CALL Scotland

The use of Communication and Assistive Technologies for disabled candidates in Assessments

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Introduction

This report describes Communication and Assistive Technologies that might be used by disabled learners in assessments. The report was written to enable the Scottish Qualifications Authority to:

(i) consider the ways in which technologies have the potential to increase access to these new qualifications for disabled candidates, and;

(ii) consider what the impact might be of using such technologies in terms of maintaining the credibility of the assessment.

The CALL Scotland team were asked to consider three questions:

- What Communication and Assistive Technology is currently in use in schools and colleges?
- Which disabled candidates might need Communication and Assistive Technology?
- What is the current understanding among stakeholders as to its current use in assessments?

Although the report was originally written for internal use within SQA, SQA and CALL Scotland recognise that it may also be useful to other assessment and examining agencies, and also to teachers, practitioners, parents and learners, and so we have therefore published it and made it generally available.

Summary

Communication and Assistive Technology provides some learners with their only means of independent communication, expression and access to the curriculum. It can mean the difference between being able to read, write or communicate, or not. For these young people, access to appropriate Communication and Assistive Technology is essential if they are to become successful learners, confident individuals, effective contributors and responsible citizens[1].

At the time of writing in 2011, the most common type of support requested in SQA external assessments, after Extra Time and Separate Accommodation, is a reader and/or scribe. While such provision is in many ways extremely positive (enabling many learners to demonstrate their knowledge and skills who would otherwise be disadvantaged), we ask how you can be a:

- ***successful learner***, if you cannot read or access learning materials by yourself;
- ***confident individual***, if you rely on someone to read to you and write for you;
- ***effective contributor***, if you have difficulty accessing information;
- ***responsible citizen***, if you cannot write, talk or communicate.

A huge advantage of Assistive and Communication Technology is that it can enable children and young people to demonstrate their knowledge, understanding and skills *independently*, reducing reliance on human support. There is also emerging evidence that technology offers a more cost-effective alternative to readers and scribes in examinations and assessments.

Over the past 6 years, the use of ICT by disabled candidates and/or additional support needs in SQA external examinations has increased almost fourfold, from 2,388 requests in 2005 to 9,135 requests in 2011. Contributing to this trend has been the rapid uptake across Scotland of the use of Digital Question papers, which enable candidates to access the assessment on computer, use text-to-speech software to read the questions and type answers on-screen: in 2008, when the papers were first offered, 46 centres made 514 requests for 204 candidates and three years later this had risen to 2,839 requests from 146 centres for 1,069 candidates. The use of technology by candidates with disabilities in assessments (and in the classroom) is therefore increasing rapidly.

SQA has obligations under statutory equality duties to ensure that standards and assessments are not discriminatory, and to allow reasonable adjustments for disabled learners to published assessment arrangements. The use of Assistive and Communication Technologies falls within this scope.

For several reasons then – personal, legal, educational and financial – it is essential that assessments for SQA Qualifications can be accessed by candidates with disabilities who use Communication and/or Assistive Technologies.

This has implications for policies and processes within SQA, which should be designed to ensure that assessments and the instruments of assessment are accessible using technology; for practitioners across Scotland, who need to be aware of the potential of Assistive Technology and have expertise to support its use; and for local and national government, which must provide young people with access to appropriate technologies.

[1] The purpose of Scotland's Curriculum for Excellence is "to enable each child or young person to be a successful learner, a confident individual, a responsible citizen and an effective contributor".

SECTION 1: INTRODUCTION TO COMMUNICATION AND ASSISTIVE TECHNOLOGY IN ASSESSMENTS

SQA Assessment Arrangements

The current context of support in SQA external assessments is illustrated by Table 1, which lists the different types of Assessment Arrangements and the number of requests that were made for each, in 2011.

Requests for Assessment Arrangements were made for a total of 53,703 entries (7.3% of all entries) on behalf of 15,412 candidates (9.75% of the total number of candidates. In most cases, more than one type of support is requested (for example, Extra Time and use of a reader and/or scribe) and so the total number of specific support requests was 129,599. The most common type of support, excluding extra time and separate accommodation, is the use of a reader and/or scribe. This is expensive in terms of staff and resources; raises questions of accuracy of measurement; and does not, it could be argued, encourage the development of 'successful learners' or 'confident individuals'.

The rapid uptake of SQA Digital Question Papers since their introduction in 2008 demonstrates that Assistive Technology and AAC can have significant benefits for pupils and for centres. There is some evidence emerging that Digital Papers and ICT can replace reader/scribes, for many students with disabilities, in assessments.

However, despite the increase in the use of ICT, Table 1 shows that in most schools, reader/scribes are still the first resort for supporting learners with disabilities. This needs to change: reader/scribes should be the last resort and only employed in cases where other independent methods of support cannot be used.

The introduction of new assessments and National Qualifications is an excellent opportunity to establish and promote the use of ICT and accessible digital assessments.

