Chapter 12 - Assistive Technology for Students who are Blind or Have Low Vision

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Assistive Technology for Students who are Blind or have Low Vision

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This chapter intends to provide information regarding a process for evaluating the assistive technology of students who are blind or have low vision. Assistive technology advances at a quick pace, requiring ongoing research and awareness on the part of the practitioner. The reader will find a list of low- and high-technology devices that offer students access to the academic curriculum as well as extra-curricular activities. Although the focus of this information is on assisting students who are blind or have low vision, these tools may also be helpful for many students with other disabilities. Included are specifically designed tools to assist students both in accessing and processing curriculum. It is important to understand the necessity of teaching the underlying skills needed to be independent in the use of assistive technology, which can be equally valuable in classrooms and community. For example, Braille notetakers are useful not only for note taking in class, but also for composing and printing essays, writing notes, send e-mails, or browsing the Internet.

Assistive technology can give students who are blind or have low vision support in all academic areas as well as in expanded core curriculum. The selection of devices is contingent upon a variety of factors. To begin the process of consideration, the student's vision condition needs to be identified. Additional information should be acquired regarding the students' appropriate media format through the learning media assessment. For the purposes of this information visual impairment is divided into three major categories – low vision, functional blindness/blindness, and cortical (cerebral) visual impairment. Each of these groups has specific characteristics that will govern the selection of appropriate assistive tools.

Visual Impairments Defined

Group	Description
Low Vision	An ocular condition where a person's visual acuity ranges from 20/70 to 20/200 (legally blind) after best correction, or visual field subtends the angle of 50 degrees or less.
Functional Blindness/Blindness	An ocular condition where a person perceives light or less, or is unable to efficiently use their residual vision.
Cortical (Cerebral) Visual Impairment	A neurological condition related to the visual pathway where a person has difficulty in interpreting visual information.

Using the SETT Process and the Decision Making Guide

The SETT process is designed to establish those characteristics in order to recommend the best possible solutions. The SETT process considers several factors that influence the choice of tools, devices, and interventions. It is imperative that the student's strengths and weaknesses are known. The needs assessment also considers the environment in which the student receives instruction. It is also important to know about the student's plans after high school graduation. When all of the above information is gathered, conclusive decisions can be made. It is worth mentioning that in some cases more than one solution may be implemented to obtain desired results. The process of decision-making about assistive technology can be complex and inexact, making it difficult to match one tool with a specific area. For example, to give a student with low vision better access to print, either a large print book, or regular print book with some type of magnifier can be provided.

WATI Assistive Technology Decision Making Guide

Area of Concern: Vision

PROBLEM IDENTIFICATION

Student's Abilities/Difficulties	Environmental Considerations	Tasks
• Print size • Reading visual or tactile medium • Illegible handwriting • Navigating the computer operating system and programs • Identifying & finding details in pictures • Touch typing • Need for audio enhancement • Color blindness • Photosensitivity • Activities of daily living • Participation in gym activities • Organization • Physical or motor-related issues	• Desk space • Classroom space • Location in the room • Visual access of board work • Visual access of classroom presentations • Type of learning medium • Type of light and level of illumination • External noises • Assistive Technology: past and present	• Reading • Writing • Note-taking • Large group distance presentations Visual activities • Computer-assisted tasks • Converting print into electronic format • Activities of daily living • Gym activities

Sensory Considerations	Narrowing the Focus
What sensory challenges does the student have that impacts learning? (i.e., visual, auditory, tactile)	Identify Specific task(s) for Solution Generation

Solution Generation Tools & Strategies	Solution Selection Tools & Strategies	Implementation Plan
Brainstorming only— No decisions yet Review solutions in respect to type of visual impairment and the area that requires additional support.	Use a feature match process to discuss and select ideas(s) from Solution Generation	AT trials/services needed: Formulate specific task objectives to determine effectiveness of trial: • Training needed • Date • Length • Person(s) Responsible **Follow-Up Plan** Who & When Set specific date now.

Important: It is intended that you use this as a guide. Each topic should be written in large print where everyone can see them (i.e. on a flip chart or board). Information should then be transferred to paper for distribution, filing, and future reference.

Student's Abilities/Difficulties

Can the student read regular print?
Students with low vision and cortical visual impairments may require change in the print size and typeface. All of the changes will be contingent on students' vision condition and their preferences, and should be delivered through evaluation, functional vision assessment and/or learning media evaluation

What are the student's most effective reading media?
Reading medium is another important consideration. Some students may use a combination of media—visual, tactile, audio or electronic (e-text)—to enhance or support the primary reading mode. AT teachers of the visually impaired will determine what learning media will be most functional.

Can the student understand pictorial information?
When students with low vision need to interact with pictorial information, they may need some type of magnification. Enlarged material may be sufficient for some students. Others will need optical or electronic magnification tools. Magnification needs are determined through low vision clinical evaluation.

Is the student's print legible?
Writing can be problematic due to poor vision and hand-eye coordination. Some students with low vision may be able to write but the shape and size of the letters might make the handwriting illegible. In such cases, unless a student is a Braille user, typing needs to be considered.

Can the student type?
Typing is one of the most essential skills that allows for written communication. A computer or other typing device may offer large and high contrast keys, but to be an effective typist, touch-typing should be considered as a long-term solution.

Can the student navigate the computer system independently?
Students with visual impairments will require various types of operating system accessibilities to do computer-based assignments. For some, built-in accessibility features will suffice, while others will need full-fledged specialized software.

Is the student photophobic (extremely sensitive to light)?
Students that are photosensitive may require tools that allow them to adjust color schemes. Additionally, consideration must be given to students who are colorblind. Learning material may also need to be provided in preferred color combination to reduce glare and enhance contrast.

Can the student participate in gym activities?
Many games in the gym involve the use of a ball. Depending on the sport played the balls differ in size and weight. Students with visual impairment may require adapted gym tools. The way games are played may also be modified to include students with vision concerns.

What are the student's organizational skills?
Keeping items organized is an especially important skill for a student with visual impairments. Many students, especially younger students, need assistance in learning to keep material organized. It should be an ongoing part of instruction.

