Assistive technology
for Learners with Impairments

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A TEDI Report

TEACHER
EMPOWERMENT
FOR DISABILITY
INCLUSION

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Contents

Acronyms

AAC   Augmentative and Alternative Communication

ADL   Activities of Daily Living

AT   Assistive Technology

CAN   Computer-assisted note taking

CAPS   Curriculum and Assessment Policy Statement

DBE   Department of Basic Education

DSU   Disability Service Unit (University of Cape Town)

FET   Further Education and Training (Grades 10–12)

FM   Frequency Modulation

FP   Foundation Phase (Grades 1–3)

ICT   Information and Communication Technology

IP   Intermediate Phase (Grades 4–6)

ISP   Individual Support Plan

LTSM   Learning and Teaching Support Materials

NCS   National Curriculum Statement

SP   Senior Phase (Grades 7–9)

SPID   Severe to Profound Intellectual Disability

List of tables

Appendix C Devices to assist learners with SPID

1. Devices to assist learners with neurological and neurodevelopmental impairments

2. Devices to assist learners with cognition and learning impairments (moderate to profound)

3. Devices to assist learners with communication impairments (little or no functional speech)

1. Introduction

Teacher Empowerment for Disability Inclusion (TEDI) is a project of the Disability Studies Division of the University of Cape Town (UCT) in partnership with the Christoffel-Blindenmission (CBM), and is co-funded by the European Union and CBM. This project was set up in response to a call to address the exclusion and poor quality education of children with disabilities in South Africa. It aims to empower teachers and carers to provide quality education for children with severe to profound sensory or intellectual impairments (SPSII) through training that is focused on inclusivity, diversity, and addressing learners' disability-specific needs.

This report responds to the need for practitioners who are working and interacting with learners with impairments to understand more about assistive technology (AT), enabling them to identify the need for technology and assist in the selection of appropriate devices. Guidelines are provided on how technology can be used to support teaching and learning across the learning programme/ curriculum. We have adopted a practical, skills-based approach that is aligned with the Department of Basic Education's policy framework and learning programmes.

This report:

› Provides basic knowledge on AT devices for learners with sensory and/or intellectual impairments.
› Highlights things to consider when teachers and facilitators select and use AT for learners with sensory and/or intellectual impairments.

› Enhances teachers' and facilitators' knowledge on AT for learners with sensory and/or intellectual impairments.

› Illustrates how learners with sensory and/or intellectual impairments can engage with the national school curriculum/learning programmes aided by appropriate AT devices.

› Promotes a collaborative approach to teaching and caring for learners with sensory and/or intellectual impairments.

The recommendations and considerations presented in this report come from observations, findings and guidelines from multiple research efforts, projects and sources. The starting point for determining the AT needs of learners with sensory impairments derived from the prescribed learning activities in the National Curriculum Statement (NCS) for Foundation Phase (FP) (Grades 1–3) set out by the Department of Basic Education (DBE). The FP Curriculum and Assessment Policy Statement (CAPS) comprises four subjects: Home Language, First Additional Language, Mathematics, and Life Skills (DBE, 2011a, b, c).

The FP is the initial stage of schooling in which foundations of knowledge and skills development are laid for future learning and potential academic success. During this stage, learners with sensory impairments (i.e. learners who are blind or have low vision, and learners who are D/deaf or hard-of-hearing) need to be able to fully engage with the curriculum in order to maximise their learning potential. Identifying AT needs is vital for optimal learning and to enable learners to enter subsequent phases.

For learners with severe to profound intellectual disabilities (SPID), the starting point for determining AT needs is derived from the prescribed learning activities in the DBE's draft National Curriculum Statement Grades R–9 for learners with SPID (DBE, 2016). This comprises three subject areas – Communication and Language, Mathematics, and Life Skills – which are to be taught in an integrated manner with a learner's daily schedule in order to maximise their learning potential. The use of AT is vital for optimal learning to take place, and to enable learners with SPID to develop fully and engage meaningfully with their environment.

It is important to note that it would be impossible for this report to list all known AT devices as technological developments are ongoing. Rather, this report acts as a point of reference for teachers and carers to support teaching and learning using technology to enrich the experience of learners with impairments.

2. Defining assistive technology

Key points
› Defining assistive technology
› AT device classification
› Matching AT devices to individual learners
› DBE recommendations

2.1 What is AT?

Technology is about how we use different types of knowledge and tools to carry out a variety of practical functions. We use technology all the time, ranging from simple low-tech tools such as pencils to high-tech devices such as cell phones and computers. Technology is growing in sophistication all the time and reflected in its use in schools and their classrooms. It presents great opportunities for the enrichment of learning if there is the right match according to the needs of learners, the environment, the knowledge of the teacher and the tools available (Dalton, McKenzie, et al., 2012).

AT is a device, piece of equipment or system that helps bypass, work around or remove barriers to participating in the curriculum (Reading Rockets, n.d.). It

can be used to address specific barriers to learning by enabling the learner to capitalise on strengths and bypass areas of difficulty.

2.1.1 AT device classification

AT devices can be classified from no-tech to high-tech according to the degree of mechanical and electronic parts they are made up of, other requirements such as a power source, and the knowledge and training the device user must have to optimise its assistance. A descriptive summary of AT device classification is presented in Table 1. It is always recommended that no-tech and low-tech solutions be considered before looking at mid-tech and high-tech options. Some experimentation may be required before the best learner-technology match is achieved.

Although no-tech or low-tech devices may save on costs, the main objective is to find the tools that offer learners full access to the school curriculum/learning programme and ensure they are able to meaningfully engage in teaching and learning activities.

Table 1: AT device classification

No-tech	No-tech solutions make use of procedures, services and existing conditions in the environment, and do not involve the use of special devices or equipment. Examples include pencil grips; coloured paper; extra time for testing; and the use of a scribe, reader or interpreter (Roy, 2003; Weiland, 2003, cited in Martinez-Marrero and Estrada-Hernandez, 2008).
Low-tech	Low-tech devices are simple devices that have few mechanical parts and do not require a power source. They include adapted spoon handles, adapted pens, canes, non-tipping drinking cups, magnifying glasses, and eyeglasses. Limited or less training is needed to use these devices compared to mid-tech and high-tech devices.

Mid-tech	Mid-tech devices are relatively complicated mechanical devices that may require a power source, but do not contain sophisticated electronic systems. These devices include manual wheelchairs, talking calculators, adapted keyboards, and trackballs. The operation of mid-tech devices requires some training and technical knowledge.
High-tech	High-tech devices are often computer-based systems that incorporate sophisticated electronics. They are complicated to use and require extensive training, technical knowledge, and access to technical support. With their sophisticated electronics, high-tech devices are often much more expensive than other technologies. Examples include speech recognition software, eye gaze-controlled computers, closed captioning televisions, power wheelchairs, and environmental control units.

2.1.2 AT devices recommended by the DBE

The DBE's 'Draft National Guidelines for Resourcing an Inclusive Education System – Annexure A' (DBE, 2018) details, among other important aspects of inclusive education, examples of learning technologies recommended for learners with impairments. The standardised provision of AT to learners throughout South Africa would ensure they have access to appropriate educationally enriching information and communication technology (ICT). AT devices that are suitable for learners with impairments are listed in the appendices to this report.

3. Selecting AT devices

Key points

‣ Challenges to the effective use of AT

‣ Selecting appropriate AT devices

‣ Learning and teaching support materials (LTSM)

‣ Examples of mid- and high-tech AT devices

3.1 Challenges to the effective use of AT

Access to AT by children with disabilities, and their families, is a difficulty experienced worldwide. Equipment may be costly and there is a lack of funding for the provision of AT. Devices might be expensive and need to be insured against risks such as theft or accidental damage. Apart from these factors, there is little information available about AT for persons with disabilities. Teacher education on how to support learners with impairments, and ongoing support for learners and their families, is problematic. There are often no clear procedures set out for teachers and parents to learn how and who can get access to AT devices, which devices are available and suitable, and how to get funding or payment options for their provision (Alper and Raharinirina, 2006). There is also no process in place for learners to obtain devices when they leave school, thereby limiting their educational opportunities.

A further challenge is the environment in which AT devices are used and the level of knowledge required to use them. Even when AT devices are available, they may not be used; for example, the device might not fit the learner or suit the family's needs, or require maintenance that the family cannot provide. In some instances, the device might be too complex for the learning and home environment without additional support. It is important that suitable AT devices are matched to individual learners.