Table 1: Requests for Assessment Arrangements, 2011

Assessment Arrangement	Number of Requests, 2011
Extra Time	40,800
Separate Accommodation	31,950
Reader	18,032
Scribe	14,962
Use of ICT	9,135
Prompter / Practical Helper	2,622
Digital Question Papers	2,841
Coloured Paper	2,713
Rest Period	1,664
Enlarged or Adapted Print Question Papers	1,305
Transcription with correction	1,255
Calculator	653
Transcription without correction	721
Referral of script to the Principal Assessor	398
Modified Content (e.g. text description of images)	316
Adapted Certificate (e.g. in Large Print / Braille)	91
Braille paper	35
Question Paper signed to candidate	43
Candidate Signs Responses	23
Live presentation	40

Communication and Assistive Technology in Assessments

Table 2 takes the current 'Use of ICT' and 'Digital Papers' categories used by SQA and splits them up into the full range of tools discussed in this report. Currently, SQA does not have a distinct category for Augmentative and Alternative Communication (AAC) or voice-output communication aids, and so these have been added to Table 2 as an additional category. Note that decisions about whether a particular tool or method are appropriate or permitted in an assessment are taken on the basis of the candidate's disability and support need, and the purpose of the individual assessment. Some types of Assistive Technology may not help some candidates at all, while in other cases the technology may give the learner an unfair advantage in the assessment.

Table 2: Expanded list of Communication and Assistive Technology for Assessments

Assessment Arrangement	Tool
Use of ICT	• Word processor • Digital paper • Text reader (text-to-speech software for dyslexic or visually impaired candidates) • Screen reader (text-to-speech software for blind or partially sighted candidates) • Zoom / screen magnification software • Spellchecker • Autocorrect (automatic spelling correction) • Thesaurus, dictionary and research tools • Word banks • Word prediction • Speech recognition • Voice notes • Equation editor • Art and design software • Simulation or modelling software
Digital Question Papers	• Interactive on-screen assessments • Text-to-speech • Magnification / colour modification • Digital version of Large Print / Braille / Modified etc paper • Modified digital paper for visually impaired candidates who use screen readers
Augmentative and Alternative Communication (AAC)	• "High Tech" complex Voice Output Communication Aid (VOCA) with open-ended vocabulary accessed using text, or mixed symbol & text • "Medium tech" pre-programmed VOCA (restricted vocabulary – may require vocabulary pre-prepared to suit assessment) • "Low tech" letter, word or symbol board or book • Transcription of AAC output by scribe (verbatim/expansion from telegrammatic speech)

Linguistic Support and ICT

As we shall see, many of the tools we describe in this report are designed to help learners who have difficulty with some aspect(s) of reading or writing, and we will consider some of the implications for assessment that apply to these tools in general here.

SQA currently allows the use of linguistic support which is "designed to overcome a candidate's substantial difficulties in reading (for example, reading accuracy and/or reading speed) and in writing (for example, handwriting speed and/or legibility) where this is because of a disability/additional support need" [2].

In practice, pupils might require linguistic support to address difficulties arising from different circumstances:

- a candidate with a physical disability might use a scribe instead of handwriting or keyboarding;
- a reader/scribe might be used to support a pupil with a visual impairment;
- a candidate with reading difficulties due to dyslexia might use a reader.

Linguistic support is currently held to include use of a reader; scribe; tape recorder to record responses; transcription with/without correction of spelling and punctuation; and ICT.

ICT tools that can provide linguistic support include:

- a word processor or text editor;
- text-to-speech (i.e. where the text is read out by the computer using synthetic speech);
- spellcheckers, AutoCorrect, thesaurus, dictionary and research tools;
- word & phrase banks;
- word prediction;
- speech recognition (i.e. where the candidate's speech is converted into typed text);
- voice notes and recording (i.e. where the candidate's speech is recorded as an audio file).

One of the issues with linguistic support is that it may or may not actually support the candidate's language, depending on the nature of the pupil's difficulty and the assessment. For example, a pupil with a physical disability and no difficulties with spelling or language might use word prediction to increase writing speed or reduce fatigue. Whereas another pupil with dyslexia might use word prediction to support their spelling. Policies and assessments must be able to accommodate both scenarios.

SQA's policy is that "all software such as spellchecks, predictive software etc, must be disabled, unless it has been approved by SQA".[2] At time of writing in 2011, ICT that provides linguistic support can be requested and approved by SQA **only** for learners who have reading or writing difficulties, **if** these difficulties will put them at a substantial disadvantage in the assessment. Linguistic support can be used in all subjects apart from the assessment of writing in Modern Languages and Gaelic.

Linguistic support beyond the printed word

Linguistic support is most commonly regarded as a technique to help learners generate written language; for example, a candidate with dyslexia might use a word processor, or a deaf candidate might use sign language. However, linguistic support also applies to pupils who have difficulty with understanding or expressing other types of language, including spoken language.

Pupils with communication impairments can use a range of different types of technologies and support in SQA assessments, including voice-output devices and also 'low-tech' letter and words boards and charts, although these are not explicitly described or discussed in current SQA Assessment Arrangements guidelines.

[2] SQA 2008, Assessment Arrangements Explained, http://www.sqa.org.uk/assessmentarrangements

Looking to the future, to the possible development of a more inclusive policy, the concept of linguistic support may need to be extended to include candidates who not only have difficulties with aspect(s) of reading or writing, but who also have difficulties with aspects of speaking, responding and expressing themselves. Such students can nonetheless answer questions and demonstrate their knowledge.

