Chapter 2

Assessment for Special Access

2.1 Overview of Assessment

Assessment for special or assistive technology can be very simple (e.g. a pupil who has problems with a standard mouse tries out and finds they can use a trackball instead) or a complex and skilled process (e.g. for a voice output communication aid).

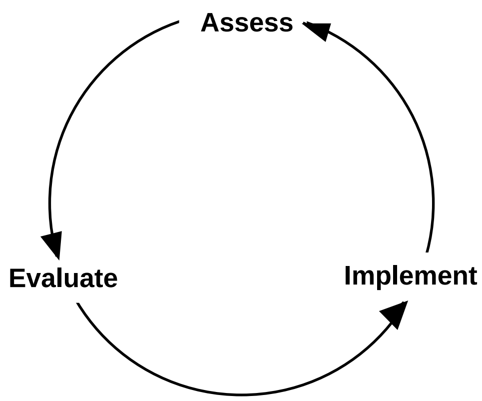
In this chapter we aim to provide sufficient information to help readers who are new to the field to approach assessment with some confidence. We hope the chapter will help you to know what you know, know what you don't know and therefore know when to call on others for assistance.

We do not intend to provide a comprehensive computer access 'how to do it' assessment manual. The references cited give detailed advice on different aspects of assessment. Most of the references are from the related fields of Augmentative and Alternative Communication (AAC) and Assistive Technology (AT) because there is little published material specifically within special education

Assessment: A Process, Not an Event

Teachers and therapists are experts in evaluating pupil's skills: they do it all the time, continuously, as part of their day to day routine. Assessing for special access is no different – one assessment session can only take a 'snapshot' of the pupil's abilities at that point in time and these abilities will change. Inevitably, the pupil will be maturing, developing and learning over time.

Figure 2-1 The Cycle of Assessment



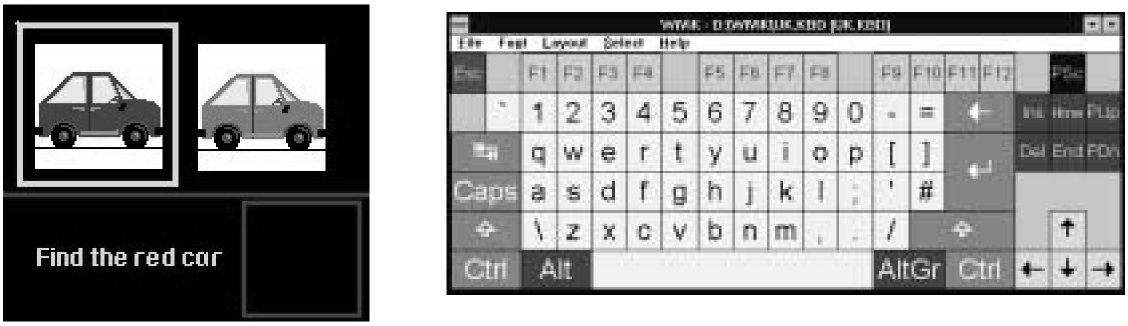
The provision of special access should open up new learning opportunities and increase the pupil's rate of development. Most pupils in Primary 1 start off with a relatively simple set of writing and drawing tools (commonly, pencil, jotter, eraser, ruler) and gradually requires more complex tools for accessing more complex curricula (scientific calculator, dictionary, thesaurus, periodic tables). Similarly, pupils using technology to access the curriculum will progress through a range of technology as the curriculum develops. A switch user in P1 may start with simple single-switch age appropriate curriculum tasks such as matching objects or picking the odd one out (Figure 2-2).

Over time, access skills must be developed to use more complex tools for accessing a more suitable advanced curriculum; in this case, an on-screen keyboard operated by switch and scan where the user has full access to the computer and/or communication aid (Figure 2-2b).

Consequently, it is important to establish a mechanism for monitoring the access technology to ensure that it is appropriate to the pupil's skills, needs and curriculum. It is not necessary to continually assess at an in-depth level: part of the initial 'assessment', whether involving the class teacher, specialist teachers, visiting professionals or a specialist Centre, must take into account likely changes and developments. Beukelman & Mirenda put this succinctly: "Assess to meet today's needs, then tomorrow's, and tomorrow's, and tomorrow's..." (Beukelman & Mirenda 1992 p.101).

Figure 2-2   (a) Matching activity accessed by single switch scan (Widgit Software)

(b) WiVik on-screen keyboard accessed by single switch scan



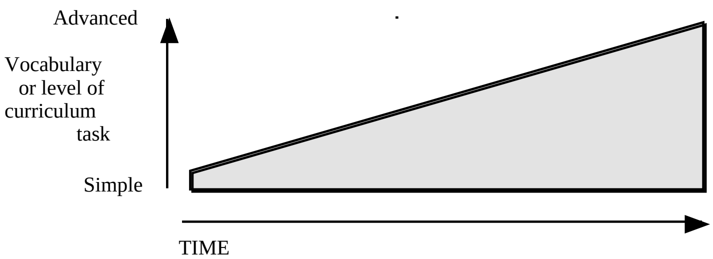
(a) **(b)**

A Special Access Curriculum

For all pupils, including those with special educational needs, learning to use IT across the curriculum is a requirement of the National Curriculum in England and Wales, and an attainment target in the Scottish 5-14 curriculum. If an able-bodied pupil does not have a high level of skill with information technology it may not greatly affect access to other parts of the curriculum. But for some pupils with special educational needs the computer is the *only* chance they have to access the curriculum independently: learning to use the technology effectively is therefore vital and should be given a high priority in the individualised curriculum.