3.2   Choosing AT devices for learners with impairments

Learners with different sensory impairments will have differing needs, despite being in the same category of disability. Similarly, learners with SPID will have vastly different needs depending on the type and extent of their disability. What works well for one learner might not work well for another. The AT chosen for learners with impairments should reflect their unique strengths and needs, and the activities they need to do to be fully included in the curriculum or prescribed learning programme. It should form part of each learner's individual support plan (ISP).

AT for learners with impairments should comprise instructional materials in appropriate media (including braille for those with a visual impairment) to enable learners to communicate effectively, and enhance social competence and personal independence. AT would, therefore, need to allow learners with impairments to learn through alternate media, using their (other) senses and alternate modes of learning.

Before choosing AT for learners with SPID, it is important to keep in mind that they may have multiple sensory and physical disabilities, are likely to have difficulties with communicating, and may require extensive assistance with activities of daily living (ADL). They will need graded content delivered at a slower pace and with frequent repetition to learn successfully. AT can enhance their capabilities in any or all of these areas.

Several factors are important to consider when selecting AT for learners with impairments. These include Universal Design for Learning (UDL) principles, curriculum/learning programme requirements, family involvement and support, and the socio-economic conditions of the learner's school and home environment.

› **UDL principles**

The UDL principles of representation, expression and engagement should inform the selection of AT devices for learners with impairments. AT devices should:

- present information and enable the acquisition of information and knowledge in different ways (*representation*);
- differentiate the ways in which learners can express what they know (*expression*); and
- allow learners to deepen their engagement and interest in the world around them through an array of learning activities that are accessible to learners with different abilities (*engagement*).

    The UDL philosophy or framework is defined more fully in section 4.1.

› **Curriculum/learning programme requirements**

Different subjects require different types of engagement. AT devices should empower learners to engage in activities across the curriculum/learning programme.

› **Family involvement and support**

Family involvement in the selection and use of AT is often neglected, despite it being important for children to generalise skills at home as part of their overall development. Without the support of families, there is a risk of AT devices being abandoned. It is also important to be mindful that many parents want to be active partners in supporting their child's learning, and will feel disrespected if they are not consulted when making these choices (Alper and Raharinirina, 2006). Where learners are based at hostels, the hostel staff function as family and need to be involved.

› **Socio-economic conditions of the learner's school and home environment**

If AT devices cannot be utilised to their full potential due to a lack of knowledge or facilities at a school or place of care, they will not be used properly and, therefore, not achieve their goal. It is important to choose devices that will be used in school and at home.

3.3   AT for learners who are blind or have low vision

There are different types of AT that learners who are blind or have low vision may use to increase their participation in teaching and learning activities, and fully cover the school curriculum. Where possible, it is wise to choose devices that are used by the general public that can be adapted through the use of apps to meet learners' needs. For example, for learners with low vision, using a smartphone can be beneficial where AT is costly (e.g. electronic magnifiers) or bulky (e.g. electronic braille). A single device can often perform multiple functions. Magnifier apps can turn smartphones into magnifiers with zoom, focus, light control, saving and sharing capabilities. Voice feedback on tablets can be used for teaching content and to access audio books. Smartwatches with haptic feedback can help people with visual impairment, particularly blind people, navigate between different places.

Table 2 lists some of the basic resources that learners who are blind or have low vision should have access to in their classroom. It also indicates resources that teachers can make use of when teaching learners who are blind or have low vision. Further specifications can be found in Appendix A.

Table 2: Classroom resources for learners who are blind or have low vision

Degree of visual impairment	Learners' resources	Teachers' resources
Blind	› Perkins Brailler › Braille paper › Braille eraser › Braille ring binder › Braille textbooks, maps, dictionaries (electronic), other LTSM › Tactile measuring instruments/devices › Talking calculators › Tactile models, graphic material for 'visual' and perceptual development › Access to computers with screen-reading software › White cane	› Computers with specific software for developing LTSM in braille/large print › Access to a braille embosser and a braille graphics embosser › Access to a photocopier with enlargement functions › Access to scanners with suitable software › Access to braille curriculum documents and guidelines (if teachers are blind themselves) › Classrooms equipped with suitable assistive devices
Partially sighted	› Bold-lined exercise books › Suitable pen/pencil, sometimes felt-tip pens, depending on eye-condition and acuity › Large-print textbooks, dictionaries and other LTSM › Magnification devices › Low-vision measuring instruments/devices › Simplified, bold-lined graphics › Calculators with good contrast/font size or talking calculators › Access to computers with suitable software	› Required specialised skills/training for teaching learners who are blind or have low vision and how to use the recommended resources

Table 3 indicates the different categories of AT devices for learners who are blind or have low vision. It is helpful to know about these categories, their particular functions, and how they can assist in effective teaching and learning.

Table 3: Categories of AT devices for learners who are blind or have low vision

Category	Description
Braille technology	High-tech braille devices are available for people who are blind or have low vision to access and produce braille.
Non-optical low-vision devices	There are various non-optical devices that help people with low vision to access print and complete activities visually. There are also devices that adjust lighting, colour or print size (e.g. screen magnification software).
Low-tech and mid-tech devices for tactile learners	There are various low-tech and mid-tech devices that allow people who are blind to access and produce braille, complete Math activities, and activities of daily living in a tactile manner (i.e. touching and doing rather than seeing and doing). See Table 4 for examples.
Optical devices for near viewing	People with low vision may be prescribed optical devices for near viewing that will allow them to access standard-size print.
Optical devices for distance viewing	People with low vision may be prescribed optical devices for distance viewing that will allow them to access information and print at a distance.
Video magnifiers	Video magnifiers are a non-optical way of viewing print and information at a short distance. Some devices also have long distance capabilities. These use a stand-mounted or handheld video camera to project an image onto a screen.
Screen enlargement and readers	Some people can access information by using the magnification range built into computers. Others need to use additional magnification or screen-reading software.
Tactile graphics technology	The ability to read tactile graphics and charts is an essential part of blind literacy programmes.
Auditory access devices	Different devices are available for accessing auditory books, as well as materials and software to access information in auditory format.

Table 4 lists examples and functions of mid- and high-tech AT devices for learners who are blind or have low vision.

Table 4: Examples of mid- and high-tech AT devices for learners who are blind or have low vision

Mid-tech AT devices	Function
Large-print keyboard	High-contrast large-print keyboard.
Braille reader and note-taker	Portable device with braille display and keyboard for reading braille content and taking notes.
Manual braille writer	Mechanical typewriter device for typing braille on special braille paper.
Low- and medium-volume braille printer*	A braille printer/embosser is an impact printer that renders text as tactile braille dots using braille translation software, embossing on thicker braille paper to better retain the dots.
High-volume braille printer*	Same as low- and medium-volume braille printer, but capable of producing braille books at high speed and for extended periods (long service intervals).
Braille translation software	Software that translates text to braille for embossing on a braille printer/embosser and formats documents according to braille layout rules.
Digital voice recorder	Sound recording device most commonly used to record speech for later playback.
Audio labelling device	Device to label items with voice memos for later identification.
Desktop electronic magnifier	Device that uses a camera and a wide display screen to perform digital magnification and contrast of printed materials, suitable for long periods of reading.
Portable electronic magnifier	Device that usually connects to a monitor or a computer to perform digital magnification and contrast of printed materials, suitable for long periods of reading.
Mouse-type magnifier	Electronic device that usually connects to a TV to perform digital magnification and contrast of printed materials.

Electronic handheld monocular	Portable electronic device to view and magnify objects in the near distance and close up.
Optical magnifier	Convex lens that is used to produce a magnified image, usually mounted in a frame with a handle.
Tactile duplicator	Device to produce graphics using raised surfaces to convey non-textual information (e.g. tactile diagrams, maps and graphs).
Tactile touchpad and audio software	Incorporates audio feedback with tactile graphics, providing an interactive way to understand complex, visually-oriented information.
Handheld talking GPS	Device that voices street names, intersections and landmarks when approaching them.
Talking calculator	Calculator with audio feedback.
Large display calculator	Calculator with large display and buttons.
Navigational aid for the visually impaired	Wrist-worn navigational aid for increased awareness of obstacles.
Cane-mountable electronic travel aid	Sensor-based technology that detects the presence of obstacles from knee to head height and pre-warns from a distance of up to a few metres.
Handheld electronic magnifier	Device with a built-in camera and a small LCD screen to perform digital magnification and contrast of printed materials, suitable for limited periods of reading.
High-tech AT devices	**Function**
Screen magnification software	Software application that presents computer screen content with magnification, colour contrast, and pointer and cursor enhancements.
Screen reading software	Software application that converts what is displayed on a computer screen into synthesised speech and braille output (braille display required for braille output).
Refreshable braille display	Device for displaying braille characters, usually by means of round-tipped pins raised through holes in a flat surface. Blind computer users use it to read text output.