What motor challenges does the student have?
It is important to determine if there are any other physical or related issues that need to be considered. Certain motor impairments may affect a student's ability to interact with Braille or to navigate their environment effectively.

What does this student need to focus on in their Expanded Core Curriculum?
Students with visual impairments should participate in an expanded core curriculum that includes the use of compensatory skills, orientation and mobility, social interaction skills, independent living and personal management skills, recreation and leisure skills, career and vocational education, visual efficiency and need for/use in Assistive technology.
Compensatory skills include the use of tools, adaptations, modifications and behaviors that maximize the student's opportunity to access the environment, educational activities information and basic human needs. This can include a variety of communication tools, adapted reading and writing, organizational and counting tools.

Can the student participate in extra-curricular activities?
In most cases yes, many sports are fully accessible to a student with visual impairments such as wrestling, swimming, track and field. For a student with severe impairments or blindness adaptations can be created to cue location or destination. Sports that use a ball or object that moves may need to use a ball with colors are high contrast, larger or softer shape, or some kind of sound mechanism to help the student locate it.
For many non-athletic activities no special equipment may be needed, such as in front six debate or language clubs. Some activities may require cueing to location and/or destination. Materials may require adaptation to the appropriate media such as Braille or audio formats of information needed to participate effectively

Sensory Considerations
Different environments have different levels of sensory stimulation if the team is determined that sensory impacts are influential for the students learning identify the sensory level it in each environment that the student will be in. Coping with environmental noise is a fact of life. If a student is distracted by background noises, they may need to learn coping strategies or have the environment modified as they learn how to prioritize the sounds around them. For students who are deaf blind and have multiple disabilities, see chapter 14 for additional information on sensory considerations.

Environmental Considerations

Desk space
Ample desk space is required due to the size of material and supporting tools. That space is necessary not only to fit all the material and tools but also to help students get organized. If

sufficient space cannot be offered, tools that take up less space but meet specific requirements may need to be considered.

Classroom space
Classroom space is also essential so that the students can freely move around without too many obstacles. Some students, despite being seated in front of the room, may need to go up to the board or other presentation areas to access information. The change in the table layout may need to be considered to clear the path to the distance information.

Location
The location of the adaptive equipment may also affect the choices. The student with low vision may be seated in front of the room, which means that a CCTV could be in the visual path of other students sitting behind him/her.

Visual access of classroom presentations
Large-group presentations and board work might be inaccessible for students with visual impairments without specially designed access tools. Students may require desktop copies. In some cases a different type of board may increase the student's visual access.

Type of light and level of illumination
Type of light and level of illumination will also determine where the student can be seated. Some students may require dimmed light, while other will need higher brightness level. If students need to individually adjust the light level, they may need a table light;. their table or desk should be positioned near a power outlet.

Type of learning medium
Access to power outlet(s) will also be necessary when students work with different electronic tools. Many modern devices have rechargeable batteries but their operation time usually does not exceed two to three hours. Therefore students will have to plug in their devices once or twice a day in to recharge the batteries. Some of the new computers do have longer battery life but the trade-off is that the screen may not be bright enough for a student with visual impairments to see.

External noises
Since students with visual impairments, especially those with severe low vision or blindness, rely on their hearing to gather information during the classes, it is important to ensure that any unnecessary external noises are eliminated or reduced.

Assistive Technology: past and present
What assistive technology (AT) has been employed in the past or is currently used with the student? List all assistive technologies that have been used with the student. If some have been discontinued, make note of the reasons. Sometimes effective tools are discontinued for reasons that no longer exist such as computer conflicts, lack of training, lack of interest, or other reasons. Do not discount assistive technology that was previously tried and discarded. There may have been a mismatch between the assistive technology and the student's skills at the time. Differences in skill development, maturity, a different environment or other factors may make all the difference. If the student is currently using assistive technology note the AT used, location,

level of effectiveness, trained staff, and any other issues that are pertinent to the student/building. Be certain to list low and high tech AT supports.

Sensory Considerations
Different environments have different levels of sensory stimulation. If the team has determined that sensory impacts are influential for the student's learning, identify the sensory levels in each environment the student will be in.

Tasks

As a team, discuss and write on chart paper the curricular and extra-curricular tasks that the student needs to do.

One of the most important questions when assessing a student's need for assistive technology is: what tasks must be accomplished by the student in order to fully participate in a given curriculum? The following questions may provide guidance as teams begin to assess students' assistive technology needs:

- Is this student currently reading? Is there evidence of difficulty with textbooks, worksheets, math, or chapter books?
- Is this student currently writing? Is the student able to compose sentences, fill out forms, and complete worksheets?
- Is this student currently taking notes? Does the student have a functional system or efficient medium?
- Can this student independently access distance presentations such as board work, posters, multimedia presentations, document camera presentations?
- Is this student accessing visual activities related to science experiments, graphing, etc.?
- Can this student do computer-based tasks? Is the student able to use word processing programs, visual presentation programs, e-mail and/or online research?
- Can this student prepare accessible text to match their reading medium?
- Is this student participating in gym activities? Can they see the ball? Can they direct the ball to the target? Can they run without a guide?
- Is this student taking part in extra-curricular activities?

Narrowing the Focus

As a team, identify the tasks that are priorities and will be most beneficial for the student to access the curriculum. You may circle or highlight them.

After the team has generated a list of tasks that the student needs to do, refine the list to limit the tasks that the team (including the student) will focus on. Too many tasks can overwhelm the team. Introduction of too many factors and tools may reduce your ability to determine effectiveness. Maintain your original list of tasks and review it later. Some tasks may already be effectively addressed with the new tools/strategies that you are using. The tasks that remain can become your new focus at a later date.

Solution Generation: Tools/Strategies

As a team, brainstorm and write on chart paper any assistive technologies &/or strategies you think will assist the student in successfully completing those tasks you identified.

The team brainstorms strategies and assistive technology tools that may be of benefit for the student to complete the identified tasks in the given environments. Do not critique or otherwise evaluate the suggestions at this time. List all suggested tools and strategies including those currently in use on chart paper for all to see. The tools and strategies discussed below follow the continuum for vision. The continuum is generally organized from low to high Assistive Technology. It is not intended to be used as a step-by-step protocol for using AT tools with a student, but rather an organizational continuum of types of Assistive Technology.