It will be clear from the later chapters in this book that pupils have to learn a whole set of different skills at different levels to use technology effectively. These skills do not spontaneously appear: they must be developed through planning and delivering an appropriate curriculum (Figure 2-3).

Figure 2-3 Skill progression for special access technology



Undoubtedly, this can take a great deal of teaching and especially preparation time, technological skill and good equipment resources. However, teaching staff do not necessarily have to devise a completely new curriculum based around the special access equipment. A better approach is to develop access skills *in line with and as the overall curriculum develops.*

A Team Approach

The assessment process will often require specialist expertise from:

- a special educational needs and information technology specialist;

- occupational and/or physiotherapists to assist with seating/positioning and control selection;
- bioengineering and technical services to build or adapt the control devices;
- speech and language therapists to advise on vocabulary selection and language strategies;
- visual and hearing impairment specialists to test functional vision and hearing;

and so on.

In addition, devices which were previously designed for distinct tasks are becoming multi-functional so that the same computer-based device can be used for writing, communication and control of the environment. Effective assessment and provision of these devices requires co-operation between the health, education and social work services that provide different types of technology.

Over the years a number of mechanisms have been enshrined in legislation to help to achieve effective models for assessing a pupil's special educational needs and how he or she might access the curriculum. These are discussed in Appendix A.

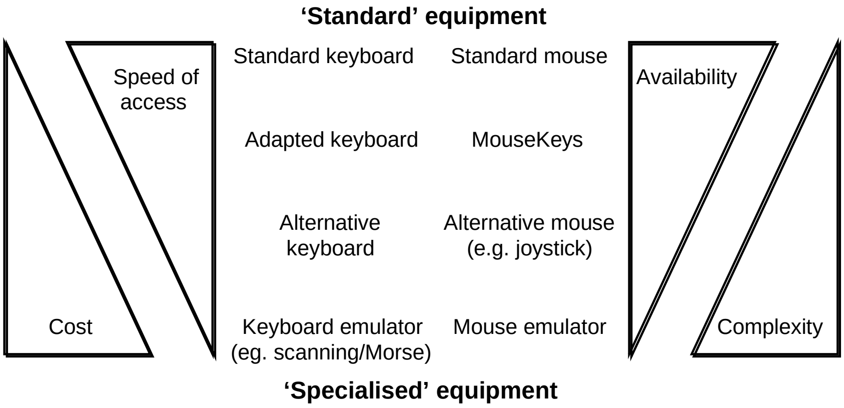
2.2 Approaches to Assessment

There are many different approaches to assessment which have evolved and developed over the last 20 years or so (Millar at al, 1986).

'Supermarket' Assessment

One common technique is simply to try what you have available and see if you can find something that works. This has advantages: you can start immediately and there is no need to put the pupil on a waiting list for a specialist service. Also, the assessment is more likely to involve standard, readily-available equipment which usually costs less; is more common; is easier to maintain and support; may not require extra staff training; and may be simpler to operate. In some cases, it may be more effective to adapt and use equipment which is readily available in the school, than to introduce new complex equipment - even if the more specialised equipment is a slightly better 'theoretical' solution. (Examining the classroom resources is discussed in 2.5: Assessing the Context.) Figure 2-4 attempts to represent the relationship between different types of equipment.

Figure 2-4 Relationship between types of equipment



These are generalisations: for *most* users, the standard equipment is cheaper, faster, easier to get and less complex. But if someone cannot hold a mouse let alone move it, it is clearly not going to be faster than a switch-and-scan mouse controller which they *can* operate.

Supermarket assessment can therefore give quick, effective results. However, it has several crucial disadvantages.

First, it is inevitable that the skills of the staff and the range of equipment and resources available will influence the assessment: you cannot evaluate things you don't have or assess areas which are not within your field of expertise.

Second, although Supermarket assessment may provide a means of access, there is no way of showing it is the most effective means of access. One difficulty with special access is that there is no accepted 'standard' for effectiveness: it is very hard to judge if the equipment is maximising the student's potential. (Skill and attainment levels of users of special access technology is an area which requires research. Little is known about the average speed of writing of students using switch and scan methods, for example.) Suppose you work in a school where the special access equipment consists of standard keyboards with keyguards, mice, and *Clicker Plus*. You try these first with an athetoid cerebral palsy pupil and come up with a scheme which seems to work, more or less. If you stick with this level of provision, the student will not have the opportunity of trying other possibly faster or easier options.

Thirdly, supermarket assessment does not actually provide a comprehensive view of what the pupil can do: it only tells you if the learner can use that particular equipment.

Maximal Assessment

One way to ensure that skills are thoroughly investigated is to perform a series of comprehensive specialist tests for each of the areas. This approach is generally referred to as 'Maximal Assessment' (Glennen & DeCoste, 1997; Beukelman & Mirenda, 1992). Here is a simplistic example. When assessing for a suitable keyboard (such as an overlay or expanded keyboard) an O.T. could measure range of hand movement, accuracy of targeting and releasing, and activation pressure (amongst other things). Then you could look in manufacturers' catalogues, or Chapter 3 in this book, or the *Handbook of Adaptive Switches and Augmentative Communication Devices* (George & Lacefield, 1994) and match up the measurements with the most appropriate keyboard. This will not *guarantee* a good result: you still need to try out the likely device in practice, in the school, over a reasonable period of time. And the whole process may be more time-consuming compared with simply sitting the pupil down in front of an assortment of keyboards and asking them to try each one.