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Keyboard literacy software	Software to teach keyboard touch typing skills (typing without using the sense of sight to find the keys).
Braille personal digital assistant*	Portable device usually with braille or QWERTY keyboard for integrated computing experience, with speech synthesiser and braille display.
Optical character recognition*	Scans printed documents or electronic files and converts them into electronic text, for speech or braille output.
Simple computing environment	Bundle of easy-to-use software programs including user interface, email creation, word processing, book reading and internet access.
Specialised e-Reader*	Accessible mobile electronic device that is designed primarily for reading digital publications such as e-books and periodicals.
Multimedia player	Portable multimedia player, e-book reader and optional voice recorder.
DAISY reading software	Software for reading documents in DAISY format (an audio substitute for print material).
Tactile graphics producing software	Software to produce images using raised surfaces to convey non-textual information (e.g. tactile pictures, diagrams, maps and graphs).
TapTapSee*	Application for Apple mobile phones designed to help people who are blind or have low vision identify objects they encounter in their daily lives.
Mathematics software	Software used to create mathematical notation for inclusion in braille translation software.

* Potentially unavailable in South Africa

3.4   AT for learners who are D/deaf or hard-of-hearing

There are different types of AT that learners who are D/deaf or hard-of-hearing may use to increase their participation in teaching and learning activities. Many learners who are D/deaf or hard-of-hearing use hearing aids or cochlear implants (a surgically implanted device that sends sounds electronically to the brain). These electronic aids are personal amplification devices that do not create normal hearing for the learner, and further AT is required for optimal use. Cochlear implants and hearing aids work best in quiet environments and/or with other AT devices.

D/deaf signing students may also benefit from using hearing aids to access residual hearing of environmental sounds such as traffic, a door banging, the school bus arriving, and other louder sounds. Hearing aids are unlikely to enable learners to hear spoken language, but will allow them to participate in their sound environment, promoting their safety and independence.

There are many more devices and systems available to learners who are D/deaf or hard-of-hearing that can assist engagement with the learning environment. Some devices convey information visually, while others enhance auditory information. It is helpful to know and understand the particular functions of different AT devices for learners who are D/deaf or hard-of-hearing, and how they can be used to assist effective teaching and learning.

Table 5 outlines the different categories of AT devices for learners who are D/deaf or hard-of-hearing.

Table 5: Categories of AT devices for learners who are D/deaf or hard-of-hearing

Devices to enhance listening	
These devices are designed to overcome distance, background noise and reverberation, so that the auditory signal is clearer.	
Frequency Modulation (FM) systems (personal and sound field)	These systems transmit sound directly from a microphone worn by a speaker via FM radio signals at a constant volume, regardless of the person's distance from the FM microphone. There are two types: › A **personal FM system** is coupled directly to a hearing aid or cochlear implant, with sound transmitted directly to the individual. A personal FM system needs to be set to the person using it. › A **sound field FM system** provides increased and directed sound levels to a group of individuals. Special speaker units are placed strategically throughout a classroom or open space (e.g. auditorium, cafeteria, etc.) to direct amplified sound to the area where it is needed. Everyone sitting within range of a speaker unit benefits from the amplified voice, including individuals who are not D/deaf or Hard-of-Hearing.
Infrared and audio induction loop systems	These systems may be used for listening in large spaces such as schools, religious institutions, and theatres. › An **infrared system** uses invisible light beams to carry sound to a personal receiver. Different types of attachments may be connected directly to a personal hearing aid or cochlear implant, or sound can be transmitted to headphones or speakers. › An **audio induction loop system** is a cable that circles a room and transmits sound electromagnetically. The electromagnetic signal is picked up by the telecoil in a hearing aid, cochlear implant or headset. To be tied into the audio loop, the telecoil is switched on in an individual's hearing aid or cochlear implant.

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Coupling accessories (for connectivity to media devices such as computers, TVs, tablets, smartphones, etc.)	These accessories are used with hearing aids or cochlear implants to connect to media devices. For example, there are cables that plug directly from a hearing aid or cochlear implant into tablet devices or phones, and couplers that transmit sound wirelessly from hearing aids to media devices.
Devices to convey information visually	
Visual alerting devices	These devices alert individuals to sound using visual support. Specially designed alarm clocks, smoke detectors, doorbells, timers, baby monitors, and phone-alerting equipment provide typically audible information in visual or vibratory ways.
Captioning	This is an important vehicle that assists individuals who are D/deaf and Hard-of-Hearing access many media devices. TVs have closed-caption settings for programmes that offer this feature. A 'CC' logo in TV guides or on media programmes (e.g. YouTube™) indicates when something is closed captioned. There are also cinemas that offer open-captioned movies at specific dates/times.
Real-time transcription	This provides instant translation of the spoken word using a stenotype machine, notebook computer, and real-time software. The stenography may occur onsite or remotely and the captions are viewed on a screen or individual monitor. The process is quick, with virtually no delay from speech to text.
Telecommunication	Smartphone technologies have made text and video increasingly accessible. There are also captioned telephones that show word-for-word text of everything a caller says.

Table 6 lists some examples of mid- and high-tech AT devices for learners who are D/deaf or hard-of-hearing.

Table 6: Examples of mid- and high-tech AT devices for learners who are D/deaf or hard-of-hearing

Device	Function
Mid-tech devices	
Personal sound-amplification device	An assistive listening device that amplifies the sound near the individual while reducing ambient noise.
Remote interpreting	A video service that provides sign language or spoken language interpretation.
High-tech devices	
FM amplification system	Wireless FM system for personal amplification that uses a transmitter for the speaker and a receiver for the listener.
Induction loop system	The induction loop system uses the built-in receiver (telecoil) in a hearing aid to transmit the sound without background noise.
Conversion software for communication via video, text and voice	Software that enables individuals who are D/deaf, Hard-of-Hearing or deafblind to communicate directly or via an interpreter to hearing people.
Live captioning	Service that provides accurate and real-time speech-to-text from spoken content.
Video close captioning	Caption creation service to enhance existing video materials with displayed text.
Wearable warning system	Customisable system of transmitters and receivers to alert the user about various events in their environment, such as a bell or smoke alarm.
Touchscreen tablets	E-devices enabling visual communication for teaching and learning activities.

Technology, with its various software programs, has increased access to communication and educational outcomes for all learners, and especially those in the D/deaf community. This has meant that various stakeholders are now able to be more engaged and involved with learners through these platforms.

› **Note taking**

Note taking is the practice of capturing information from another source, most commonly oral discussions and lectures. Note takers support learners by providing clear and accurate notes as a record of what was discussed or taught in class (Fitzpatrick and Neild, 2017).

› **Computer–assisted note taking (CAN)**

CAN allows learners to watch a computer monitor, TV monitor or LCD panel as the note taker types the lecture from a computer. CAN enables the D/deaf or hard-of-hearing student to scan the text as it is being typed, and offers the learner a hard copy as notes for future use. CAN also allows for post-class editing and formatting to suit the needs of the learner (Fitzpatrick and Neild, 2017).

› **Real-time captioning**

The Disability Service Unit (DSU) at the University of Cape Town has developed a low-tech way of assisting D/deaf or hard-of-hearing learners. Transcribers transcribe lectures using a shared Google Drive document. The DSU uses Google Drive and Google Docs, connecting through eduroam (WiFi network). It offers a real-time experience for learners. Both the transcriber and the learner connect to the same shared document. As the transcriber types, the D/deaf or hard-of-hearing learner can see the words appearing on the computer screen. There is also a chat option, where the learner can ask questions and communicate with the transcriber. This screen text capability allows the learner time to look up at the educator and return to the screen without missing any information, and the document can be saved for future reference (Fitzpatrick & Neild, 2017).

› **Live Transcribe**

Live Transcribe is a speech-to-text app from Google. Live Transcribe (and other apps such as Web Captioner) converts speech and sound to text that can be viewed on a smartphone, tablet or laptop. The app saves transcriptions for three days. Although not specifically developed for use in the classroom, it could be used in this setting to encourage more participation and engagement between educators and learners (Google Play, n.d.).

› **Video modelling**

Visual strategies are essential when teaching expected behaviours to learners who are D/deaf or hard-of-hearing. Modelling a behaviour on video is one such strategy and can be used to provide learners with insight into social situations

and narratives. While a variety of skills can be addressed by video modelling, it most readily addresses the behavioural, social, and emotional needs of the learner. Videos and video modelling can support the integration of signed language, spoken language, cued speech, speech reading, and other visual aspects to access and improve communication (Stromek and Sinnott, 2017).