The continuum of assistive technology for vision is broken down into several areas. Students will use a variety of tools, depending on the task. For example, some students with low vision will read short passages visually, but because of visual fatigue, may require either audio or tactile format for longer readings. Low-tech solutions may be sufficient for some types of tasks, while higher-end technology may be needed to complete other tasks.

The following chart includes continuums of options to support students with visual impairments in the standard curriculum tasks. These suggestions are divided into the three areas of identified visual impairments: low vision; functional blindness; and cortical visual impairment.

Computer Access	Technology for Academic Areas			Expanded Core Curriculum		
Computer access	**Reading**	**Writing**	**Math**	**Pictorial Information**	**Note-Taking**	**Mobility**
Color scheme ↓ Large operating system features ↓ Built-in Magnification ↓ Fully featured magnification ↓ Magnification with screen reader ↓ Screen reader ↓ Screen reader with Braille device	Glasses ↓ Color filter ↓ Slantboard ↓ Large print ↓ Optical magnifier ↓ Electronic magnifier ↓ CCTV ↓ Monocular ↓ CCTV with distance camera ↓ Audio text ↓ Computer based reading software ↓ Electronic Braille notetaker	High contrast pen ↓ Portable word processing device ↓ Typing with audio support ↓ Braillewriter ↓ Typing with Braille support ↓ Electronic Braille notetaker ↓ Voice Recognition	Large print measuring tools (rulers, protractors) ↓ Large key calculator ↓ Tactile measuring devices ↓ Abacus ↓ Talking calculator ↓ Models or 2D & 3D geometric shapes ↓ Tiger embossed, PIAF Tactile representation	Enlarged format ↓ CCTV ↓ Models or objects ↓ Tactile graphics ↓ Tactile-audio graphics	Slate and stylus ↓ Tape or digital recording device ↓ Computer-based recording software ↓ Electronic Braille notetaker	Cane ↓ Monocular ↓ Braille/talking compass ↓ Electronic Travel Device ↓ GPS Device

Classification of Educational Technology

Assistive Technology for Academic Areas

Low vision:

- Magnification-there are four types of magnification: relative-size (large format, bigger manipulatives), relative-distance (material presented closer to the student), angular (lens-based magnifiers), and projection (camera-based electronic magnifying devices).
- Specialized lighting-lamps and lights with various types of illumination may enhance the visibility of the working surface.
- Material positioning devices-page holders, book holders, or book stands, and slant boards enable better positioning of the material to decrease distance, angle or glare.
- Audio support-software or hardware that gives information through auditory channel in addition to the primary channel whether it be visual or tactile.
- Text-to-Speech- software that converts digital text into audio. It is implemented in talking programs, like word processors, or is part of read aloud imported text.
- Portable reading devices- Hardware that supports various formats of audio text. Information may be stored either as audio files on media cards, or as soundtracks on CDs.
- Large key calculators-oversized numbers to accommodate vision needs.
- Audio graphic calculator- software or hardware they give students with visual impairments visual and auditory access to graphing capability
- Large print keyboard stickers – in order to make the keyboard labels more visible stickers with large print characters can be used. They come in two color versions – white on black, or black on white.
- Built-in magnifier (PC), Zoom (Mac) – computer operating systems come with magnification accessibility features.
- Third party magnification software – a full-fledged application that increases the size of screen content.
- High contrast (20/20) pen- simple writing tool that makes letters more visible due to the high contrast ink.
- Third party combo magnification and screen reading software – combines features of screen magnifying software and speech output software giving dual-mode access to computer information.
- Hardware screen magnifiers – monitor-mounted screens with magnifying screen, used less than software magnification

Blindness:

- Braille keyboard stickers – in order to make keyboard labels tactually accessible stickers with Brailled characters can be used.
- Power Chord Braille Keyboard – computer keyboard based on 6 Braille keys with additional function keys.
- SIXIN – computer software that turns six home row keys into Braille keys allowing a student who is not proficient with QWERTY keyboard to type on the computer.

- Narrator (PC), VoiceOver (Mac) – computer operating systems come with built-in voice output applications to support access.
- Third party screen reading software – full-fledged speech output program that gives full access to computer systems and menu-driven programs and applications.
- Talking Web browsers – self-voiced browsers that give access to many Websites through auditory channel.
- Braille display – hardware devices that show up to one computer line at a time in Braille. As the user moves around the computer screen, tiny solenoid pins on the display raise and lower to form the Braille character of each computer screen character.
- BrailleWriter-a special typewriter that produces immediate text in Braille as it is being typed. It is the most common mid-tech device used for typing in Braille.
- Electronic Braille note-taker -a device with numerous functionalities used to input, store, and output text either in Braille or print. Depending on the model, note takers may have Braille or QWERTY keyboard, speech only output, or speech and Braille output. The newest devices store various types of files using internal drives or memory cards. They also have Internet capabilities.
- Electronic Braille typewriters- a tool that is a combination of BrailleWriter and electronic note-taker. It produces an immediate hardcopy of Braille, allowing prior insertion and proofreading of text.
- Tactile images-graphical information created and tactile format that is accessible for blind people. There are a number of methods to create tactile images. Some may require specialized equipment, while others can use low-tech materials.
- Tactile-audio - overlays and devices link to a computer to output audio information assigned to a specific area in the overly that is put over a touch sensitive board.

Cortical (Cerebral) Visual Impairment (CVI):

- Large or color-coded keys keyboard – modified keyboard giving better access because of the bigger size of the characters, and various colors assigned to specific groups of keys.
- Portable word processing device – a stand-alone tool for typing; its functionalities are usually much simpler than those of a computer system; it is also smaller and easier to handle than desktop or laptop computer.

Assistive Technology for Regular and Expanded Core Curriculum

Low vision:

- Long Cane- a walking tool used to support independent travel or to identify for others that a person is visually impaired or blind.
- Monocular-an optical device used for close-ups of distant objects. It may be used in classroom to read more for or presentation projected on large screens.
- Digital talking compass-a directional device that announces the directions through an audio output.