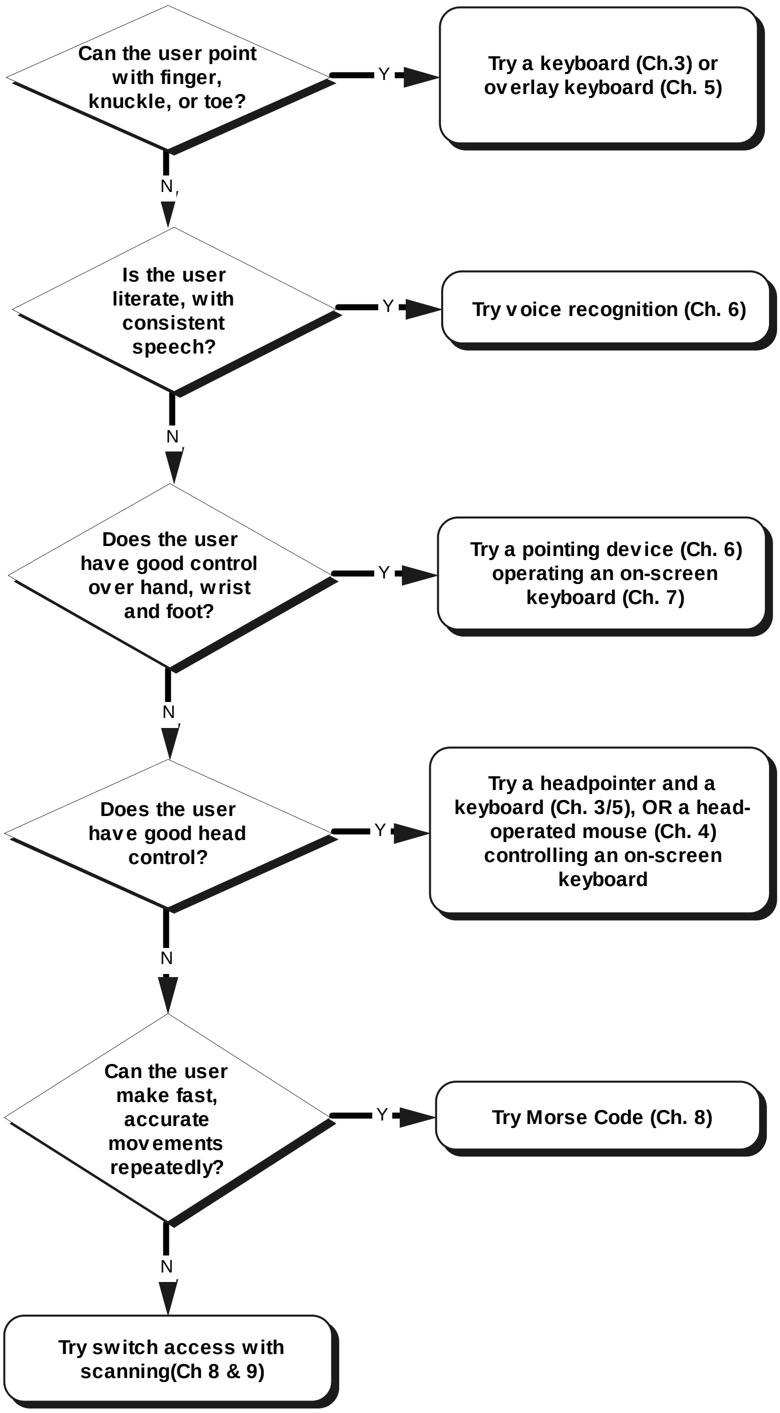
Criteria-based Assessment

You don't want to assess absolutely everything just for the sake of it; but you also want to make sure that you have not missed anything. One approach is to use a checklist or ***decision tree***, which guides you down a path of investigation by answering yes-no questions that reject options and areas which are not worth exploring. Figure 2-5 gives a simple assessment decision-tree. The PCA Checklist (Fraser et al, 1994) from Don Johnston is a good example of this method. It can be quick and efficient: the limitation is that it is often not possible to make definitive decisions at each level in the checklist and so assessors must apply additional expertise and experience to the assessment process.

Predictive, Feature-matching Assessment

Current practice for AAC assessment favours predictive or feature-matching assessment (Yorkston & Karlan, 1986; Glennen and DeCoste, 1997; Beukelman & Mirenda, 1992) and this is most appropriate for special access as well. This model attempts to choose a system that matches the user's needs and skills most closely and uses elements of the other assessment methods described above. Often, the process uses a decision-tree to guide the overall assessment process, and a more 'maximal' approach for particular areas of interest. It is common practice to use the technology itself within the assessment process both to gather information about the client's skills and to ensure that the potential access tools actually perform satisfactorily in practice. One of the most important aspects of assessment which is a feature of criteria-based and maximal assessment, but which is easy to neglect with more flexible approaches, is documentation. Regardless of the approach, it is important to document the assessment tasks, observations made, and conclusions. It is also helpful to record performance measures such as speed, accuracy, effort required, and the opinions of the user both to provide a means of comparison between access tools, and to give a benchmark to measure progress.

Figure 2-5 An example of a simple decision-tree



2.3 Barriers to Learning

In discussing how IT can be used to support learners with visual impairment, Aitken & McDevitt (1995, p. 5) describe the difficulties faced by them as *barriers to learning*. Beukelman & Mirenda's *Participation Model* for assessment and intervention for AAC (Beukelman & Mirenda 1992, p. 101) similarly identifies *opportunity* and *access barriers* which must be assessed if a suitable intervention plan is to be devised. It is useful to approach assessment for special access technology for use by students with special educational needs in a similar vein. Following Hawkridge and Vincent (1992), Aitken & McDevitt state that the 'essence of good assessment' involves understanding three inter-connected sets of factors which construct barriers to learning:

- individual learner's needs and abilities;
- environment or conditions in which learning takes place (the context);
- the nature of the learning task (including the task of using the technology).

