays gradually increased to 4 groups with up to 8 items in a group.

Although Mary made progress in her ability to scan, she was often unwilling to engage in the task. Scanning was eventually abandoned in favour of a direct selection method using a head pointer. Mary found scanning to be too tedious and her motivation to communicate was not strong enough to tolerate the slow speed of using this method.

Emerging Access Options

Eye Gaze

Eye gaze input systems use a camera that tracks eye gaze and movement and converts it to computer input. The camera may be mounted on an eyeglass frame or on a computer monitor. For most systems the user must remain very still in order to maintain the delicate calibration that allows these systems to work. These systems work well for users with spinal chord injuries who cannot use a speech input system. Users with ocular motor problems or involuntary head or eye movements may not be suited for eye gaze systems.

- **Eyegaze Computer System**, by LC Technologies - an eye controlled (eye gaze) computer input system designed for use by individuals with severe physical disabilities. The system is controlled by the use of one eye; nothing is attached to the user's body. Using a camera and an infrared light source, the computer interprets where the eye is focused on a computer screen. Various options permit the user to turn on lights and appliances, dial and receive telephone calls, and run most Windows software.

Mind Control

A number of research institutions are investigating techniques of controlling computers using brain waves. While this is still in the very early stages of experimentation and development, there are some indications that this may be a future access method for individuals with no other means of physical access. The following products are currently available

- **Cyberlink**, by Brain Actuated Technologies - a mouse emulator designed to provide hands-free computer operation for individuals with upper extremity disabilities. The device uses a headband/sensor harness to detect electrical signals on the forehead resulting from subtle facial muscle, eye, and brain activity. These signals are amplified and digitized and sent to the computer for cursor control. Eye motions and facial gestures are also decoded into mouse button clicks, keystrokes, and cursor resolution control.

- **Mind Controlled Switch** (MCTOS), by Technos America - eye-controlled or brain-controlled switch designed for use by individuals with severe physical disabilities. This switch utilizes consciously generated signals detected by a receiver worn on the user's forehead. These signals are converted to an output of electrical control signals, enabling the user to control a single switch using eye movement, facial muscle activity, or thought. No physical movement is required. The user must be able to learn to quiet the mind and increase conscious mental activity at will.

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Alliance for Technology Access   www.ataccess.org
American Occupational Therapy Association   www.aota.org
Apple Computer's Disability Resources   www2.apple.com/education/k12/disability
Assistive Technology Industry Association   www.atia.org
CALL Centre   http://callcentre.education.ed.ac.uk
Closing The Gap   www.closingthegap.com
Michigan's Assistive Technology Resource   www.cenmi.org/matr/
Microsoft Accessibility   www.microsoft.com/enable
RESNA   www.resna.org
TASH   www.tash.org
University of Kentucky Assistive Technology   http://serc.gwsA.uky.edu/www/ukat
University of Wisconsin-Madison Trace Center   www.trace.wisc.edu
Wisconsin Assistive Technology Initiative   www.wati.org

Resources in BC

BC Child Development & Rehabilitation Assoc.   www.fvcdc.org/bcacdr/
Community Health Units or Hospitals   www.healthservices.gov.bc.ca/socsec
                                                   www.gov.bc.ca/healthservices/
Queen Alexandra Centre for Children's Health   www.viha.ca
SET-BC   www.setbc.org
Sunny Hill Health Centre for Children   www.sunny-hill.bc.ca

Assistive Technology Vendors & Manufacturers

Ablenet   www.ablenetinc.com
Adaptivation   www.adaptivation.com
Alphasmart   www.alphasmart.com
Apple Accessibility   www.apple.com/accessibility
Assistive Technology   www.assistivetech.com
BigKeys Company   www.bigkeys.com
Brain Actuated Technologies   www.brainfingers.com
Crick Software   www.cricksoft.com
Daedalus Technologies   www.daessy.com
Datadesk Technologies   www.datadesktech.com

DJ Technical Sales	www.djtech.com
Don Johnston	www.donjohnston.com
Dvorak International	www.dvorakint.org
Enabling Devices	www.enablingdevices.com
Fingerworks	www.fingerworks.com
Humanware	www.humanware.com
Hallogram Publishing	www.hallogram.com/bat
Infogrip	www.infogrip.com
IntelliTools	www.intellitools.com
Keytime	www.keytime.com
Kurzweil Education Systems	www.kurzweiledu.com
LC Technologies	www.eyegaze.com/
Madentec	www.madentec.com/
Matias Corporation	www.halfkeyboard.com
Mayer Johnson Company	www.mayer-johnson.com
Natural Point	www.smartnav.com
Origin Instruments Corp	www.orin.com/access
Palm Gear	www.palmgear.com
PenFriend Limited	www.penfriend.biz
Penny + Giles	www.pennyandgiles.com
QuillSoft	http://Wordq.com/
RJ Cooper & Associates	www.rjcooper.com
ScanSoft, Inc.	www.scansoft.com
Smart Cell Technology	www.smartcell.com
Tablet PC Talk	www.tabletpctalk.com
Tash International	www.tashint.com
Technos America	www.mctos.com
TextHelp Systems	www.texthelp.com
Textware Solutions	www.fitaly.com
Westest Engineering Corp	www.darci.org
Westing Software	www.ablemouse.com
WiViK	www.wivik.com
Words+	www.words-plus.com
Zygo Industries Inc	www.zygo-usa.com