- Manipulatives- toys, shapes, models and other objects to support the learning process. Real objects should be used whenever possible. They may complement and/or replace pictures they might not be clear or meaningful.
- Adapted games- for computer games specially designed to accommodate vision loss.
- Typoscope-a rectangular cutout used to provide borders which outline the area for one to write their signature.
- Voice output measuring and household devices-various kinds adapt. Appliances with speech output and/or tactile markings.
- High contrast or large numbered watches and clocks.
- Magnification - there are four types of magnification: relative-size (large format, bigger manipulatives), relative-distance (material presented closer to student), angular (lens-based magnifiers), and projection (camera-based electronic magnifying devices).
- Specialized lighting – lamps and lights with various types of illumination may enhance the visibility of the working surface.
- Material positioning devices – simple page holders, foldable book holders, or more sturdy book stands, and slantboards enable better positioning of the material to decrease distance, angle, or glare.
- Audio support – software or hardware that gives information through auditory channel in addition to the primary channel whether it be visual, or tactual.
- Text-to-speech – software that converts digital text into audio. It is implemented in talking programs, like word processors, or is part of read aloud imported text.
- Portable reading devices – hardware that supports various formats of audio text. Information may be stored either as audio files on media cards, or as sound tracks on CDs.
- Large key calculators – oversized tool to accommodate vision needs.
- Audio graphic calculator – software or hardware that gives students with visual impairments visual and auditory access to graphing.
- High contrast (20/20) pen – simple writing tool that makes letters more visible due to high contrast ink..
- Money management software-programs to assist in managing financial activities like balance checkbooks, etc.
- Large print or magnified screen typing instruction software/programs to assist in keyboard instruction.
- brightly colored/high contrast balls.
- lightbox-a device that provides a lighted working surface to give higher contrast or attract visual attention.

Blindness:

- Long Cane (see above)
- Brailler – a special typewriter that produces immediate text in Braille as it is being typed. It is the most common mid-tech device used for typing in Braille.

- Electronic Braille note-taker – a device with numerous functionalities used to input, store, and output text either in Braille or print. Depending on the model, note takers may have Braille or QWERTY keyboard, speech only output, or speech and Braille output. The newest devices store various types of files using internal drives or memory cards. They also have Internet capabilities.
- Electronic Braille typewriters – a tool that is a combination of Braillewriter and electronic note-taker. It produces an immediate hard copy of Braille, allowing prior insertion and proofreading of text.
- Tactile images – graphical information created in tactile format that is accessible for blind people. There are a number of methods to create tactual images. Some may require specialized equipment, while others can use low-tech materials.
- Tactile-audio presentations – overlays and devices linked to a computer to output auditory information assigned to a specific area in the overlay that is put over a touch sensitive board.
- Portable reading devices - portable players that play back different types of audio that is stored on CDs or removable media cards.
- Talking software or hardware calculators – math support with speech output functionalities.
- Braille calculator – math support device with Braille display.
- Audio graphic calculator – software or hardware that gives students with visual impairments visual and auditory access to graphing.
- Math tiles – a set of Braille tiles with a magnetic board to help blind students understand different math concepts.
- Text-to-audio conversion software – programs that allow converting digital text into audio formats.
- Abacus – low-tech tool for calculation tasks.
- Math support software – programs to give access and explain math concepts.
- Audio support – software or hardware that gives information through the auditory channel in addition to the primary channel, whether it is visual, or tactual.
- Text-to-speech – software that converts digital text into audio. It is implemented in talking programs like word processors, or is part of read-aloud imported text.
- Audio graphic calculator – software or hardware that gives students with visual impairments visual and auditory access to graphing.
- Adapted cane- modified tool that enhances safety in traveling. It is used with people who have other concerns in addition to blindness.
- Electronic Travel Devices (ETDs) electronic devices that are a secondary tool used in addition to obtain or adapted cane.
- Braille compass-I directional device with a priest arrow; braille characters indicate the four directions of the world
- Talking GPS-positioning tools separately informed person about the current position and route
- Manipulatives-extra objects should be used whenever possible, shapes, models, and other objects to support learning process.
- Sign maker-a device that helps create Braille labels to be used for marking all kinds of objects

- Talking watches, clocks-timepieces with speech output
- Talking Typing Instruction Software-programs to assist in keyboarding instruction
- Beeper balls or other acoustic balls-assist with ball interaction to sound generating components.
- Adapted games-Board or computer games specially designed to accommodate vision loss.
- Swing cell-a tool that assists instruction in Braille.
- Images-tactile, graphic, audio description or real object.
- Braille blocks- plastic box with Braille characters to assist instruction in Braille.
- Beeper Ball or other acoustic balls- balls with sound generating elements
- Voice output measuring and household devices-various kinds of adapted appliances with speech output and/or tactile markings, talking management software.

Cortical (Cerebral)Visual Impairment (CVI):

Students with CVI may not read at grade level. These suggestions may increase their access to text.

- Modified reading format – print is converted into a digital format as e-text and read by text-to-speech software or hardware.
- Changed letter kerning – increased space between characters in words, or images presented at one time.
- Reading guides – low-tech cutouts that leave one line visible at a time making the reading process easier
- Acetate filters – color transparent sheets that change the color of the page with text concurrently reducing glare and altering contrast.
- Text-to-speech software – programs that recognize digital text and provide auditory output. Some of them have a variety of features that help to follow the text as it is being read.
- Slant-board or other material positioning devices – simple constructions that reposition reading material at different angles.
- Highlighter tapes – transparent tape that easily sticks to and peels off paper to emphasize important fragments or words in text.
- Highlighters – bright color markers use to emphasize important facts or words in text.
- Talking typing instruction software - programs to assist in keyboarding instruction
- Money management software-programs to assist in functional financial activities.
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- Lightbox-a device that provides lighted working surface to give higher contrast or visual attention.
- Adapted Phy Ed tools- balls, baskets, etc. modified with extra bright colors to increase their visibility or auditory cues to assist in locating them.
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***All of these strategies may be helpful for students with low vision as well.