Investigating these areas helps form a specification for an Individualised Educational Program which may include provision of technology, but assessment for special access must also consider a fourth factor, which is:

- the features of the technology.

In practice, there is considerable overlap between each factor and consequently those involved in assessment must have knowledge and skills in all four areas. The fourth factor may not be addressed specifically but is considered by investigating how technology may help overcome the three barriers to learning. In this section, we look at each of the three barriers to learning and present a framework for assessment.

2.4 Assessing the Individual Learner's Needs and Abilities

Earlier we noted that assessing for an access system involves more than finding a keyboard, mouse or switch which the pupil can operate because the type of technology and the purpose for which it is being used affects the choice of control. Lee and Thomas (1990) describe the various components of a generalised assistive technology access system as:

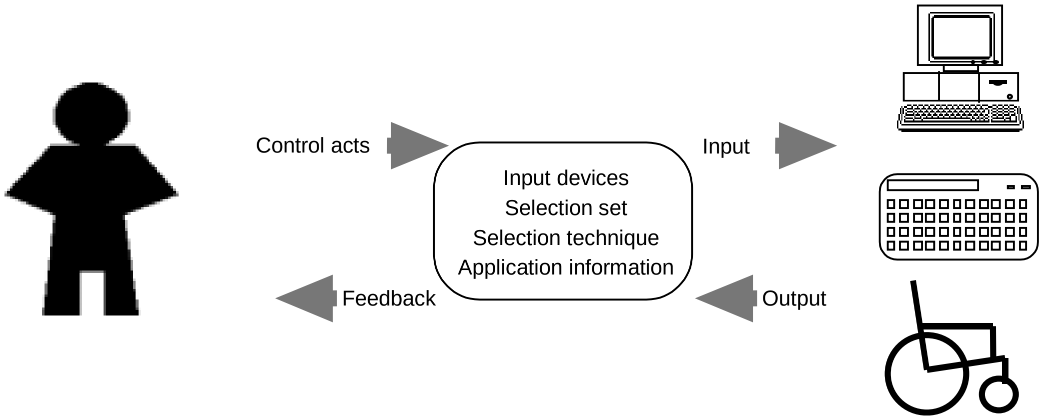
- **Input device.** The device by which the client controls the switch (e.g. switch, keyboard).
- **Selection Set.** The visual, auditory, and/or tactile presentation of available items from which the client chooses (e.g. letters and keys on the keyboard).
- **Selection technique.** The means by which the client chooses items to be selected (e.g. scanning or direct selection).
- **Application Information.** The output from the target system as it is presented to the client (e.g. text on the monitor screen, speech, Braille print-out, movement of a powered wheelchair).

Figure 2-6 below summarises how these components interact.

Assessing a pupil's skills and needs for special access technology involves looking at:

- Seating and positioning
- Vision and Visual Perception
- Physical motor control
- Cognitive and linguistic skills

Figure 2-6 Components of an access system (after Lee & Thomas, 1990)



Seating and Positioning

Control over any body part will be impaired if the student does not have a stable, supportive position. This does not mean that assessment must wait until a functional position is achieved because there are often delays in obtaining specialist seating, and it may not be possible to provide a satisfactory solution for an individual with severe physical involvement. For the purposes of assessing physical motor control, a seating or positioning specialist may use temporary measures to obtain a functional position. Gray (1988) gives an excellent introduction to seating at a level suitable for newcomers to the field. Glennen and DeCoste (1997) has a chapter with a more detailed discussion for more experienced readers, while there are numerous textbooks which provide detailed discussion of techniques for assessing and providing seating and positioning for people with physical disabilities.

Positioning not only affects motor function and a user's ability to use an input device: it also effects ability to receive feedback from the system. For example, a user will find it more effortful to attend to a computer screen in a reclined seating position than when upright; while a young child seated on a small seat will need the monitor or screen on a lower table to see it properly. Many 'computer tables' marketed for schools are simply not appropriate for young children because they are too high, while wheelchair users may have difficulty fitting the wheelchair underneath the table to reach the keyboard. Sources of adjustable tables and furniture are given in *Chapter 3 Using the keyboard*.

Vision and Visual Perception

Visual abilities will have an impact on the selection of an access system. For example:

- **Visual acuity** (a measure of the ability to discriminate details of a particular size target at a specific distance) will determine the size of the items on the selection set (i.e. the keys and/or information on keyboard or screen) and the distance of the set from the user. Someone with poor visual acuity may need large keys with the keyboard or screen located close to them.
- **Visual field** (the area which can be seen without a shift in gaze) will influence the overall size and positioning of the selection set and the layout. A learner with central field loss will need the selection set located to one side; someone with peripheral field loss may only be able to see a small selection set located in the central field.
- **Eye movement problems** (difficulties with maintaining gaze, or involuntary movements) may affect the positioning of the selection set, the layout, the spacing between items, and the ability to track moving items (e.g. when scanning).
- **Light and colour sensitivity** may affect the learner's ability to use the access system. Some individuals are sensitive to light and prefer low ambient light; while others require high levels of illumination. Glare can cause difficulties which are minimised by consideration of the position and angle of the equipment relative to light sources. Some students are more comfortable with particular colour combinations (e.g. yellow-on-black key stickers are available for standard keyboards), while colour coding particular keys (e.g. vowels, or the left hand item in each row) may help navigate around the selection set.