On this basis, linguistic support might also include:

- use of symbols as a language representation system;
- use of text-to-speech software as a replacement for oral speech;
- picture / symbol supported word / phrase banks;
- picture / symbol supported word / phrase prediction;
- use of transcription by a scribe with linguistic expansion, i.e. to 'translate' telegrammatic utterances into grammatically correct expressions.

These types of support are often referred to as ***AAC***, or ***Augmentative and Alternative Communication*** and are most typically used by candidates who have speech, language and/or communication difficulties.

It is important to recognise that for some students with the most complex linguistic support needs, a range of different forms of support - both ICT and non-ICT - may be required, not just one. For example, although ICT with text-to-speech, symbol supported word banks and prediction may be needed, it is likely that extra time and a scribe may *also* be necessary.

These methods of support (like all Assessment Arrangements) must be considered and employed carefully, taking into account the needs of the candidate and the requirements of the assessment to ensure that the support does assist the learner appropriately, and that the learner is not given any advantage or disadvantage during the assessment.

Assistive Technology in schools

Considerable investment in ICT for schools in Scotland has resulted in computers and other technologies being available for use by learners with additional support needs and disabilities in schools. However, access to appropriate Assistive Technology varies between schools and across local authorities. Some local authorities have well developed systems and staff for assessment of Assistive Technologies for pupils; while provision in others is not as good. For example, the HMIe report on Education for Learners with Dyslexia notes that "Parents and children identified considerable variation in provision for dyslexia support."[3]

Candidates who will use Assistive Technology in assessments clearly must be skilled in its use, and staff (subject, support for learning and technical) must be aware and have expertise to support the pupils.

Therefore, the successful use of Assistive Technologies in assessments requires:

- ***Pupils with the necessary ICT and keyboarding/access skills.*** This means that pupils will need access to appropriate Communication and Assistive Technology, and also teaching in its use.
- ***Access to ICT and Assistive Technology.*** Learners need to have access to desktop or more usually laptop or netbook computers with appropriate Assistive Technologies, if necessary. Pupils with communication impairment may require personalised voice output communication aids. Assessment of appropriate Communication and Assistive Technologies requires knowledge, skill and experience to avoid provision of ineffective and expensive resources.
- ***Accessible school ICT***. Most schools have 'managed' ICT resources, where installation and configuration of software is undertaken by dedicated ICT support staff. Some authorities contract out ICT support services to commercial providers. Managed services are quite rightly protected to prevent installation of unwanted or harmful software, but this can cause difficulties and delays when learners need specialist software to be installed.
- ***Staff awareness and expertise***. School staff need to be aware of how Assistive Technology can support pupils' learning, and how to teach and support learners. Much remains to be done in this regard: the same HMIe report notes that "there was considerable scope for all teachers to learn about the full range of ICT available to support children and encourage independence." [3]

[3] HMIe 2008 Education for Learners with Dyslexia. ISBN 978-0-7-53-1148-9. www.hmie.gov.uk

Mapping support needs and disability to ICT

Table 3 summarises how different ICT tools and methods can support pupils with different support needs and disabilities. Table 3 is not a formulaic assessment tool for determining exactly which ICT tools will benefit which learners. Some tools and techniques benefit candidates with different support needs and underlying disabilities, while not all support tools will assist candidates with the same support need. Digital papers, for example, may be of benefit to many candidates with dyslexia, learning difficulties, visual impairment, hearing impairment, language difficulties and physical impairments, but not all candidates with these difficulties will benefit from using a digital paper for every assessment. It is also important to ensure that ICT does not provide the learner with an unfair advantage over other candidates during the assessment.

When considering the use of ICT (or any other method of support) in assessments, the support needs of the learner and the purpose and nature of the assessment must be considered on an individual basis.

Table 3: Mapping support need, disability and ICT support

Candidates with...	due to...	might need...
difficulty reading the assessment	dyslexia, or other specific learning difficulty	Digital Question Papers and Assessments with: • appropriate font / size / colour / line spacing • screen mask / ruler software • text reader software • audio recording of questions inserted into the digital assessment Audio recording of the assessment text/questions
difficulty writing or spelling	dyslexia, dyspraxia or other specific learning difficulty	Digital Question Papers and Assessments and/or word processor with: • on-screen question and answers • appropriate font / size / colour / line spacing • screen mask / ruler software • text reader software • spellchecker • Autocorrect (automatic spelling correction) • word prediction • word banks • speech recognition software • voice recording into the digital assessment or word processor • scribe to type dictated answers into the digital assessment or word processor Voice recording with tape or digital recorder Planning / mapping / outlining software
difficulty seeing and reading the assessment	visual impairment	Digital Question Papers and Assessments with: • appropriate font / size / colour / line spacing • screen mask / ruler software • text reader software • screen reader software • screen magnification software • audio recording of questions inserted into the digital assessment Audio recording of the assessment text/questions Portable magnification systems such as camera, handheld magnifier or Closed Circuit Television system