Assistive Technology for Expanded Core Curriculum

Low vision:

- Monocular – an optical device used for close-ups of distance objects. It may be used in classroom to read board work or presentations projected on large screens
- Digital talking compass – a directional device that announces the directions through an audio output.
- Manipulatives – toys, shapes, models, and other objects to support the learning process. They may complement and/or replace pictures that might not be clear or meaningful.
- Adapted games – board or computer games specially design to accommodate vision loss.
- Typoscope – a rectangular cutout used to provide borders which outline the area for one to write their signature.
- Voice output measuring and household devices – various kinds of adapted appliances with speech output and/or tactual markings.
- Talking watches, clocks – timepieces with speech output.
- Talking typing instruction software – programs to assist in keyboarding instruction.
- Money management software – programs to assist in managing financial activities like balancing checks, etc.
- Beeper ball or other acoustic balls – play balls with sound-generating components.
- Light box – a device that provides lighted working surface to give higher contrast or attract visual attention.
- Signmaker – a device that helps create Braille labels to be used for marking all kinds of objects.

Functional Blindness/Blindness:

- Cane – a walking tool used for safe and independent traveling.
- Adapted cane – modified tool that enhances safety in traveling. It is used with people who have other concerns in addition to blindness.
- Electronic Travel Devices (ETDs) - electronic devices that are a secondary tool used in addition to cane or adapted cane.
- Braille compass – a directional device with a raised arrow; Braille characters indicate the four directions of the world.
- Talking GPS – positioning tools that verbally inform a person about the current position and the route.
- Manipulatives - toys, shapes, models, and other objects to support learning process. They may be used as a replacement for images.
- Adapted games - board or computer games specially design to accommodate vision loss.
- Swing cell – a tool that assists instruction in Braille.

- Braille blocks – plastic blocks with Braille characters to assist instruction in Braille.
- Beeper ball or other acoustic ball - play balls with sound-generating elements.
- Voice output measuring and household devices – various kinds of adapted appliances with speech output and/or tactual markings, talking management software

***All of these strategies may be helpful for students with low vision or CVI.

Cortical (Cerebral) Visual Impairment (CVI):

- Talking typing instruction software - programs to assist in keyboarding instruction
- Money management software - programs to assist in managing financial activities like balancing checks, etc.
- Highlighter tapes – transparent tape that easily sticks to and peels off paper to emphasize important fragments or words in text.
- Highlighters – bright color markers used to emphasize important fragments or words in text.
- Light box – a device that provides lighted working surface to give higher contrast or attract visual attention.
- Adapted gym instruments– balls, baskets, etc. modified with extra bright colors to increase their visibility or auditory cues to assist in locating them.

Assistive Technology for Additional Support

Low vision:

- Talking dictionary/large print – hardware or software tools to assist in language-related tasks.
- Word-prediction software – programs that support composition of sentences.
- Organization tools – software or hardware to facilitate organization and learning material management.
- Tactile-audio systems – haptic devices that enhance tactile exploration.
- 3-D images for concept development – tactual images to complement or supplement textual information.

Functional Blindness/Blindness:

- Talking dictionary – hardware or software tools to assist in language-related tasks.
- Talking test software – software that reads out the content of the test entered by the teacher or another person that administers the test.
- Word-prediction software – programs that support composition of sentences.
- Organization tools – software or hardware to facilitate organization and learning material management.
- Tactile-audio systems – haptic devices that enhance tactile exploration.
- Image simplifying software – programs that convert images from visual to textual by simplifying their content.
- 3-D images for concept development – tactual images to complement or supplement textual information.

Cortical (Cerebral) Visual Impairment:

- Talking dictionary – hardware or software tools to assist in language-related tasks.
- Word-prediction software – programs that support composition of sentences.
- Organization tools – software or hardware to facilitate organization and learning material management (like color coding, binders, bright color or tactual markings).
- Tactile-audio systems – haptic devices that enhance tactile exploration.
- Models – real objects are typically more appealing and meaningful than pictures and should be used when possible.

Many of the tools mentioned above recur in different groups, meaning they can be used for various purposes. It is often the case that a variety of tools and support services will be used contingent upon the student's visual impairment, skills, abilities, and needs. Tasks will also determine the selection of one or more accommodations. For example, if a communication skills activity requires writing, particular writing tools will be involved to accommodate a specific student performing this activity. Talking dictionaries may appear useful both for reading and writing as well as for other classes where new terminology is introduced.

Students with cortical visual impairment often require some accommodations. Tools that are described in the Reading, Writing, or Organization chapters may be effective and efficient. Students with CVI may present decreased acuity, while others will not experience significant loss in the vision sharpness. An excellent resource that includes instructional strategies for students with CVI is the article *Strategies for Working with Children with Cortical Visual Impairment* by Jeanne Gardier. This article is available online as a .pdf file at www.pattan.k12.pa.us/files/db/cvi.pdf.

Tools for Transition

AT solutions that students may need once they leave school, such as portable text reading or ADL equipment, should be explored **during** the school years and used in context in the work/home environments. This helps the students prepare for their post-school lives, careers and experiences. Other information the graduating students should know about include accessibility options for PDAs, cell phones or household appliances. Please see the resource section for further information on these resources.

Tools for Teachers

Adaptation and conversion of learning material to make it accessible may be time-consuming. It also requires knowledge and planning to ensure quality and correctness. There are various ways and methods of preparing material. Some things can be done using low-tech materials, while others will require specialized software and hardware. Below is a list of possible devices that are needed to provide academic services to students with visual impairments:

- Text-to-Braille translation software – programs that translate print to Braille
- Embosser – aka Braille printer, a device used to emboss text in Braille
- Braille instruction support tools.
- Scanner with Optical Character Recognition (OCR) software – device used to convert paper text into digital format. Optical Character Recognition OCR is software that converts the image of the text on pages that are being scanned and turns it into e-text.
- Image simplifying software – programs that convert images from visual to textual by simplifying their content.
- Image embossing devices – hardware that makes flat print images tactually accessible.
- Color copier with enlarge function – a device that allows enlargement of print material.
- Text-to-audio software – programs that convert electronic text into an audio format. Some programs also save files as portable audio files like .mp3 or .wav.
- Voice recording software – programs that allow digital voicing recording and editing. Files can be saved in various formats and subsequently either listened to on the computer, or transferred to portable media players.