If there is concern about visual ability a referral should be made to an ophthalmologist or visual specialist. Functional vision may also be investigated in the classroom provided the learner understands the task and can indicate a response to questions:

- Hold a target in a fixed position to assess ability to fixate on a target. Use different sizes and distances and positions to get an idea of visual acuity and field.
- Use a moving target to assess tracking and the ability of the eyes to work together. Move the target over different sections of the visual field to test for particular deficits.
- Ask the student to locate a particular item (symbol, picture or word) on a page to assess ability to localise and discriminate. Gradually increase the number of items on the page (bearing in any problems of acuity or field).
- Ask the student to scan along rows and columns of items to assess visual scanning skills, again gradually increasing the number of items.

A significant percentage (estimated at between 40% to 90% depending on diagnosis) of people with visual impairments also have other physical and/or cognitive disabilities and therefore traditional visual assessments may prove difficult to administer. *Vision for Doing* (Aitken & Buultjens, 1992) describes a comprehensive approach to assessing functional vision in students with multiple and visual impairments.

Physical Motor Control

The purpose of assessing physical motor control is to find the most effective input device and selection technique for access. Some formal procedures for assessment have been developed: *Control of Computer-Based Technology for People with Physical Disabilities* (Lee and Thomas, 1990) is a comprehensive manual covering the complete assessment process; the *Physical Characteristics Assessment* (PCA) (Fraser at al, 1994) is a straightforward and effective ‘decision tree’ checklist; while the *Lifespace Access Profile* (Williams et al, 1995) is a systematic approach to observation, collection and analysis of all factors relevant to the selection of assistive technology.

In practice, many specialists adopt the ‘feature-matching’ approach to assessment, but also adapt elements of criteria-based assessment tools with maximal assessment covering particular areas requiring rigorous investigation. Glennen & DeCoste favour an informal technique described as ‘MSIPT Assessment’ following the original *MSIPT* method devised at the Hugh MacMillan Medical Center in Toronto (Goosens & Crain, 1986). This involves looking at:

***M* Movement pattern.**	The range of movements possible taking into account type, range, speed and effort and the use of adaptations such as headpointers, handsplints etc.
***S* Control site.**	The body part which contacts the input device.
***I* Input method.**	The equipment and method used for selection. The input method may be direct selection from a keyboard; switch encoding (Morse); voice recognition; or switch and scanning.
***P* Position.**	The position of the computer or target device, and the input device.
***T* Targeting.**	A measure of the accuracy of selection.

A sample chart for recording the results of the access and control and assessment (modified from Glennen & DeCoste, 1997, p.254) is given in Figure 2-7.

Using the Assessment Chart

The chart allows for several methods to be investigated because in most cases there are several potential sites and methods which must be compared. Also, it is often necessary to investigate different tools for different tasks so it may be worth using several forms, or adapting the form to create one form for direct keyboard selection, another for pointer control, another for scanning selection, and so on. In the example in Figure 2-7, different techniques were chosen for different tasks: the chin pointer for writing using the keyboard, and switch and scan using on-screen word banks for whole-word activities.

Figure 2-7 Control and Access Assessment Chart

Access and Control Assessment	**System A**	**System B**	**System C**
	T-bar	*Chin pointer*	*Single switch scan*
Client name:			
Assessor name:			
Date:			
Position of client:	*seated, Leckey chair*	*same*	*same*
Positioning adaptations	*right arm held by helper*	*grab bar*	*grab bar*
Activity	*copy typing*	*same*	*sentence build*
M **- Movement Pattern**	*right arm extend*	*head*	*right arm raise/lower*
Comments/concerns			
S **- Control Site**	*right hand*	*head*	*right hand*
Control Site adaptations (e.g. splint, pointer)	*T-bar pointer*	*chin pointer*	
I **- Input Method**			
Direct selection: (e.g. keyboard size, layout, keyguard, key travel)	*standard keybd, guard,*	*standard keybd guard*	
Pointing device: (e.g. type, guards, button, speed, adaptations)	-	-	-
Scanning selection: (e.g. scan method, speed, switch timing, feedback)	-	-	*single Jelly Bean switch*
Switch encoding selection: (e.g. coding method)	-	-	-
Voice recognition selection: (e.g. discrete word/continuous speech, vocabulary)	-	-	-
P **- Position of input device**	*keybd at 45*	*keybd at 80*	*midline, velcroed to desk*
T **- Targeting method** (e.g. target size, number of items)	*standard keybd*	*standard keybd*	*12 items*
Observations	*requires assistance*	*OK*	*OK but speed limited by athetoid movements*
Speed of overall response	*slow*	*OK*	*OK for words*
Accuracy of overall method	*poor*	*OK*	*good*
Reliability	*poor*	*OK*	*good*
Effort	*hard*	*OK*	*easy*
Overall quality	*poor*	*OK*	*OK*

Other comments

The hand-held T-bar is hard work, and T. needs restraining. For writing letter by letter, the chin pointer is reasonably fast and accurate, and T. can also type independently. For whole word sentence building or exercises with a small number of words, scanning is fast and relatively easy.

T. cannot use a mouse, trackball or joystick effectively; a possible tool to control the mouse pointer are MouseKeys with the chin pointer.

Consider use of head-operated mouse and on-screen keyboard at a later date; and voice recognition.

- **Control sites and movements** are usually investigated in the following order for reasons of efficiency and social acceptability (Lee & Thomas, 1990):
  - hand and arm;
  - head and chin;
  - foot and leg.
- **Input Method.** Assessment usually focuses on direct selection first (Beukelman & Mirenda 1992, p.123) because it is potentially the fastest, easiest and cheapest (Lee & Thomas, 1990, p.98, Glennen & DeCoste, 1997, p.259, Szeto et al (1993), Ratcliff, 1994) of the methods which involve physical contact with an input device. If an effective direct selection method is achieved, there is usually no need to investigate switch encoding or scanning.
- **Voice recognition.** The recent availability of cheap, relatively reliable voice recognition systems offers a different type of direct selection access method which can be faster or easier for some people who would previously have used some other form of access technique. However, although it is possible to operate a system solely using voice commands, it is usually preferable to also have a physical access method as well.