Candidates with...	due to...	might need...
difficulty writing or recording	visual impairment	Digital Question Papers and Assessments and/or word processor with: • on-screen question and answers • appropriate font / size / colour / line spacing • screen mask / ruler software • text or screen reader software • spellchecker • Autocorrect (automatic spelling correction) • word prediction • word banks • speech recognition software • voice recording into the digital assessment or word processor • scribe to type dictated answers into the digital assessment or word processor Voice recording with tape or digital recorder Talking scientific calculator
difficulty seeing and reading the assessment	no sight	Digital paper with modified content designed for screen reader with: • screen reader software • audio recording of questions inserted into the digital assessment Audio recording of the assessment text/questions Raised diagrams
difficulty writing or recording	no sight	Digital paper with modified content designed for screen reader and/or word processor with: • on-screen question and answers • Braille display • Braille keyboard • Spellchecker • speech recognition software • voice recording into the digital assessment or word processor • scribe to type dictated answers into the digital assessment or word processor Talking scientific calculator Voice recording with tape or digital recorder
difficulty with physically navigating and accessing the assessment	physical / motor disability	Digital Question Papers and Assessments with: • complete access and navigation using keyboard or mouse • appropriate font / size / colour / line spacing • text reader software • standard keyboard and mouse • alternative keyboard or pointing device, switch access or other Assistive Technology • helper to navigate the digital paper

Candidates with...	**due to...**	**might need...**
difficulty physically writing or recording	physical / motor disability	Digital Question Papers and Assessments and/or word processor with: • on-screen question and answers • appropriate font / size / colour / line spacing • text reader software • spellchecker • Autocorrect / abbreviation expansion • word prediction • word banks • speech recognition software • voice recording into the digital assessment or word processor • standard keyboard and mouse • alternative keyboard or pointing device, switch access or other Assistive Technology • on-screen keyboard • scribe to type dictated answers into the digital assessment or word processor Computer & drawing/CAD with/without the above Voice recording with tape or digital recorder Planning / mapping / outlining software
difficulty reading the assessment	learning difficulties	Digital Question Papers and Assessments with: • appropriate font / size / colour / line spacing • screen mask / ruler software • text reader software • audio recording of questions inserted into the digital assessment • symbolised questions Symbolised printed question paper Audio recording of the assessment text/questions
difficulty writing or recording	learning difficulties	Digital Question Papers and Assessments and/or word processor with: • on-screen question and answers • appropriate font / size / colour / line spacing • screen mask / ruler software • text reader software • spellchecker • Autocorrect (automatic spelling correction) • word prediction with/without symbol support • onscreen word or symbol banks • voice recording into the digital assessment or word processor • scribe to type dictated answers into the digital assessment or word processor Voice recording with tape or digital recorder
difficulty reading the assessment	hearing impairment	Digital Question Papers and Assessments with: • text reader software.

Candidates with...	**due to...**	**might need...**
difficulty writing or recording	hearing impairment	Digital Question Papers and Assessments and/or word processor with: • on-screen question and answers • appropriate font / size / colour / line spacing • text reader software • spellchecker • Autocorrect (automatic spelling correction) • word prediction • word banks • voice recording into the digital assessment or word processor • scribe to type dictated/signed answers into the digital assessment or word processor Voice recording with tape or digital recorder Planning / mapping / outlining software
difficulty reading the assessment	speech, language or communication impairment	Digital Question Papers and Assessments on computer or on the candidate's AAC device with: • appropriate font / size / colour / line spacing • screen mask / ruler software • text reader software • audio recording of questions inserted into the digital assessment • symbolised questions • helper to navigate the digital paper
difficulty writing or recording	speech, language or communication impairment	Digital Question Papers and Assessments and/or word processor with: • on-screen question and answers • appropriate font / size / colour / line spacing • screen mask / ruler software • text reader software • spellchecker • Autocorrect (automatic spelling correction) • word prediction with/without symbol support • standard keyboard and mouse • alternative keyboard or pointing device, switch access or other Assistive Technology • on-screen keyboard • onscreen word or symbol banks • voice recording into the digital assessment or word processor • direct input to digital assessment/computer from the learner's AAC device • Communication Facilitator and/or scribe to type spoken answers from the AAC user into the digital assessment or word processor
difficulty speaking or responding verbally	speech, language or communication impairment	AAC system with/without Communication Facilitator

SECTION 2: ASSISTIVE TECHNOLOGY

'Mainstream' computers and word processors

A computer (netbook, laptop or desktop) is the most common type of assistive technology hardware used in schools and colleges. Computers are available in a very wide variety of shapes and sizes and there are many access tools and assistive software programs to enable access by pupils with a very wide range of disabilities. It is not appropriate to describe all the devices that are available and so we summarise the main classes here before exploring particular assistive and communication technologies in later sections.

Desktop computers

Desktop computers are available in all schools in Scotland. In secondary schools, most subject classes will have one or two machines, and suites are usually available in Business Studies, Computing and Support for Learning Departments. Provision and access to these machines varies between different schools. The accessibility of desktop computers also varies: some local authorities have well-developed policies and strategies and may have, for example, authority-wide licences for assistive software or may have installed assistive software on all their machines (for example, *WordTalk*[4], for reading Word files). Some local authorities have not followed Scottish Government guidance in terms of implementing accessibility strategies[5] and do not make their machines as readily accessible.

Laptops

Laptop computers offer a more portable and often more personal tool for accessing the curriculum. Pupils can carry laptops to different classes and use them at their own desks instead of having to use desktop machines which are often located at the back of subject classes, or only access machines in suites out with subject classes. Some schools and local authorities provide laptops for individual pupils; others have a bank of machines that can be booked out.