3.5 AT for learners with SPID

There are different types of AT that learners with SPID may use to increase their independence and participation in teaching and learning activities. Some AT devices assist with a range of processes that could complement or replace speech for learners with complex communication needs. While AT can compensate for learners' skill deficits or areas of disability, this does not exclude learners from receiving remedial instruction. For example, a learner might use a calculator for mathematics, but still learn how to do calculations. AT contributes to the development of a child's self-reliance and sense of independence. Rather than being overly dependent on parents, siblings and friends, they can experience success while working independently.

Learners with SPID often have multiple disabilities. AT can be used not only to enhance their learning, but also to improve their ADL and, therefore, their independence.

These are some of the areas learners with SPID may use AT:

› Aids for daily living/self-help in activities such as eating, bathing, cooking, dressing, toileting, and home maintenance.

› Augmentative and alternative communication (AAC) strategies or devices that provide a means of expressive and receptive communication for those with limited speech output.

› Computer applications, input and output devices, alternative access aids (touchscreens, mouth sticks, light pointers), modified or alternative keyboards, switches, special software, and other devices that enable persons with disabilities to use a computer.

› Seating and positioning adaptations to a wheelchair or other seating system to provide greater body stability.

› Vision/hearing aids for learners who are visually or hearing impaired.

› Wheelchair/mobility aids, manual and electric wheelchairs.

Table 7 outlines impairments that can affect learners with SPID, and gives examples of suitable AT devices that may assist them.

Table 7: AT devices for impairments experienced by learners with SPID

Category	Description of condition	Examples of suitable AT devices
Neurological and neurodevelopmental impairments	Cerebral palsy, autism spectrum disorder, foetal alcohol spectrum disorder, traumatic head injury, stroke, epilepsy, attention and hyperactivity disorder, dyslexia, Down syndrome, dyscalculia, dysgraphia	› Literacy software for reading and writing support › Mathematics development software › Text-to-speech devices › Sensory development resources
Cognition and learning impairments	Moderate, severe and profound intellectual impairments	› Mouse skills software › Keyboard skills software › Literacy and numeracy development software › Mind-mapping software
Communication impairment	Little or no functional speech	› Portable voice amplifier › Message recordable devices › Picture symbol software › Text-to-speech devices
Learners who are D/deaf or hard of hearing, and/or blind or have low vision	D/deaf of hard of hearing Blind or partially sighted	See Table 3 for the recommended devices for learners who are blind or have low vision, and Table 5 for recommended devices for learners who are D/deaf or hard of hearing.

Table 8 lists some examples of mid- and high-tech AT devices for learners with SPID.

Table 8: Examples of mid- and high-tech AT devices for learners with SPID

Mid-tech AT devices	Function
Alternative large-print keyboard	High-contrast large-print keyboard.
Colour-coded mouse	Mouse alternative with colour-coded buttons.
Mouse-skills software	Software that includes activities to practice clicking, double clicking, drag and drop, and other mouse skills. These can be customised to suit the user's needs.
Single-message recordable device	A device that allows playback of one message or a sequence of separately recorded messages.
Multi-message recordable device	A device that allows playback of several recorded messages at various levels.
Noise-cancelling headphones	Noise-cancelling headphones can help to block out background noise for children who are sensitive to sound. They may find it helpful to connect their headphones to a white noise app that plays sounds like rain or static. If children need to listen to audio, they can listen through the headphones to help filter out distracting background noises.
Sensory development resources	A selection of developmental resources to stimulate: › Vision (e.g. glowing and light-up products) › Touch (e.g. objects with a variety of textures) › Auditory (e.g. bells, musical instruments) › Olfactory/smell (e.g. essential oils, objects that have an aroma).
Talking calculator	Calculator with audio feedback.

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High-tech AT devices	Function
Literacy development software	Literacy development and curriculum delivery software that caters for a variety of barriers to learning.
Communication software	Communication software can be installed on a non-dedicated hardware device. It can generate synthesised or recorded speech by selecting words or symbols on the screen.
Dynamic communication device	Specialised portable device with pre-installed communication software. It can generate synthesised or recorded speech by selecting words or symbols on the screen.
Specialised e-reader	Accessible mobile electronic device that is designed primarily for the purpose of reading digital publications such as e-books and periodicals.
Mind-mapping software	Idea capture software that assists users to plan, research, outline, study and present information.
Picture-symbol software	Electronic picture-symbol libraries on a CD, USB stick or online. They enable the creation of paper-based overlays for speech-generating devices, communication boards, books, and symbol-based materials for learning and classroom management support.
Proximity switch	A device that replaces a computer keyboard or a mouse. It can also be used with a communication device and software, switch-adapted toy, switch interface for computer access, sensory room equipment, and environmental control device. It is designed to meet the needs of individuals with limited movement, strength and/or endurance.
Multimedia player	Portable multimedia player, e-book reader and optional voice recorder.

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Keyboard skills software	Software to develop keyboard skills. This includes typing tutor programs to teach keyboard layout, develop touch typing skills, and improve spelling and other keyboard skills. It can be customised to suit the user's needs.
Literacy, numeracy, science, creativity curriculum activities software	Software to develop literacy, numeracy, science or creativity skills. There are multiple software titles with fun and engaging activities.
Simulation software for math, science, technology, computing, automotive skills	Simulation software to develop different skills.
Inclusive interactive music system	Interactive music system that can be accessed in various ways to promote inclusion.
Text-to-speech handheld scanner	Portable handheld device that reads English text aloud when scanned over print, to promote independent reading.

4. Using AT devices

Key points
› Using AT devices to assist learners with impairments
› The UDL and AT
› AT devices and the curriculum/learning programme
› Using AT devices to achieve specific learning outcomes

4.1 Universal Design for Learning

UDL is a research-based framework or approach to teaching and learning that helps to make education accessible to all learners. It is based on the notion that the needs of all learners should be accommodated during the design, implementation and teaching of learning stages and activities. It promotes a set of principles for curriculum development that gives all learners equal opportunities to learn (Sadao and Robinson, 2010).

UDL principles can be adopted to ensure that AT devices are chosen and used in a way that best suits individual learners. They encourage flexible ways of using devices, which are customised and adjusted for individual needs, and do not subscribe to a one-size-fits-all approach. The ultimate purpose of UDL is to increase access to learning for all learners by removing barriers that impede involvement and engagement.

4.1.1 Principles of UDL

The three overarching principles of UDL that should guide curriculum design, the selection and planning of teaching and learning activities, and the selection of AT for the classroom and individual learners, are:

› **Representation:** Giving learners various ways of acquiring information and knowledge. This means that information and content is presented in different ways, and that different methods of teaching and reaching learning goals are used.

› **Expression:** Differentiating the ways that learners can express what they know. This means that learners are allowed to communicate what they know through various modes of expression, and can demonstrate their proficiency or mastery of a skill through a variety of means.

› **Engagement:** Stimulating interest and motivation for learning using content that is suitable for the varied levels of abilities and preferences/interests of learners. This is achieved by facilitating options and choices of activities and resources.

Table 9 indicates the AT devices that can be used to practically apply the UDL principles while teaching learners who are blind or have low vision.

Table 9: AT for learners who are blind or have low vision that enable the practice of UDL principles

UDL principle	AT devices
Representation	**Mid-tech**
Enabling multiple ways of presenting content	› Braille reader and note-taker
	› Low- and medium-volume braille printer
	› Digital voice recorder
	› Desktop electronic magnifier
	› Portable electronic magnifier
	› Handheld electronic magnifier
	› Electronic handheld monocular
	› Optical magnifier
	› Braille translation software
	› Tactile touchpad and audio software
	› Handheld talking GPS
	› Navigational aid for the visually impaired
	› Cane-mountable electronic travel aid

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UDL principle	AT devices
	High-tech ‣ Screen reading software ‣ Refreshable braille display ‣ Braille Personal Digital Assistant ‣ Optical character recognition software and hardware ‣ Simple computing environment ‣ Braille translation software ‣ Specialised e-Reader ‣ DAISY reading software ‣ Screen magnification software ‣ Tactile graphics producing software ‣ TapTapSee ‣ Mathematics software
Expression Enabling learners to communicate what they know and can do through various means	**Mid-tech** ‣ Large-print keyboard ‣ Manual braille writer ‣ Tactile duplicator ‣ Digital voice recorder **High-tech** ‣ Keyboard literacy software ‣ Tactile graphics producing software ‣ TapTapSee ‣ Simple computing environment

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UDL principle	AT devices
Engagement Enabling the facilitation of choices of learning activities to cater for varied abilities of learners	**Mid-tech** › Audio labelling device › Mouse-type magnifier › Braille translation software › Tactile duplicator › Tactile touchpad and audio software › Optical magnifier › Handheld talking GPS › Navigational aid for the visually impaired › Cane-mountable electronic travel aid **High-tech** › Screen reading software › Multimedia player › Keyboard literacy software › Simple computing environment › Tactile graphics producing software › Specialised e-Reader › Mathematics software › TapTapSee

Table 10 indicates the AT devices that can be used to practically apply the UDL principles while teaching learners who are D/deaf or hard-of-hearing.