In addition to the above solutions, various simple tools and materials can complete the inventory of adaptive material. A comprehensive list would be too long to include in this chapter. Teachers may use a variety of textures, models, shapes, foods, ingredients, etc. to either replace visual material, or supplement it. It is recommended that a combination of simple, self-made material and ready-made commercially produced teaching aids be utilized. To cover all curricular areas a teacher may use a mixture or low-tech to high-tech solutions.

Accommodations

Accommodations that do not include specialized equipment may be sufficient to support students with visual impairments. In rare cases, students' academic needs may be met without them. However, accommodations are only part of complete curricular support. The following list gives the most common strategies for accommodating students who are blind or have low vision in educational settings.

- Large print materials
- Modified print text: amount per line, kerning, letter size, letter and background color
- Bold-line paper
- Raised-line paper
- Braille materials
- Braille paper
- Braille transcriber
- Personal copy of chalkboard materials
- Personal copy of overhead materials

- Peer note-taker
- Reader
- Scribe
- Special seating
- Special lighting
- Time for individual/small group instruction/test taking
- Minimizing visual distraction
- Monitoring and make adjustments for visual fatigue
- Minimizing auditory distraction
- Modification of length of assignments, tests, exams
- Extended time for assignments, tests, exams
- Take tests and exams with TVI (Teacher of Visually Impaired)
- Test items explained or paraphrased as needed
- Access to notes/text/learning materials such as tactiles/manipulatives during tests, exams

Assessments

Before you thrill your students with the news about cool equipment they are going to work with, make sure you know the level of their technological advancement. You would not want to overwhelm them with a learning tool that is far too complex. The initial excitement might quickly turn into frustration. Several publicly available informal assessments will be helpful in determining how much your students know, and how much they still need to learn. A few have been included here as examples.

The following are checklists and instruments available online that may assist you in the assessment process:

- VI Technology Assessment – www.tsbvi.edu/technology/tech-assess.htm - A variety of assessments and checklists broken down into various categories. Unlike many other assessment lists, this set is designed for assessing students who are blind or have low vision.
- Vision Assessment Toolkit – www.gpat.org – AT for students with low vision.
- Assistive Technology Assessment Tool – www.e-advisor.us/workshop/tmaggiorePPT/vieval.pdf - another comprehensive tool by Georgia Project for Assistive Technology.

Profiles

The following are real-life profiles of students who are blind or have low vision and use various types of assistive technology. Their names have been changed to respect their privacy. As indicated throughout this chapter, students who are blind or have low vision constitute a heterogeneous group. Each student will require a different set of instructional and adaptive tools that will offer support in academic and extra-curricular activities. The

examples below show how students can benefit from different learning media and corresponding technology.

Fernando, 8 years old, blind
Fernando is only beginning his adventure with assistive technology. He is a proficient Braille reader who has been using a Braille writer for writing. He has also learned touch typing, allowing him to produce some of his schoolwork in print. Because he has no vision he uses a screen reading program to give access to the computer system. He is only beginning to master his computer skills, so he relies mostly on the lower tech devices, including an abacus for math.

Britney, 14 years old, low vision
Although, Britney has only some residual vision in one eye, she is a visual learner. She tends to access learning material visually with a minimal addition of touch. She uses three different learning media, with print being the primary. Britney is an avid reader both in print and braille. Large print has been determined to be impractical due to its physical dimensions. She is a proficient user of a portable electronic magnifier for shorter readings. She uses this device to access her print textbooks and worksheets. This method is not for longer readings due to eye fatigue. Braille appears to be a logical solution here. What is difficult for her is handling large braille books. An electronic note-taker or laptop with braille display would solve most of the issues in her case.

Marquee, 15 years old, low vision, Asperger Syndrome
Marquee is a high school student with retinopathy of prematurity. He has some residual vision in one eye only. He has been learning Braille for many years, but has not been able to master it, thus it is not a viable learning medium at this time. He likes using CCTV, especially for short reading or writing. He has excellent computer and auditory skills. So although he can access written material visually, audio versions work best for him. His comprehension soars when he listens to his learning material. Because his handwriting is rather poor he uses computer for longer papers. Marquee also occasionally records his answers as he finds written composition difficult.

Amelia, 11 years old, cortical (cerebral) visual impairment
Amelia's condition affects the brain's ability to interpret visual information. Although she can see print, she is not able to identify the characters. She uses Braille as her primary learning medium. She can distinguish some details in pictorial information, so simple graphical presentations are functional for her. She has been learning to use a screen reader to access text information on the computer. She enjoys using the mouse to start programs from the desktop. Her enjoyment of the mouse led to the use of software that reads information under the mouse pointer, providing her with auditory support.

Bruno, 6 years old, low vision
As a young child, Bruno is only beginning to familiarize himself with various pieces of technology. His condition allows him to access slightly enlarged material on his desk. However, he needs support for classroom presentation. To access whiteboard and posters on the walls, he uses a CCTV system with a camera that can be tilted and swiveled to

point at distant objects. Additionally, this camera also sends the signal to a TV set showing the teacher what the student sees on his monitor. Thanks to this system the teacher can position the material she holds in her hands appropriately. Bruno also uses the CCTV to explore details in pictorial information.

Built-in accessibilities in Mac, Windows, and Linux computers

Universal Design for Learning (UDL) recommends that products should be designed for diverse users, meaning accessibility features should be implemented at the onset of development. Computer operating systems are not entirely accessible for some users with visual impairments who need to install specialized third party software to operate their computers. However, both Mac and Windows platforms offer a variety of accessibility features that allow users with visual impairments to customize the screens and to access them.

Both manufacturers of the above mentioned operating systems inform their clients about accessibility features on their respective Websites:
Windows (98, 2000, ME, XP, Vista)
http://www.microsoft.com/enable/guides/vision.aspx
Mac (OS X Leopard)
http://www.apple.com/accessibility/macosx/vision.html

Windows has a very comprehensive set of online tutorials broken down by the version of the operating system. Even users who may still be working on Windows 95 computers will find extensive information about available accessibility features. Users w ho are blind or visually disabled and those with low vision will be directed to the respective sections to learn what the best possible alterations are there to enhance access to the operating system.

Apple's Website also has a section on universal access for users with visual impairments. The Mac users will find an overview of accessibility features specific for persons with visual impairments. Those users that need speech output can expand their knowledge of screen reading feature following the VoiceOver link.