Cognitive and Linguistic Skills

The student's cognitive and linguistic skills will have an effect upon the selection of an access system. Particular cognitive skills required for use of access technology (Cook & Hussey, 1995, pp. 102-122) include:

- **Cause and Effect.** Any form of access system demands an understanding of cause and effect. This is not to say that a learner must have demonstrated such understanding before technology can be used, since technology may be used to develop understanding of cause and effect.
- **Memory and Sequencing.** Different types of input method have different cognitive demands: scanning requires the user to plan a sequence of steps to make a selection. Encoded systems (such as Morse; semantic compaction; or text-based abbreviation expansion) place demands on memory and recall.
- **Motivation.** To make use of special access technology, the learner must be motivated to use the technology to tackle the learning task.
- **Language Skills.** Understanding of syntax, semantics and pragmatics will all influence the choice of access system and how the vocabulary is stored and presented in the device. Literacy abilities will affect the choice of application and the items in the selection set: non-readers will use symbols, while literate students may use text. In situations where symbol-based systems or voice output aids are being considered it is important to obtain advice from suitably experienced speech and language therapists.
- **Problem Solving and Decision Making.** Special technology is a tool which can be used to accomplish learning tasks in several ways: choosing a particular approach and strategy requires problem solving and decision making skills.

Section 2.6 covers assessment of the learning task and discusses the cognitive and linguistic demands of special access technology in greater detail.

2.5 Assessing the Context

The school context in which the technology is to be used will have a great influence upon the choice of system and how it is introduced and used. Beukelman and Mirenda (1992, pp.107-111) propose a systematic approach to identifying policy, practice, attitude, knowledge and skill barriers to successful participation. *Access Technology* (NCET, 1995) has a helpful chapter on the use of technology in a school context in which these barriers and methods for overcoming them are discussed.

Policy

National, local and school policies have a direct affect upon the daily lives of students with special educational needs, and also impact upon the use of IT (see Appendix 1). Segregationist or integrationist policies will define the physical and learning context for an individual with special educational needs. As a result, special schools with considerable experience in special access may have very well developed technology-based resources and programmes and good support from occupational, speech and language and physiotherapists. But there may be more limited opportunities for interaction with non-disabled peers, and fewer specialist IT resources.

Policies can also influence the type of technology which is provided: usually it is helpful to use access technology which is already available and supported in the school. For example, if the school has built up a stock of Acorn computers and software then it is sensible, if possible, to choose access systems which operate on this platform. In some cases this may not be possible: if a voice recognition system is identified as the best solution, for example, a Windows PC or Macintosh computer will be needed because there is no system available for Acorn machines.

Practice

School practices will affect successful implementation of special access technology. In some schools with limited technological resources the practice is to time-table access to a computer and this may reduce opportunities for use by a particular individual. The intervention plan resulting from the assessment process must specify how much time a student needs on the machine, and this may require purchase of more machines. Sometimes, school practice is to locate the computer in a particular place (in the corner of the class, or in the corridor) and students must leave the rest of the class to go and work on it. In some situations this may be appropriate, but it is not if a student uses the computer as the main means of recording work. Therefore, the intervention plan must make recommendations about where the machine is to be located. Often, one person takes responsibility for working with a student using technology and it is important that the curriculum allows other staff to work with the student, both to build a wider knowledge base and to avoid dependency and isolation.

Attitude

Attitude of staff within the school where the equipment will be used will affect choice and use of technology. If staff have a negative attitude towards the presence of students with special educational needs, or towards technology, then time and training will be required to overcome these attitudes, otherwise it is very unlikely that the technology will be used effectively. Conversely, the presence of staff with positive attitudes towards technology will greatly reduce the amount of training and support needed to make the technology work. Attitudes of students and parents will also have a huge effect: some students prefer to use technology which is as ‘standard’ as possible (or is black, small, or ‘cool’ in some other way) even if it is less effective than a more specialised method.

Knowledge and Skills

Clearly, staff involved in using technology must be able to operate it and, more importantly, to use and apply to the learning task. This ‘soft’ technology is just as important as the ‘hard’ technology that is the access system and computer. In many schools there is a lack of knowledge concerning special access technology (hence the reason for writing this book). The assessment process must identify any knowledge and skill barriers and prepare materials and courses to overcome them. It is necessary to institutionalise and document procedures and systems so that changes in staff or class do not leave the student without satisfactory support.

2.6 Assessing the Learning Task

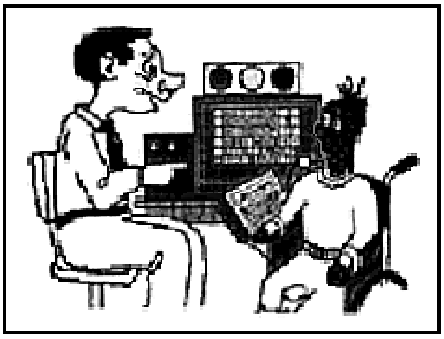
The task for which the technology is to be used will influence the choice of access method:

- **Nature of the Task.** Different activities (writing, reading, drawing, mathematics) will place different demands on the technology tool and access device.
- **Curriculum Level.** Young children tackling a simpler curriculum will generally use simpler technology than those at a later stage.
- **Location.** A learner may use different methods of recording work in the classroom, at home, in libraries, or in other locations.
- **Speed and Quantity of Work.** Time-constrained examinations and tests may require a tool which can be used to generate material quickly and in quantity.