Table 10: AT for learners who are D/deaf or hard-of-hearing that enable the practice of UDL principles

UDL principle	AT devices
Representation Enabling multiple ways of presenting content	**Mid-tech** › Personal sound-amplification device › Remote interpreting **High-tech** › FM amplification system › Induction loop system › Live captioning › Video closed captioning › Wearable warning system
Expression Enabling learners to communicate what they know and can do through various means	**High-tech** › Conversation software for communication with video, text and voice › Touchscreen tablets
Engagement Enabling the facilitation of choices of learning activities to cater for varied abilities of learners	**Mid-tech** › Remote interpreting **High-tech** › Conversation software for communication with video, text and voice › FM amplification system › Live captioning › Video closed captioning › Wearable warning system

Table 11 indicates the AT devices that can be used to practically apply the UDL principles while teaching learners with SPID.

Table 11: AT for learners with SPID that enable the practice of UDL principles

UDL principle	AT devices
Representation Enabling multiple ways of presenting content	**High-tech** › Literacy development software › Specialised e-reader › Picture-symbol software
Expression Enabling learners to communicate what they know and can do through various means	**Mid-tech** › Alternative large-key keyboard › Colour-coded mouse › Mouse-skills software › Talking calculator **High-tech** › Multimedia player › Literacy, numeracy, science, creativity curriculum activities software › Simulation software for math, science, technology, computing, automotive skills › Inclusive interactive music system
Engagement Enabling the facilitation of choices of learning activities to cater for the varied abilities of learners	**High-tech** › Screen reading software › Literacy, numeracy, science, creativity curriculum activities software › Mind-mapping software › Simulation software for math, science, technology, computing, automotive skills › Inclusive interactive music system

4.2   AT devices and the curriculum/learning programme

Every school subject has different types of knowledge and skills that learners need to acquire. Different AT devices will be required depending on the types of teaching and learning activities planned for the different subjects making up the school curriculum/learning programme.

In this report, the DBE's FP CAPS curriculum documents for the various FP subjects are used to illustrate how AT devices could be used to achieve specific learning outcomes for learners with sensory impairments. (DBE, 2011a, b, c). However, these devices can also be used in the Intermediate Phase, Senior Phase, and Further Education and Training. For example, the devices specified for Home Language could also be used for other languages and in the teaching of other school subjects. The DBE's Draft Learning Programme for Children with SPID (DBE, 2016) is used to illustrate how AT devices could be used to achieve specific learning outcomes for learners with SPID.

Table 12 indicates the AT devices recommended by the DBE for each subject in the FP curriculum for learners who are blind of have low vision. Further specifications can be found in Appendix A.

Table 12: DBE-recommended AT devices for FP CAPS subject topics/skills for learners who are blind or have low vision

Topics/skills	Recommended AT devices
Home Language	
Reading and phonics	› Keyboard literacy software
	› Screen magnification software
	› Large-print keyboard
	› Screen reading software
	› Refreshable braille display
	› Braille reader and note-taker
	› Braille personal digital assistant
	› Optical character recognition software and hardware
	› Simple computing environment
	› Manual braille writer
	› Low- and medium-volume braille printer
	› High-volume braille printer
	› Braille translation software
	› Specialised e-Reader
	› Multimedia player
	› Digital voice recorder
	› Audio labelling device
	› DAISY reading software
Writing and handwriting	› Electronic handheld monocular
	› Optical magnifier
	› Tactile graphics producing software
	› Tactile duplicator
	› Tactile touchpad and audio software
	› TapTapSee

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Topics/skills	Recommended AT devices
Mathematics	
Numbers, operations and relationships	‣ Electronic handheld monocular ‣ Mathematics software ‣ Tactile graphics producing software ‣ Tactile duplicator ‣ Tactile touchpad and audio software ‣ Talking calculator ‣ TapTapSee
Patterns, functions and algebra	‣ Electronic handheld monocular ‣ Large display calculator ‣ Mathematics software ‣ Tactile graphics producing software ‣ Tactile duplicator ‣ Tactile touchpad and audio software ‣ Talking calculator ‣ TapTapSee
Space and shape (geometry)	‣ Electronic handheld monocular ‣ Mathematics software ‣ Tactile graphics producing software ‣ Tactile duplicator ‣ Tactile touchpad and audio software ‣ Talking calculator ‣ Navigational aid for the person who is blind or has low vision ‣ Cane-mountable electronic travel aid ‣ TapTapSee

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Topics/skills	Recommended AT devices
Mathematics	
Measurement	› Electronic handheld monocular › Large display calculator › Mathematics software › Tactile graphics producing software › Tactile duplicator › Tactile touchpad and audio software › Talking calculator
Data handling (statistics)	› Electronic handheld monocular › Mathematics software › Tactile graphics producing software › Tactile duplicator › Tactile touchpad and audio software › Talking calculator › TapTapSee
Life Skills	
Beginning knowledge and personal and social well-being	› Electronic handheld monocular › Optical magnifier › Tactile graphics producing software › Tactile duplicator › Tactile touchpad and audio software › Navigational aid for the person who is blind or has low vision › Cane-mountable electronic travel aid › Handheld talking GPS › TapTapSee

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Topics/skills	Recommended AT devices
Life Skills	
Creative arts	‣ Tactile graphics producing software
	‣ Tactile duplicator
	‣ Tactile touchpad and audio software
	‣ Navigational aid for the person who is blind or has low vision
	‣ Cane-mountable electronic travel aid
Physical education	‣ Electronic handheld monocular
	‣ Navigational aid for the person who is blind or has low vision
	‣ Cane-mountable electronic travel aid
	‣ Handheld talking GPS

Table 13 indicates the AT devices that are recommended by the DBE for learners who are D/deaf or hard-of-hearing. Further specifications can be found in the Appendix B.

Table 13: DBE-recommended AT devices for FP CAPS subject topics/skills for learners who are D/deaf or hard-of-hearing

FP CAPS subject topics/skills	Recommended AT devices
Home Language	
Sub-skills: Listening and speaking Writing and handwriting	‣ FM amplification system ‣ Induction loop system ‣ Personal sound-amplification device ‣ Conversation software for communication with video, text and voice ‣ Remote interpreting ‣ Live captioning ‣ Video closed captioning
Mathematics	
All topics: Numbers, operations and relationships Patterns, functions and algebra Space and shape Data-handling	‣ Same as above
Life Skills	
Beginning knowledge Personal and social well-being Creative arts	‣ Same as above
Physical education	‣ Same as above ‣ Wearable warning device

Table 14 indicates the AT devices that are recommended by the DBE for each learning area for learners with SPID. Further specifications can be found in the Appendix C.

Table 14: DBE-recommended AT devices for specific learning outcomes for learners with SPID

Specific learning outcomes	Recommended AT devices
Communication and Language	
Listening and receptive skills	› Amplification through a variety of hearing aids systems › Picture-symbol software
Expressive skills	› Single-message recordable device › Multi-message recordable device › Picture-symbol software › Dynamic communication device › Communication software
Pre-literacy skills	› Text-to-speech handheld scanner › Colour-coded mouse › Mouse-skills software › Keyboard-skills software › Literacy, numeracy, science, creativity curriculum activities software
Mathematics	
Numbers, operations and relationships; Patterns, functions and algebra; Space and shape (geometry); Measurement; Data handling	› Literacy, numeracy, science, creativity curriculum activities software › Simulation software for math, science, technology, computing, automotive skills › Talking calculator

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Specific learning outcomes	Recommended AT devices
Life Skills	
Personal and social well-being	› Sensory development resources › Noise-cancelling headphones
Creative arts	› Adapted grips for paintbrushes, pens, etc. › Adapted slanted boards or adjusted tables and chairs for positioning
Physical education awareness	› Exercise and physical fitness can be supported by video-based technology › Proximity switch › Toys can be adapted with switches and other technologies to facilitate play. Computer or video games provide age-appropriate social opportunities, and help children to learn cognitive and eye-hand co-ordination skills. › Specially designed Internet-access software can help people with intellectual disabilities access the World Wide Web.