Laptops must be able to access the school network and it must be possible to configure the accessibility options and to install assistive hardware and software.

Netbooks

Netbooks are proving very popular in secondary schools because they are smaller, lighter, cheaper and generally more practical than standard laptops. Netbooks do not cope well with resource-hungry applications such as speech recognition software, but are excellent for most general writing and recording purposes. Procurement Scotland[6] has negotiated favourable discounts on Toshiba netbooks and we believe that these devices will become more and more common in schools.

Figure 1: Toshiba NB300 netbook

There is anecdotal evidence from some local authority staff that pupils are increasingly using their own personal netbooks and mobile devices in school. This trend may increase, given the expected cuts in public sector budgets, and may raise issues regarding security (see below) in assessments.

[4] *WordTalk*, the free text-to-speech reader for Microsoft Word, http://www.WordTalk.org.uk

[5] *Planning to Improve Access to Education for Pupils with Disabilities; Guidance On Preparing Accessibility Strategies*. http://www.scotland.gov.uk/library5/education/gpas-00.asp

[6] http://www.scotland.gov.uk/Topics/Government/Procurement/directory/IThardware/achievements

AlphaSmart

Figure 2: AlphaSmart Neo

AlphaSmarts are very common in most schools in Scotland because of their light weight, size, long battery life, low cost and simplicity. They offer basic word processing and can be extremely effective for students who can use a standard keyboard and who require a simple note-taking device. Most secondary schools have (or should have) a stock of AlphaSmarts for use by pupils. The screen and font size is relatively small, screen contrast is limited, and there are fewer options for spellchecking, word prediction and text-to-speech than netbooks or laptops. Because of this, AlphaSmarts are less suitable for pupils with significant physical and visual impairments or those with significant reading difficulties.

Smartphones, iPods, tablets, eBook Readers and other handheld devices

Smartphones, tablets and other handheld portable ICT devices such as the iPod Touch and iPad have considerable potential for learning and assessment in schools. Most learners own mobile phones; many possess Smart Phones or other devices with Wi-Fi, and therefore have access to the internet or potentially, school intranets. These devices can therefore be used both to access digital learning resources and assessments digitally.

The small physical size of screen and keyboard on Smartphones limits accessibility for learners with disabilities: the maximum font size is constrained by the size of the screen; learners with physical disabilities may not be able to use the device, and options for alternative physical access are limited, compared to netbooks or tablets.

Figure 3: iPad

Tablet computers have been available for many years but the advent of Apple iPad and similar devices appear to have great potential benefits for learners with additional support needs and disabilities. The tablets have larger screens which are more accessible for pupils with visual or perceptual difficulties; they have text-to-speech (albeit of variable functionality and quality); and the ever-increasing number of low cost 'Apps' offers a huge range of activities and options.

Figure 4: Samsung Q1

At Islay High School[7], every student was provided with a Samsung Q1 device using School for Ambition funding. Apart from the positive benefits reported by staff and students, the school has reportedly saved 80% on photocopying costs (£20,000 per annum) because materials were distributed digitally[8] instead of on paper.

Figure 5: Amazon Kindle

EBook readers such as the Amazon Kindle or Sony devices are becoming more popular and while they offer limited functions (reading eBooks) compared to the iPad, for example, they are of relevance for learners with disabilities. The devices have 'e-ink' screens which many people find less tiring than computer screens; they can display relatively large fonts; and they have built-in text-to-speech. EBook readers are not (yet) particularly relevant for assessment, but they are contributing to the general shift from paper learning resources to digital.

Which disabled candidates might need mainstream ICT?

Mainstream ICT has huge potential to enable candidates with *all* type of disabilities to demonstrate their knowledge and understanding more independently and effectively.

Pupils with disabilities do not necessarily require specialist assistive technology in assessment contexts: Windows[9] and MacOS[10] computers all have Accessibility Options and features to adjust, for example:

[7] Islay High School http://www.futurelab.org.uk/resources/publications-reports-articles/web-articles/Web-Article903

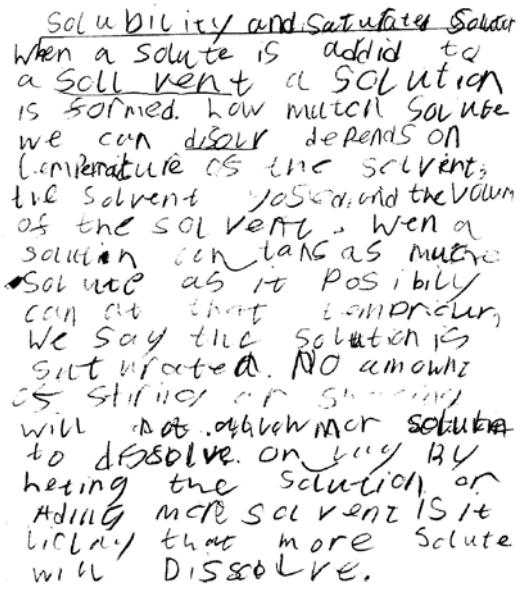
[8] Islay High School http://www.guardian.co.uk/education/2008/jan/08/link.link2

[9] Windows XP Accessibility Options http://www.microsoft.com/windowsxp/using/accessibility/default.mspx

- mouse speed and size of the pointer;
- keyboard response and repeat rate;
- font size and colours;
- window and icon sizes and colours.