Learning to use special access technology is also a curriculum subject in itself. All computer users must learn how to operate the program running on the machine. Keyboard users must become familiar with the keyboard layout and practised at making selections. Some access techniques are more complex than others. Scanning is more demanding (physically, cognitively and perceptually) than direct selection using a keyboard. Yet, conversely, it is the only access technique possible for some pupils with more severe physical and/or learning difficulties. Scanning is also generally slower than direct selection, and therefore requires greater patience and motivation. Yet it is vital that pupils with greater physical involvement, who have reduced opportunities for independent activity, experience success as rapidly and efficiently as possible with this same complex and difficult-to-use technology. It is therefore unreasonable and unrealistic to expect pupils to learn to scan and operate the computer without a great deal of practice using graded activities.

Figure 2-8 from IMPACT (Jones 1994)

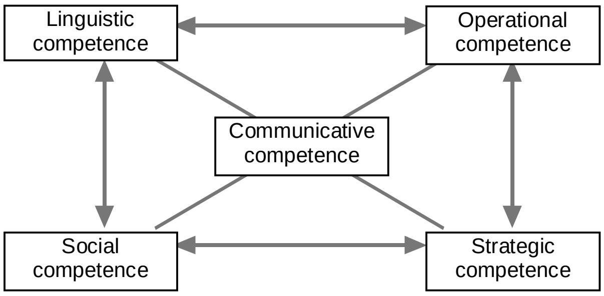
One thing at a time



“Right Shani. All you have to do first is concentrate on the lights. When the red one comes on, you hit the switch to switch on the environmental control. Then watch the panel on the EC. When it says computer hit the switch. That turns on the computer – but the light box must be green otherwise you’ll blow the whole system up. Ha! Only joking! Anyway, the computer will start to scan and so will your word prediction VOCA. Keep an eye on both because we will be using both at the same time to help us do the job. See it’s all very simple isn’t it? Never used a switch before? Oh don’t worry about that.”

To use special technology for writing, communication or any other purpose, requires several types of competence. Let’s look at an example.

Figure 2-9 Model of Communicative Competence



(after Light 1989, MacDonald & Rendle 1992)

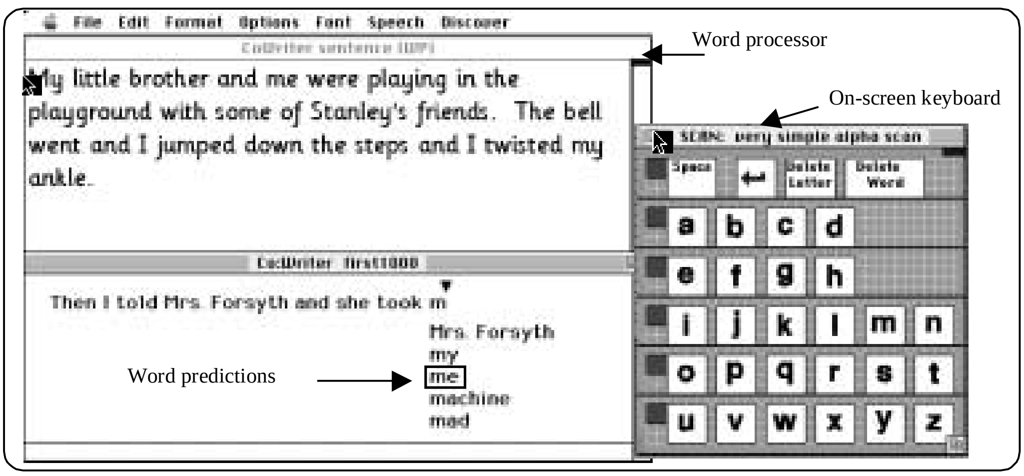
Figure 2-9 above was created for voice output communication aids, but we will demonstrate how it also applies to other types of special technology.

The screen copy below in Figure 2-10 shows three programs for Apple Macintosh: *Discover:Switch*, *Co:Writer* and *ClarisWorks*. The learning task is writing and the text in the story is based on an example in *Exemplifications of Levels of Achievement in National Tests in Writing* (Scottish Qualifications Authority, 1997).

The main writing tool is the *ClarisWorks* wordprocessor. The student uses a single switch to scan and select letters from the *Discover:Switch* on-screen keyboard. Scanning is slow so the *Co:Writer* program uses word prediction to accelerate the writing speed and support spelling. *Co:Writer* scans round the word list and the writer presses the switch to select the whole word rather than typing it out letter by letter. The 37 word sentence given in the illustration below took 114 selections to write: if the word predictor had not been used it would have needed 198 selections (the predictor therefore gave a saving of around 42%).

The *Co:Writer* prediction dictionary was ‘untrained’ with the most common 1,000 words used by children, created by Alan Stewart, SEN/IT development officer in Highland and Islands. Through use, the system would become trained to recognise common word patterns and the prediction would improve, reducing the number of selections needed from 114 to considerably less.

Figure 2-10 *ClarisWorks*, *Co:Writer* and *Discover:Switch*



Similar access systems (*Switch Clicker 2*, *EZ Keys*, *SAW*, *Windows Switch*, *Wivik 2*) and word predictors (*Penfriend*, *Prophet*) are available for Acorn and PC computers. Chapters 7 to 11 cover the access systems, while word predictors are reviewed in more detail in *Supportive Writing Software* (Nisbet et al, 1998).

Operational Competence

To use this system efficiently requires *operational* competence. The writer must be able to use the system to select letters and words which in this case means activating the switch with good timing for a reasonable period of time, without fatigue or reduced concentration.