After selecting the most suitable AT device(s) to reach specific learning outcomes, the following aspects of AT use and inclusive education need to be considered for successful, sustainable AT implementation (Alper and Raharinirina, 2006):

› The AT devices need to fit with the learner's family's goals and values for their child's learning.

› The AT devices need to be fully integrated into the learner's learning programme (i.e. they are not used when 'thought of' or as 'an add-on', but are incorporated in the planning of teaching and learning activities.

› Family members, teachers, facilitators, support professionals and the learner work collaboratively to experiment with and use various AT devices, in order to reach learning outcomes for the learner optimally.

› Communication among the aforementioned people is ongoing.

› AT devices and accompanying equipment are maintained, replaced or modified as needed.

› Problems experienced with the use of AT devices are resolved as quickly as possible.

It is important to note that the categories of AT for different types of disabilities are not mutually exclusive and can co-exist. For example, learners with SPID often have multiple conditions, which result in multiple impairments and disabilities (e.g. a child with Down syndrome may also have visual or hearing impairments). It is recommended that teachers, facilitators and carers of learners with any type of disability, become familiar with AT devices that can be used to assist learners with other types of sensory and intellectual disabilities.

References

Alper, S. and Raharinirina, S. (2006). Assistive technology for individuals with disabilities: A review and synthesis of the literature. *Journal of Special Education Technology*, 21(2): 47-64.

Dalton, E.M., McKenzie, J.A. and Kahonde, C. (2012). The implementation of inclusive education in South Africa: Reflections arising from a workshop for teachers and therapists to introduce Universal Design for Learning. *African Journal of Disability,* 1(1).

Department of Basic Education (2011a). Curriculum and Assessment Policy Statement Foundation Phase (Grades 1-3) Home Language. Pretoria: Department of Basic Education.

Department of Basic Education (2011b). Curriculum and Assessment Policy Statement Foundation Phase (Grades 1-3) Life Skills. Pretoria: Department of Basic Education.

Department of Basic Education (2011c). Curriculum and Assessment Policy Statement Foundation Phase (Grades 1-3) Mathematics. Pretoria: Department of Basic Education.

Department of Basic Education (2016). Draft Learning Programme for Children with Severe to Profound Intellectual Disability. Available at: www.education.gov.za/Portals/0/Documents /Legislation/Call%20for%20Comments/Draft%20SPID%20Learning%20Programme. pdf?ver=2016-11-07-092618-000 [Accessed 11 March 2020]

Department of Basic Education (2018). Draft National Guidelines for Resourcing an Inclusive Education System - Annexure A. Pretoria: Department of Basic Education.

Ear Institute (n.d.). https://www.earinstitute.co.za/services/cochlear-implants/ [Accessed 11 March 2020].

Fitzpatrick, M. and Neild, R. (2017). Assistive technology in the classroom benefits deaf and hard-of-hearing students. *Odyssey 2015-2016 Extra*. Available at: https://www3.gallaudet.edu/ Documents/Clerc/Odyssey/2016_issue/ODYSSEY_EXTRA_2015-2016_Fitzpatrick_Neild_FINAL. pdf [Accessed 19 May 2020]

Google Play (n.d.). https://play.google.com/store/apps/details?id=com.google.audio.hearing. visualization.accessibility.scribe&hl=en_ZA [Accessed 19 May 2020].

Martinez-Marrero, I. and Estrada-Hernandez, N. (2008). An instructional tool to assist college students with written language disabilities. *TechTrends*, 52(1): 56-62.

Reading Rockets (n.d.). Assistive technology for kids with learning disabilities: An overview. Available at: https://www.readingrockets.org/article/assistive-technology-kids-learning-disabilities-overview [Accessed 11 March 2020]

Sadao, K.C. and Robinson, N.B. (2010). *Assistive Technology for Young Children: Creating Inclusive Learning Environments*. Baltimore: Brookes Publishing.

Stromek, R. and Sinnott, C. (2017). Lining up strategies: Video modelling with students who are deaf or hard-of-hearing. *Odyssey 2015-2016 Extra*. Available at: https://www3.gallaudet.edu/ Documents/Clerc/Odyssey/2016_issue/ODYSSEY_EXTRA_2015-2016_Stromek_Sinnott_FINAL. pdf [Accessed 19 May 2020].

Appendices

APPENDIX A: Devices to assist learners with visual impairments (blind, low vision, deafblind)

This Appendix presents the devices recommended in the DBE's 'Draft National Guidelines for Resourcing an Inclusive Education System - Annexure A' (2018) for visually impaired learners (blind, low vision, deafblind). The DBE's draft national guidelines document offers more AT device recommendations for a broad range of disabilities, some of which may also assist learners who are visually impaired.

Product Type	Functional Description	General Specifications
Desktop Electronic Magnifier	Device that uses a camera and a wide display screen to perform digital magnification and contrast of printed materials, suitable for long periods of reading.	› Typically 20" or larger screen › High definition autofocus camera › At least 30x magnification › Display real-time view of document › Adjustable magnification level › Colour contrast options › Built-in XY table available on certain models › Ability to write under the camera › Optional distance viewing › Optional speech feedback

Product Type	Functional Description	General Specifications
Portable Electronic Magnifier	Device that usually connects to a monitor or a computer to perform digital magnification and contrast of printed materials, suitable for long periods of reading.	› Connect to a monitor via HDMI or to a computer via USB › High definition autofocus camera › At least 30x magnification › Distance viewing, document reading and self-view › Colour contrast options › Ability to write under the camera › Optional XY table available for certain models › Compatible with most popular screen magnification software › Optional speech feedback
Handheld Electronic Magnifier	Device with a built-in camera and a small LCD screen to perform digital magnification and contrast of printed materials, suitable for limited periods of reading.	› From 3" to 8" screen size › High definition autofocus camera › At least 10x magnification › Accessible settings adjustment › Colour contrast options › Freeze image function › Handle and/or reading stand › Optional HDMI output › Rechargeable battery and charger

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Product Type	Functional Description	General Specifications
Mouse–type Magnifier	Electronic device that usually connects to a TV to perform digital magnification and contrast of printed materials.	› Connect to a TV via composite port › At least 28x magnification › Colour contrast options › Optional computer compatibility
Electronic Handheld Monocular	Portable electronic device to view and magnify objects in the near distance as well as close up.	› At least 16x magnification › Colour contrast options › Large field of view › Rechargeable battery and charger

Optical Magnifier	Convex lens that is used to produce a magnified image, usually mounted in a frame with a handle.	› Different fixed magnification levels
		› Multiple models:
		  • Handheld or Stand
		  • Bar or Dome
		  • Distance or Near object glasses

Keyboard Literacy Software	Software to teach keyboard touch typing skills - typing without using the sense of sight to find the keys.	› Accessible to blind and low vision users › Spoken and displayed instructions › Audio feedback when typing › Built-in curriculum and ability to create own lessons › Progress reports

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Product Type	Functional Description	General Specifications
Screen Magnification Software	Software application which presents computer screen content with magnification, colour contrast and pointer and cursor enhancements.	‣ Magnification up to 60x ‣ Different magnification views ‣ Multiple colour schemes ‣ Pointer and cursor enhancements ‣ Dual-monitor support ‣ Optional touch screen gestures ‣ Optional screen reading feature with human-sounding text-to-speech synthesiser ‣ Different reading views ‣ Create user profiles according to personal requirements ‣ Optional portable USB licence key ‣ Compatible with Windows 7 and newer
Large-Print Keyboard	High-contrast large-print keyboard.	‣ Full-size keyboard ‣ Large-print bold keycaps ‣ Different colour schemes ‣ Optional feature keys ‣ USB connection ‣ Compatible with Windows 7 and newer

Product Type	Functional Description	General Specifications
Large Display Calculator	Calculator with large display and buttons.	› Basic arithmetic operations › Percentage, square root, raise a number to a given power › Memory keys › Optional scientific functions › Optional speech output › Battery-operated
Screen Reading Software	Software application which converts what is displayed on a computer screen into synthesised speech and braille output (braille display required for braille output).	› Human-sounding text-to-speech synthesiser › Full access to Windows, MS Office applications and web browsers › Braille output support › Quick navigation keys to jump through MS Word documents, PDF files and web pages › Built-in OCR feature › Optional portable USB licence › Compatible with Windows 7 and newer