Many pupils with visual, physical, learning or reading difficulties can use ordinary computers or devices with a standard word processor such as Microsoft Word. For example:

- Candidates who experience pain or fatigue when handwriting may be able to write more, faster and with less effort by using a keyboard.
- Candidates can more easily edit and correct errors and so produce higher quality work as a result.
- Candidates with very poor handwriting can produce more legible work with a computer (benefitting both markers and the pupil, who is able to read their own work more easily).
- Candidates with dyslexia or reading difficulties can use built-in support tools such as spellchecker and AutoCorrect (where permitted – see Spellcheckers).



Solubility and Saturated Solution

When a solute is added to a solvent a solution is formed. How much solute we can dissolve depends on temperature of the solvent, the solvent yosed and the volume of the solvent. When a solution contains as much solute as it possibly can at that temperature, we say the solution is saturated. No amount of stirring or shaking will allow more solute to dissolve. Only by heating the solution or adding more solvent is it likely that more solute will dissolve.

Figure 6: A comparison of handwritten and word-processed / spellchecked work by a dyslexic student

- Learners with visual impairment can use zoom and magnification facilities built into the computer and the word processor to enlarge the text (Figure 7).

Web layout wraps the text to fit the screen at high levels of magnification

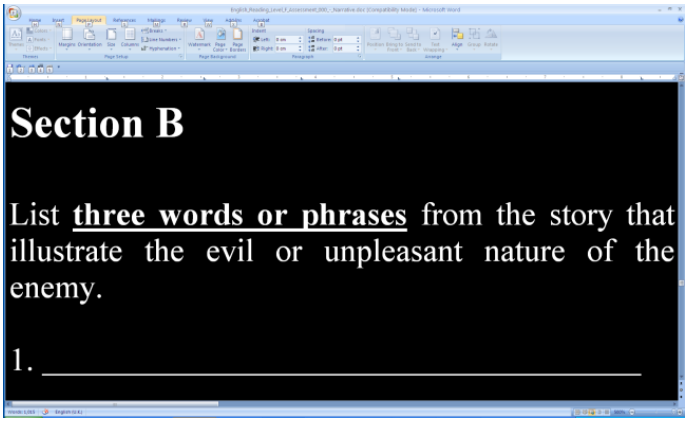


Figure 7: 5-14 Level F Reading assessment viewed in Microsoft Word Web Layout @ 500%, high contrast

[10] Apple Accessibility, http://www.apple.com/accessibility/

- Candidates with visual/perceptual difficulties can adjust font, font size, font colour, and background colour.
- Candidates with visual impairment or reading difficulties can use text-to-speech tools built in to the software or the operating system to read assessment materials.
- Candidates can use navigation tools such as the Document Map (Microsoft Word) or Bookmarks (Adobe PDF, Figure 8) to view the structure of digital assessments, and their own work, and navigate quickly between sections.

A pupil can click on the Bookmark and jump to a particular section. Bookmarks also help to see the structure of the book's contents.

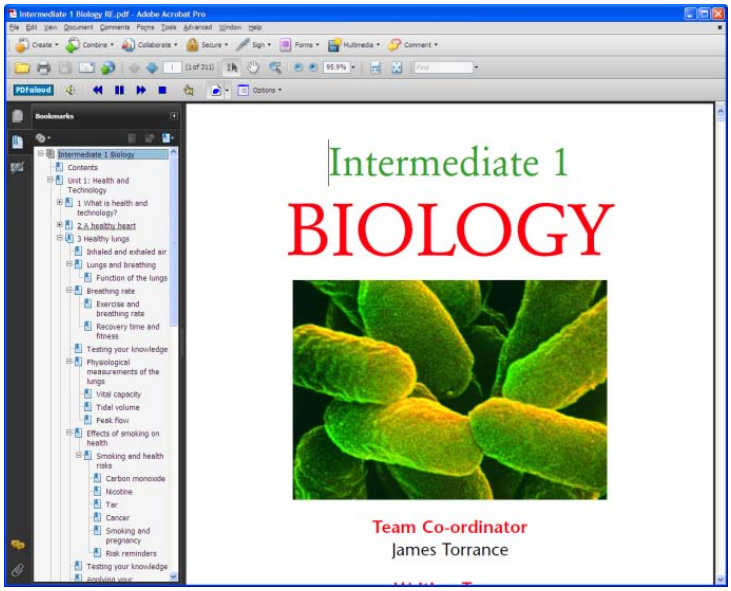


Figure 8: Hodder Gibson textbook, showing bookmarks for quick navigation[11]

Mainstream computers also have other access tools, such as basic built-in text-to-speech, screen magnification and on-screen keyboards. In most cases, these are quite limited and better tools are available as third-party software or utilities.

What is the current understanding among stakeholders regarding use of mainstream ICT in assessments?

SQA Assessment Arrangements have included the use of ICT and word processors by candidates with disabilities or additional support needs for many years[12] and consequently understanding among stakeholders is relatively good.

The use of ICT in SQA assessments has been increasing over recent years, particularly since the introduction of Adapted Digital Papers in 2008. In 2011, there were 9,135 requests for the use of ICT in external assessments, which represents 17% of the total number of requests. The number of requests for use of ICT in examinations has almost quadrupled in the past six years (Table 4).