Scanning is a perceptual-motor activity: it's hard at first and you have to concentrate but you get better at it with practice until you can execute the necessary sensori-motor patterns automatically. There are some analogies with handwriting: an able-bodied pupil is drilled in handwriting to achieve a good level of operational competence with their pen. A pupil using a computer also requires drill and practice to achieve a satisfactory level of competence. However, people with severe physical impairment may have never even *used* the particular sensori-motor patterns needed to activate a switch for scanning and so these patterns may need to be developed from scratch. They will need a great deal of practice to achieve operational competence. While they are learning these motor patterns, it can help *not* to have to think about spelling, words flashing up on predictors, and the language content of what they are trying to write. For a scanner, operational competence requires automaticity to get into the 'rhythm of the scan'. The challenge for the teacher is to create activities for practice which are sufficiently motivating to keep the child practising a task which may well require considerable effort.

Operational competence is not confined to the switch or control: it also includes operation of the various technologies in use. The writer needs to be able to use the control functions (Backspace, Return etc) on the *Discover:Switch* selection set; to select items from the *Co:Writer* predictor; and to control the required word processor functions. Consider that a typical school introductory word processing module requires 40 hours of study (and this assumes reasonable levels of literacy and motor ability). To fully operate the system above is more complex and requires greater operational competence because there are three programs on screen rather than one and because of the special mode of access and the use of the predictor. In addition, the pupil with physical difficulties will type far slower than a keyboard user and may be just beginning to read. Bearing these factors in mind, how much longer will it take to achieve operational competence of this system compared with a word processor alone? Twice the time (80 hours)? Three times (120 hours)? And this is just to *operate* the system: it does not necessarily mean the pupil will be able to *use* it effectively to access the curriculum.

Strategic Competence

Strategic competence is judging when to use the different features of assistive technology. At this early stage, it could mean knowing when to look in the prediction window for a word (perhaps to use the predictor for longer words, but just type shorter words manually), and when to ignore the predictor and concentrate on scanning and selecting the next letter. A higher level of strategic competence is choosing to change over to use different *Co:Writer* dictionaries for different writing topics; or choosing different *Discover:Switch* selection sets to suit a particular task. Strategic competence is achieved through skilled teaching and support and by the pupil experiencing different writing or access situations, which require changes in the way the tools are used. Once again, practice is important, but the practice activities require finer planning if they are to expose the writer to the range or experiences needed to develop strategic competence.

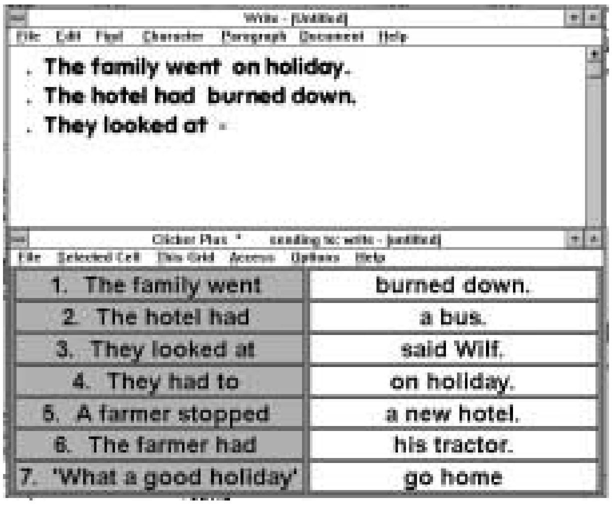
Linguistic Competence

Linguistic competence is needed to write using any form of technology. In our example, *Co:Writer* can support spelling to some extent, but the writer needs to know which words they are trying to type, and how to put words together into a sentence. They need to be able to recognise the desired word from the prediction list, and if it is not there, type the correct next letter of the word in mind.

Access tools like *Discover:Switch* and supportive writing systems like *Co:Writer* can be changed easily to suit a very wide range of linguistic abilities. The class teacher must have a good understanding of the technology and the writer to match them up at the right level.

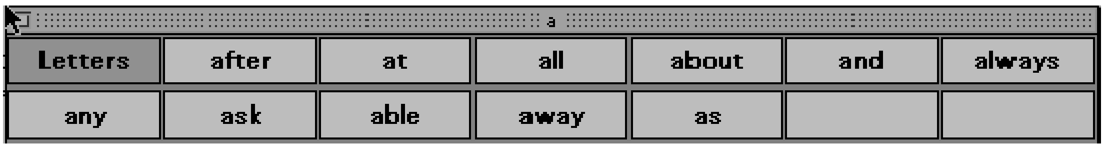
For example, a new user in the early stages of literacy might start with a selection set containing a small number of whole words or phrases drawn from the current reading books. Linguistic competences needed for this activity are to be able to recognise the words in the grid (with or without an auditory prompt as they are scanned) and select them in the correct order to create a sentence.

Figure 2-11 *Clicker Plus* Word bank for Oxford Reading Tree



As new reading books are introduced and the pupils vocabulary expands, the teacher must find some way of storing the words in selection sets in a structured manner. One method is to create several selection sets and link them together (Figure 2-12) arranged alphabetically, grammatically, or by book or topic.

Figure 2-12 *Clicker* alphabetic word bank



Such whole word sentence building develops some linguistic abilities and lets the pupil write whole, correctly spelt sentences quickly, but at some point the teacher will wish to introduce spelling activities so that the writer has an opportunity to create words rather than just recognising them. Prediction is a good way of both storing a vocabulary and introducing spelling. The whole word vocabularies developed through word banks can be used to create a very small starter dictionary. Accessing the word predictor requires the writer to have some idea of how to start the word; yet the prediction reduces the level of linguistic skill required and (hopefully) increases speed, endurance and confidence. Thereafter, adding new words to the dictionary incrementally allows the teacher to offer new linguistic tasks to the writer.

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