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Product Type	Functional Description	General Specifications
Refreshable Braille Display	Device for displaying braille characters, usually by means of round-tipped pins raised through holes in a flat surface. Blind computer users use it to read text output.	› Available in 14 to 80 cell models › Braille keyboard to input text and commands › Function keys for basic navigation › Optional cursor routing keys › Connect via USB or Bluetooth › Compatible with most popular screen reading software › Compatible with Windows, Mac OS, iOS, Android
Braille Reader and Note-taker	Portable device with braille display and keyboard for reading braille content and taking notes.	› 14 to 40 refreshable braille cells › Read braille content from SD card › Simple note-taking capability › Connect to a computer or portable device via USB or Bluetooth › Rechargeable battery and charger

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Product Type	Functional Description	General Specifications
Braille Personal Digital Assistant	Portable device usually with braille or QWERTY keyboard for integrated computing experience, with speech synthesiser and braille display.	› 14 to 40 refreshable braille cells with cursor routing keys › Read any content in speech, braille or both, with support for multiple languages › Stereo speakers and microphone › Built-in productivity applications › Access to mainstream apps › Internal flash memory and USB/SD card support for expendable storage › Wi-Fi, Bluetooth and optional GPS › Optional touch screen input › Optional camera for OCR capture › Connect to a computer or portable device via USB or Bluetooth › Rechargeable battery and charger

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Product Type	Functional Description	General Specifications
Optical Character Recognition (OCR) Software and Hardware	Scan printed documents or electronic files and convert them into electronic text, for speech or braille output.	› Automatic capture and read › A4 document size minimum › Single and multi-page capture › Optional visual enhancements of resulting text › Convert scanned and PDF files into readable and editable format › Optional feature to save as MP3 › Available as software or specialised hardware device
Simple Computing Environment	Bundle of easy-to-use software programmes including user interface, email creation, word processing, book reading and internet access.	› Simplify ways to perform computing tasks › Menus with magnification, high-contrast colours and speech output › Requires minimal computer knowledge or touch typing skills › Most tasks accomplished by Enter, Escape and the Arrow keys › Can be turned off to access the standard Windows environment

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Product Type	Functional Description	General Specifications
Manual Braille Writer	Mechanical typewriter device for typing braille on special braille paper.	‣ Typewriter-style device to produce braille manually ‣ Six-key braille keyboard ‣ Paper size up to 11" x 11.5"
Low and Medium Volume Braille Printer	A braille printer/embosser is an impact printer that renders text as tactile braille dots using braille translation software, embossing on thicker braille paper to better retain the dots.	‣ Up to 100 characters per second (300 pages per hour) ‣ Tractor-fed or cut-sheet paper ‣ Single and double-sided printing ‣ Able to produce tactile graphics ‣ USB, Ethernet or Wi-Fi connection ‣ Compatible with Windows 7 and newer
High Volume Braille Printer	Same as low and medium volume braille printer, but capable of producing braille books at high speed and for extended period. Long service intervals.	‣ Up to 650 characters per second (1950 pages per hour) ‣ Tractor-fed, cut-sheet or reel paper ‣ Single and double-sided printing ‣ USB, Ethernet or Wi-Fi connection ‣ Compatible with Windows 7 and newer

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Product Type	Functional Description	General Specifications
Braille Translation Software	Software that translates text to braille for embossing on a braille printer/embosser and formats documents according to braille layout rules.	› Supports all major South African languages as well as Unified English Braille Code (UEB) › Offers contracted and uncontracted braille › Accessible for blind users › Compatible with Windows 7 and newer
Mathematics Software	Software used for creation of mathematical notation for inclusion in braille translation software.	› Interactive equation editor › Integrate with leading braille translation software which must support UEB Maths › Compatible with Windows 7 and newer
Tactile Graphics Producing Software	Software to produce images using raised surfaces to convey non-textual information e.g. tactile pictures, diagrams, maps and graphs.	› Convert images to tactile graphics › Include basic drawing and editing tools › Compatible with most graphics capable braille printers/embossers › Compatible with Windows 7 and newer

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Product Type	Functional Description	General Specifications
Tactile Duplicator	Device to produce graphics using raised surfaces to convey non-textual information e.g. tactile diagrams, maps and graphs.	› Reproduce tactile graphics using swell paper or plastic-like paper › Resulting tactile graphics can be examined using hands › Option to make multiple copies from an original
Tactile Touchpad and Audio Software	Incorporate audio feedback with tactile graphics, providing interactive way to understand complex, visually-oriented information.	› Creates audio-tactile graphics from standard image formats › Offers different types of textures for ease of interpretation › Includes OCR software › Touchpad A4 size minimum › USB connection
Specialised e-Reader	Accessible mobile electronic device that is designed primarily for the purpose of reading digital publications such as e-books and periodicals.	› Adjustable font size › Text-to-speech › Adjustable background colour scheme › Accessible menus (voice over) › Optional adjustable font colour scheme

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Product Type	Functional Description	General Specifications
Multimedia Player	Portable multimedia player, e-book reader and optional voice recorder.	‣ Support variety of audio, text, e-book and DAISY files ‣ Built-in text-to-speech ‣ Support for bookmarks ‣ High-quality recordings and built-in microphone on devices with recording capabilities ‣ Built-in speaker and earphone connection ‣ Support for memory card ‣ USB connection for PC transfers ‣ Optional wireless connectivity ‣ Rechargeable battery and charger
DAISY Reading Software	Software for reading documents in DAISY format.	‣ Full navigational features through the document ‣ Output in synchronised speech and text ‣ Compatible with Windows, Mac OS, iOS or Android

Product Type	Functional Description	General Specifications
Digital Voice Recorder	Sound recording device most commonly used to record speech for later playback.	› High-quality recordings and playback › Built-in microphone › Built-in speaker › Minimum 8 hours of recording time › USB connection for downloading recordings to PC › Battery-operated
Talking Calculator	Calculator with audio feedback.	› Basic arithmetic operations › Percentage, square root, raise a number to a given power › Memory keys › Optional scientific functions › Speech output, adjustable volume › Optional large display and buttons › Earphones connection › Battery-operated
Audio Labelling Device	Device to label items with voice memos for later identification.	› Items such as CDs and classroom objects can be labelled › Record a description (voice memo) of the item › The device identifies the item and speaks the recorded memo

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Product Type	Functional Description	General Specifications
Navigational Aid for the Visually Impaired	Wrist-worn navigational aid for increased awareness of obstacles.	‣ Ultrasonic waves detect obstacles and device's vibrations intensify to alert the user ‣ Fast-sensing technology ‣ Water resistant
Cane Mountable Electronic Travel Aid	Sensor-based technology that detects the presence of obstacles from knee to head height and pre-warns from a distance of up to a few meters.	‣ Cane mountable device to allow one-handed operation ‣ Vibratory feedback of distance information ‣ Assist in safe and independent mobility ‣ Support for short range of detection (indoor and crowded places) and long range (outdoor) ‣ Easily detachable from the cane ‣ Audio alarms for indicating battery and charging status, sensor and vibrator failure ‣ Rechargeable battery
Handheld Talking GPS	Device that voices street names, intersections and landmarks when approaching them.	‣ Audio feedback as the person walks ‣ Announce location and surrounding areas ‣ Customised route can be set ‣ Route can be reversed

APPENDIX B: Devices to assist learners who are D/deaf or hard-of-hearing

This Appendix presents the devices recommended in the DBE's 'Draft National Guidelines for Resourcing an Inclusive Education System – Annexure A' (2018) for learners who are D/deaf or hard-of-hearing. The DBE's draft national guidelines document offers more AT device recommendations for a broad range of disabilities, some of which may also assist hearing-impaired learners.