Table 4: Comparison of requests for scribes and ICT

Number of requests	2006	2007	2008	2009	2010	2011
Requests for ICT inc digital papers	3,063	3,560	4,741	6,253	7,622	9,135
Requests for scribes	15,046	14,121	14,811	14,197	14,313	14,962
Requests for ICT (% of total requests)	7.1%	8.4%	10.7%	13.7%	15.7%	17%
Requests for scribe (% of total requests)	34.7%	33.5%	33.4%	31.1%	29.6%	27.9%

[11] Hodder and CALL Scotland now have a scheme to distribute textbooks in accessible PDF for pupils with print disabilities, http://www.books4all.org.uk/Finding-Books/Books-from-CALL/About-the-Service/

[12] SQA 2010 Assessment Arrangements Explained, http://www.sqa.org.uk/assessmentarrangements

It is interesting that requests for scribes appear to be declining slightly as a proportion to the total number of requests, while the proportion of requests for use of ICT has increased (Figure 9 and Figure 10). This may suggest that use of ICT is replacing reliance on scribes.

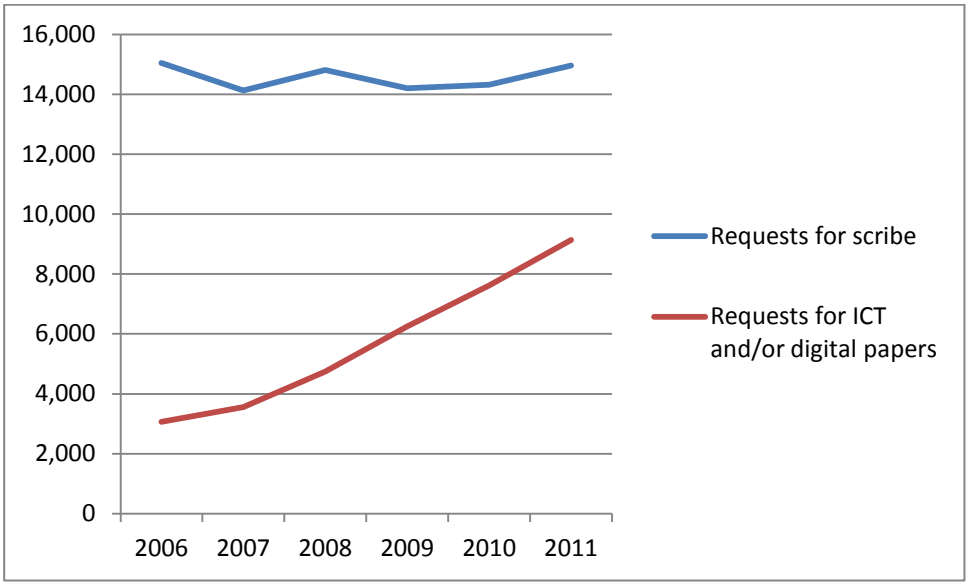


Figure 9: Number of requests for scribes and ICT

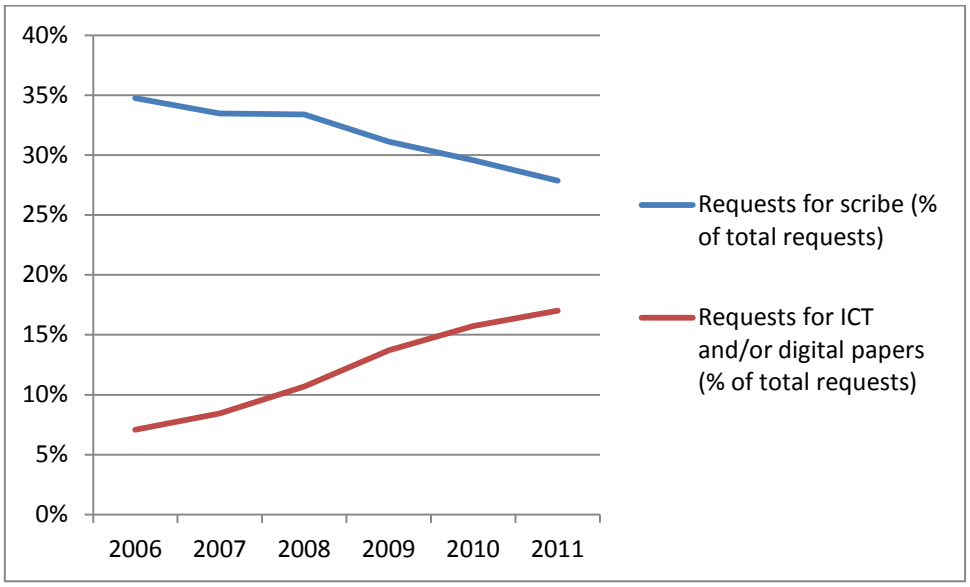


Figure 10: Scribes and ICT: percentage of total number of requests

Factors to consider regarding the use of standard computers and word processors in schools are:

- the candidate must have the necessary ICT and keyboard skills;
- security (i.e. the candidate should not have access to school networks, the internet or to other devices such as USB memory sticks or Bluetooth mobile phones);
- the computer must be configured with any Accessibility Options or assistive software required by the candidate;
- the need for separate accommodation, if the use of ICT will distract other candidates;
- appropriately trained staff and invigilators.