This section would not be complete without mentioning the Linux operating system. Although it is the least popular of the three, there may be users with visual impairments who work with this system. Currently Linux does not have many built-in accessibility options. Users who have vision disabilities and use this system should find Orca screen reader included in the most recent Solaris and Linux releases. A number of free special software available for download from different providers can be found online. The Linux Documentation Project http://tldp.org/HOWTO/Accessibility-HOWTO/visual.html page discusses options for people with vision concerns.

The following table compares accessibility features available in Mac OS X and Windows XP and Vista. Notice that both systems have made progress in adding accessibility features to help people with visual impairments.

Area	Windows Operating System	Mac Operating System
Vision	Magnifier	Zoom
	Zoom Option in IE 7.0 and up	X
	Text size in IE, Firefox	Text size in Safari, Firefox
	High contrast	High contrast
	Cursor width and blink rate	X
	Cursor size and color	Cursor size
	Pointer Speed and Acceleration	X
	SnapTo	X
	Visibility-Pointer trails	X
	Hide the pointer while typing	X
	Show location of pointer	X
	Scroll bar width	X
	Narrator	VoiceOver
	Desktop Icons size	X
	X	Dock icons size
	Keyboard shortcuts	Keyboard shortcuts
	Sound Notification when turning an accessibility features on or off	X
	X	CoverFlow OS Leopard (folder magnification)
	Audio Descriptions Vista (when available)	Audio Description (QuickTime)

X – indicates that the features is not available

Free Resources

Built-in accessibilities can be a great start in assessing a student's need to access computer systems. However, some of the features present in the operating systems may turn out not to be sufficient. Users of the Windows system may find open sources solutions that will satisfy their needs. Although the majority of free solutions are not as robust as the commercial products (the quality and features may not be comparable to commercial versions), it may be worth trying them out before spending money. Nonetheless, users will have an opportunity to explore the most significant options required to operate a computer system. These experiences will make it easier for the user to understand what skills they may need to use an enlarged screen or a keyboard controlled system environment.

When working with a student who is blind audio or tactile output of informa6tion is needed. If a student with low vision is having difficulties operating a computer, it is necessary to assess which mode will work best for them. Magnification may appear to be the best solution, but the student may find it difficult to navigate and control the enlarged screen area. The screen reading option may occur to be more functional even though the student may have sufficient vision to access the system visually. The students depicted in

the Profiles section show that individual solutions need to be prescribed to accommodate their educational needs.

There are a number of online resources that offer open source solutions for users who are blind or have low vision with access software free to download and free to use. Some need verification that the user is visually impaired, while others have no restrictions. The examples below present different types of access software ranging in the number of features and functionalities. It is advised that service providers get familiar with them prior to proposing them to their students.

Magnification:

- Desktop Zoom – A free screen-magnifying program with full screen or magnifying glass options.
- Virtual Magnifying Glass 3.3.1 - A free open source screen magnifier for Windows, Linux, FreeBSD and Mac OS X.
- iZoom Web by Issist – A web-based magnifier. The computer has to be connected to the Internet to run this program.

Screen Reader:

- NVDA – A free screen reading program that can be either installed on the hard drive or on a USB pen drive to go.
- Thunder by Sensory Software – Another free screen reader.
- System Access – a free version is available for K-12 students upon verification.
- SAtoGo – a Web-based version of System Access free to use by anyone whose computer is connected to the Internet.

Internet Access:

- LowBrowse by Lighthouse - A new way for those with low vision to access web documents, embodied in a Firefox extension (Windows, Mac, Linux).
- pwWebSpeak – a free version of a talking Internet browser.
- WebAnywhere – a Web-based browser that does not require any installation.

A more extensive chart with both commercial and free open source screen reading software for various platforms is available at http://en.wikipedia.org/wiki/List_of_screen_readers.

Products for Low Vision and Blindness

The table below is a comprehensive list of products for people who are blind or have low vision. By no means is this list complete. More detailed information of the products can be found on the companies' websites. The manufacturers' sites will also have the most updated inventory of their products. Many offer free 30 day trials of their software. American Foundation for the Blind is another informative resource; they offer a huge searchable database of products. You can browse by category, manufacturer, or task. On the Home page – www.afb.org - click Product Search and then method by which you want to locate desired products.

	Type	Product	Company
Low Vision	Magnifying software	ZoomText	AiSquared
		BigShot	AiSquared
		Dual with Solo	Claro
		Lunar	Dolphin
		SuperNova	Dolphin
		MAGic	FreedomScientific
		iZoom 1.2, iZoom2Go	Issist
		VisioVoice (Mac)	Origin Instruments
		Lighting	Sensory Software
	Magnifying hardware	QuickLook	Ash Technologies
		Fusion	Ash Technologies
		Liberty	Ash Technologies
		OPTi Verso (distance)	Ash Technologies
		Prisma	Ash Technologies
		Optic magnifiers	Bausch & Lomb; Eschenbach
		Clarity Series (distance), i-vu	Clarity
		Acrobat, Amigo, Flipper, Jordy, Max	Enhanced Vision Systems
		Topaz	FreedomScientific
		Opal	FreedomScientific
		SenseView	GWMicro
		MyReader	HumanWare
		SmartView	HumanWare
		MagniLinkS OCR (distance, scanning)	LVI
		Compact	Optelec
		ClearView	Optelec
		Traveller	Optelec
		ClearNote (distance)	Optelec
		Optron, I-stick (distance)	Optron
		MonoMouse, ColorMouse	Sensory Software
		Shoppa, BigReader	Sensory Software
		View series (distance)	Vision Technology