Product Type	Functional Description	General Specifications
FM amplification system	Wireless FM system for personal amplification, using a transmitter for the speaker and a receiver for the listener	› Comprises a transmitter microphone and a receiver unit › Greater clarity of speech/sound › Background noise reduction › Works for hearing aid and cochlear implant users › Main frequency transmission bands: 863–865 MHz and 169–176 MHz › Battery operated

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Product Type	Functional Description	General Specifications
Induction loop system	The induction loop uses the built-in receiver in the hearing aid (T-coil) to transmit the sound without background noise through the personally adjusted hearing aid	› Transmits sound to hearing aids or cochlear implants by means of cabling running around a room › No need to use a receiver/ headset › Any number of users can use the system › Must conform to Standard IEC 60118-4:2006 › Magnetic field strength at the listening height must be 400 mA/m (RMS) +/-3 dB › Variation of field strength across the listening plane must not change by more than +/-3 dB › Frequency response of the system must be within +/-3 dB of the level at 1 kHz from 100 Hz to 5 kHz › Background magnetic noise should be no worse than -47 dB(A) (-32 dB(A) is acceptable) › Affix sign depicting the presence of the induction loop
Personal sound-amplification device	Assistive listening device that amplifies the sound near the individual while reducing ambient noise	› Small and mobile › Built-in speaker › Microphone › Noise reduction

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Product Type	Functional Description	General Specifications
Conversation software for communication with video, text and voice	Software that enables D/deaf, Hard-of-Hearing and deafblind individuals to communicate directly or via an interpreter to hearing people	› Allows deaf people to sign and visualise sign language › Uses real time text (RTT) to communicate › Compatible with screen-reading software and can be connected to a braille display › Receive text back in braille or plain text › Available for Windows, Mac OS, iOS, Android
Remote interpreting	Video service which provides sign language or spoken language interpretation	› Computer device with good quality audio and video transmission › Remote site with a skilled interpreter
Live captioning	Service which provides accurate and real-time speech-to-text from spoken content	› Computer device with audio transmission and text reception and display › High-quality microphone › Remote site where a skilled captioner transcribes via stenograph or speech-to-text software › Optionally, with a good quality video feed, the service can offer sign language interpretation

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Product Type	Functional Description	General Specifications
Video closed captioning	Captions creation service to enhance existing video materials with displayed text	› Transcription of the audio portion of a video › Provides additional, interpretive or environmental information › Captions can be enabled/ disabled by the viewer
Wearable warning system	Customisable system of transmitters and receivers to alert the user about various events in their environment, such as a bell or smoke alarm	› Available in a choice of receivers based on required function

APPENDIX C: Devices to assist learners with SPID

This Appendix presents the devices recommended in the DBE's 'Draft National Guidelines for Resourcing an Inclusive Education System – Annexure A' (2018) for learners with:

›	neurological and neurodevelopmental impairments;

›	cognition and learning impairments (moderate to profound); and

›	communication impairments (little or no functional speech).

The DBE's draft national guidelines document offers more AT device recommendations for a broad range of disabilities, some of which may also assist learners with SPID.

1. Devices to assist learners with neurological and neurodevelopmental impairments		
Product Type	**Functional Description**	**General Specifications**
Literacy Software for Reading and Writing Support	Software that assists learners with reading and writing difficulties.	› Visual enhancements › Audio and visual feedback when reading text › Support for reading, writing, study and research › Can be used with any documents and web pages › Read accessible and inaccessible PDF files › Include word prediction and dictionary › Ability to create audio file from text

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Product Type	Functional Description	General Specifications
Maths Development Software	Software that supports the learning needs of users struggling with Maths.	› Activities include lesson plans, computer-based activities, number games, printable worksheets, reward certificates › Optional assessment tool to identify areas of difficulty and suggest remedial action › Can be run online or offline
Text-to-Speech Handheld Scanner	Portable handheld device that reads English text aloud when scanned over print to promote independent reading.	› Hear words and lines of text read aloud › Dictionary feature › Scan directly to a document on a computer › Access previously scanned documents on the device
Sensory Development Resources	A selection of developmental resources to stimulate vision, touch, auditory skills, sense of smell.	› Vision: examples include glowing and light-up products › Touch: examples include objects with a variety of textures › Auditory: examples include bells, musical instruments, etc. › Olfactory (smell): examples include essential oils and objects which have an aroma

2. Devices to assist learners with cognition and learning impairments (moderate to profound)		
Product Type	**Functional Description**	**General Specifications**
Colour-coded Mouse	Mouse alternative with colour-coded buttons.	› Small, fits easily into a child's hand › Coloured left and right buttons to distinguish between left click and right click › Scroll wheel › USB connection
Mouse Skills Software	Software to develop mouse skills.	› Activities to practice mouse clicking, double clicking, drag and drop, and other mouse skills › Can be customised to suit the user's needs
Keyboard Skills Software	Software to develop keyboard skills.	› Typing tutor programs to teach the keyboard layout, develop touch typing skills, improve spelling and other keyboard skills › Can be customised to suit the user's needs
Literacy, Numeracy, Science, Creativity Curriculum Activities Software	Software to develop literacy, numeracy, science or creativity skills.	› Multiple software titles with fun and engaging activities › Speech support and clear visuals › Feedback provided in the form of animation and music when questions are answered correctly › Switch accessible (where applicable) › Performance reporting tools (where applicable)

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Product Type	Functional Description	General Specifications
Simulation Software for Maths, Science, Technology, Computing, Automotive Skills	Simulation software to develop different skills.	› Variety of themes including: • Maths: experiment with mathematical models • Science: create and conduct a range of experiments in a virtual science lab • Technology: teach systems and control • Computing: teach computer control and programming • Automotive: teach and learn automotive skills › Lessons with instructions › Create own simulations › Performance reporting tools (where applicable)
Literacy Development Software	Literacy development and curriculum delivery software that caters for a variety of barriers to learning.	› Write using words, pre-set phrases and/or pictures › Intelligent word predictor and spell checker › Accessibility features such as text-to-speech output, screen magnification, colour contrast, switch, mouse emulation, eye gaze, etc. › Compatible with Windows or Mac
Mind-Mapping Software	Mind-mapping and idea capture software titles.	› Assist users to plan, research, outline, study and present information › Capture ideas, photos, notes, web page links, audio and video files › Support for touchscreen or interactive whiteboard

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Product Type	Functional Description	General Specifications
Inclusive Interactive Music System	Interactive accessible music system that can be accessed in a variety of ways to promote inclusion.	› Make music and sounds via methods such as touch, movement, switch or eye gaze › Compatible with Windows, Mac or iOS

3. Devices to assist learners with communication impairments (little or no functional speech)		
Product Type	**Functional Description**	**General Specifications**
Portable Voice Amplifier	Wearable voice amplifier.	› Worn by the user to amplify their existing voice › Microphone options include: lapel, headset, transdermal (worn around the throat) › Rechargeable battery and charger
Single-Message Recordable Device	Device that allows playback of one message or a sequence of separate recorded messages.	› Record and playback voice, music or sound effects › Recording played back on activation of a button › Different length of recording times available › Built-in microphone and speaker › Button can be labelled › Optional storage of a sequence of messages per button › Optional version with two buttons that allows the recording of two separate messages › Battery-operated

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Product Type	Functional Description	General Specifications
Multi-Message Recordable Device	Device that allows playback of several different recorded messages on various levels.	› Record and playback voice, music and sound effects › Recording played back on activation of a button › Different length of recording times available › Built-in microphone and speaker › Buttons/pages can be labelled › Optional scanning feature activated by separate switch › Battery-operated
Picture-Symbol Software	Electronic picture-symbol libraries on a CD, USB stick or online.	› Enable the creation of paper-based overlays for speech generating devices as well as communication boards, books and symbol-based materials for learning and classroom management support › Can be printed on paper or used directly on the computer screen › Optional additional symbol libraries available e.g. sign language or social skills
Dedicated Text-to-Speech Device	Device that allows typed text to be converted to synthesised speech.	› Built-in keyboard › Screen to display typed text › Synthetic voice output of the typed message › Mounting or wearable options available › Optional keyguard › Rechargeable battery and charger

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Product Type	Functional Description	General Specifications
Dynamic Communication Device	Specialised portable device with pre-installed communication software.	‣ Generate synthesised or recorded speech by selecting words or symbols on the screen ‣ Customisable interface ‣ Compatible with various access methods e.g. touch, switch, eye gaze ‣ Optional features: e-mail, internet, text messages, environmental control ‣ Mounting or wearable options available

Communication Software	Communication software that can be installed on a non-dedicated hardware device.	‣ Generate synthesised or recorded speech by selecting words or symbols on the screen
		‣ Customisable interface
		‣ Available resources include:
		  • Text-based interface
		  • Symbol-based interface
		  • Interactive learning games and activities
		  • Online community of downloadable resources
		‣ Compatible with various access methods e.g. touch, switch, eye gaze
		‣ Optional features: e-mail, internet, text messages, environmental control

Synthesised Voices	Additional text-to-speech voices for use with assistive technology.	‣ Compatible with other products e.g. communication and screen-reading software ‣ Available South African voices: SA English, Afrikaans, isiZulu, isiXhosa, Sepedi

TEACHER
EMPOWERMENT
FOR DISABILITY
INCLUSION

The Teacher Empowerment for Disability Inclusion (TEDI) project aims to empower teachers and carers to provide quality education for children with severe to profound sensory or intellectual impairments through training that is focused on inclusivity, diversity and addressing learners' disability-specific needs. This report responds to the need for practitioners who are working and interacting with learners with impairments to understand more about assistive technology, enabling them to identify the need for technology and assist in the selection of appropriate devices. Guidelines are provided on how technology can be used to support teaching and learning across the learning programme/curriculum. We have adopted a practical, skills-based approach that is aligned with the Department of Basic Education's policy framework and learning programmes.

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