	Type	Product	Company
Blindness	**Braille writers/PDAs**	PacMate, Type Lite	FreedomScientific
		Braille Lite, Braille'n'Speak	FreedomScientific
		BrailleSense	GW Micro
		Small-Talk	GW Micro
		Braillino	Handy Tech
		BrailleNote	HumanWare
		VoiceNote	HumanWare
		Maestro	HumanWare
		EasyLink	Optelec
		Mountbattern Brailler	Quantum Technology
		TatraPoint	Bronislav Mamojka
		Perkins Brailler	Howe Press (Perkins)
	Screen Readers	Hall	Dolphin
		Jaws	FreedomScientifc
		Window-Eyes	GW Micro
		Thunder-RJ	RJ Cooper
		Lifestyle, the System Access Mobile Network	Serotek
	Refreshable Braille Displays	Vario	BAUM
		Focus	FreedomScientific
		Braille Star	Handy Tech
		Handitech	Handy Tech
		Braille Wave	Handy Tech
		Brailliant	HumanWare
		Alva	Optelec
		Delphi	Optelec
		Voyager	Optelec
		Elba	Papenmeier
		BRAILLEX	Papenmeier
	Braille printers (embossers)	Braille BookMaker, Marathon	Enabling Technologies
		Braille Express	Enabling Technologies
		BraillePlace	Enabling Technologies
		Juliet, ET, Romeo	Enabling Technologies
		Triple Impressions	Enabling Technologies
		Braille Blazer	FreedomScientific
		Basic S/D, 4x4 Pro, Everest	Index Braille

		Product	Company
Blindness		Gemini embosser (Braille+print)	Nippon Telesoft
		Versa Point	TeleSensory Corporation
		Emprint (Braille+print), ViewPlus Pro, Cub, Max	ViewPlus
	Audio tactile	InteliKeys	Cambium Learning Technologies
		Talking Tactile Tablet	Touch Graphics
		IVEO	ViewPlus
	Electronic text readers	BookPort (discontinued)	APH
		ScannaR	Baum Retec
		Milestone 311/312	Bones
		Cybook	Bookeen
		Cicero	Dolphin
		Sara	FreedomScientific
		MobilEyes	Guerilla Technologies
		Bookworm	HandyTech
		Victor Reader, Vibe, ClassicX, Stream	HumanWare
		K-NFB Reader	Kurzweil – NFB
		Plextalk Series	Plextor
		BookCourier	Springer Design
	Reading/scanning software	EasyReader	Dolphin
		EasyProducer	Dolphin
		OpenBook	FreedomScientific
		FSReader	FreedomScientific
		Kurzweil 1000	Kurzweil Educational Systems
		TextAloud	NextUp
		Text-to-Audio, ScanPro	Premier Assistive Technology
		INFORM	Sensory Software
	GPS	StreetTalk	FreedomScientific
		Trekker / Breeze GPS	HumanWare
		BrailleNote GPS	HumanWare
		Mukana	Slashphone
		Wayfinder Access	Wayfinder

	Type	Product	Company
	Text-to-Braille translation software	Braille Maker	Cragside AccessABILITY Ltd
		Braille Music Translator suite	Dancing Dots
		Duxbury, Perky Duck	DuxburySystems
		MegaDots	DuxburySystems
		WinBraille	Index Braille
		iBraille for Mac	Index Braille
		OpusDots Lite	Opus Technologies
		Monty	Quantum Technology
		Braille Master	Robotron
		KWIKBRL	Sensory Software
	Type	**Product**	**Company**
CVI	Port. Writers	Alphasmart, Neo	Alphasmart
		Fusion, Writer	Advanced Keyboard Technologies, Inc.
	E-text reader	ClassMate Reader	HumanWare

Solution Selection Tools & Strategies

Use a Feature Match process to discuss and select those ideas, tools, and strategies that were generated during the solution brainstorming. Select those that best match the student, the environment and the educational tasks that need to be accomplished. Limit your selections to a reasonable number and prioritize them according to those that can be accomplished immediately, those that can be done in a reasonable time period and those that will be considered at a later time or require additional or significant staff training.

Implementation Plan

After tools have been selected and prioritized, identify any trials or services that are needed including: procurement of trial materials; team member(s) responsibilities; start date and length of trial; training needed; and any other student/staff specific issues. Be certain to identify learning objectives and criteria of performance to determine the effectiveness of the trials.

Assessment

As the team completes the SETT process, questions may arise about the student's ability to perform certain educational tasks. Various informal assessments (see Assessments section) or teacher observations may answer those questions, however, adapted, specialized or alternative assessments may be needed.

Testimonials

- http://www.freedomscientific.com/profiles/garrison/kolby-garrison.asp
- http://www.freedomscientific.com/profiles/folloa/alex-follo.asp
- http://www.humanware.com/en-usa/products/user_stories/Braillenote_user_stories
- http://www.humanware.com/en-canada/products/user_stories/trekker_user_strories
- http://www.dolphinuk.co.uk/dolphin.asp?id=23
- http://www.mountbattenBrailler.com/mb_stories/parents_kids.htm

Useful resources

- www.aph.org/webfeat/index.html - Web accessibility
- www.aph.org – Catalogs with a large collection of assistive technology for different areas
- http://www.nfb.org/nfb/Products_and_Technology.asp?SnID=1380394662 – NFB Products and Technology
- http://www.afb.org/aw/main.asp - AccessWorld is an assistive technology journal with up-to-date articles related to technological breakthroughs in the area of visual impairments.
- http://www.rnib.co.uk/xpedio/groups/public/documents/code/public_rnib001974.hcsp - RNIB Technology
- http://www.disabilityworld.org/June-July2000/access/Science.html - Making Science Accessible to Blind Students
- www.wcbvi.k12.wi.us – Wisconsin Center for the Blind and Visually Impaired
- www.badgerassoc.org - Badger Association Of The Blind And Visually Impaired
- www.able.org – Services that prepare text in alternative formats like Braille or audio
- For information on supports for Deaf/Blind severe disabilities, see Chapter 14 – Assistive Technology for Students with Multiple Challenges

Formats

There are many different formats in which data is saved and stored. Some, like TXT or ASCII are open, meaning many programs are able to recognize it. There are also some that are proprietary meaning that only specific software can handle them, e.g. KESI, WYNN, etc.

- Open vs. Proprietary formats http://www.openformats.org/en1
- DAISY http://www.bookshare.org/web/SupportDaisy.html
- BRF http://www.bookshare.org/web/AboutFormats.html
- PDF http://winplanet.webopedia.com/TERM/P/PDF.html
- TXT http://en.wikipedia.org/wiki/Text_file
- ASCII http://www.webopedia.com/TERM/A/ASCII.html
- RTF http://en.wikipedia.org/wiki/Rich_Text_Format