SQA provides guidance on the use of ICT in assessments and this is available on the SQA web site.

Digital Question Papers

In 2010 SQA received 16,554 requests for the use of a reader, and 14,197 requests for a scribe. Given that more pupils therefore need personal support to read the paper than to write their answers, it is important to consider how ICT can be used to help candidates read and access the question papers as well as record a response.

Digital question papers were first researched and evaluated by CALL Scotland, on behalf of SQA, in 2004[13]. The results were promising and in Autumn 2005 CALL and SQA created a bank of digital past papers from 2003, 2004 and 2005 for students and schools to use for practice and revision. Trials using the digital past papers went well, and 31 students went on to use digital papers in 65 examinations in May/June 2006[14]. These pilot trials were very successful: the papers themselves were reliable; staff and students were enthusiastic; and results obtained were in line with other support methods.

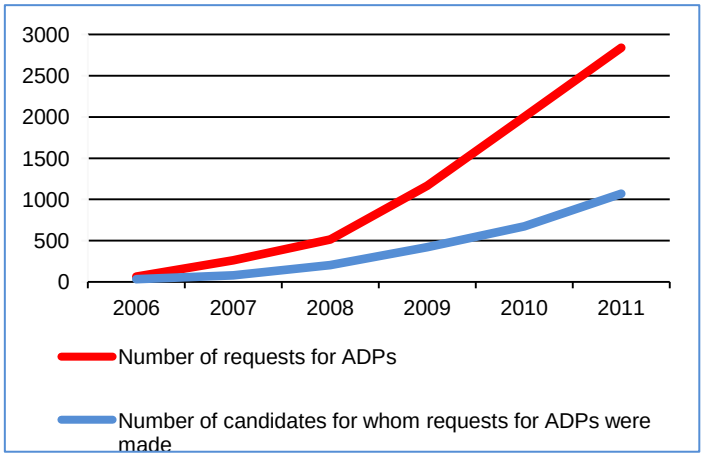


Figure 11: Requests for Digital Papers 2006-2010

The pilot was repeated on a larger scale in 2007[15], with 80 candidates from 12 centres making 265 requests for digital papers. Again, results and feedback from pupils and centres were very encouraging and so in 2008[16], SQA offered Digital Question Papers as an Assessment Arrangement for any candidate with disability and/or additional support needs. The number of requests for digital papers has increased almost four-fold over the past three years (Figure 11).

The Digital Question Papers are in Adobe PDF and candidates use free Adobe Reader software to access them. There are a range of options and features to enable access (Figure 12):

- the papers can be zoomed and re-sized;
- text and background colours can be altered;
- the text and questions can be read out using text-to-speech software;
- answers can be typed on screen (candidates can use any Assistive Technologies that can generate text, including speech recognition, on-screen keyboards, word prediction, etc);
- pupils click with the mouse or press the Space bar to 'tick' their answer in multiple choice questions;
- simple drawing tools are available.

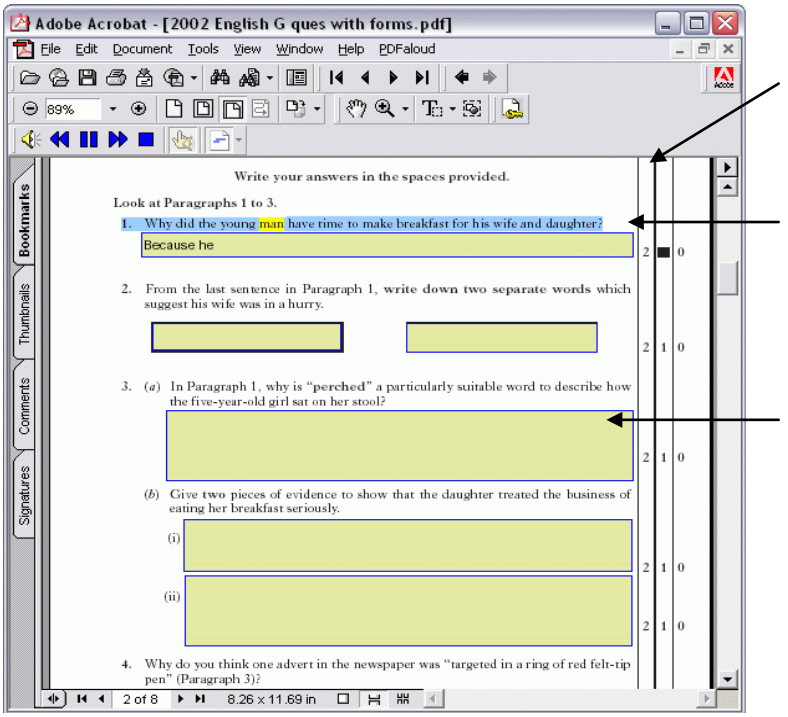
Only papers in 'question and answer' format have answer boxes for candidates to complete on-screen; to answer most Standard Grade Credit and Higher papers, which are not question-and-answer format, candidates use either a digital version of an answer booklet, or a word processor.

[13] Nisbet, P.D., Aitken, S., Shearer, N., (2004) *Trial of External Papers in Accessible PDF for Candidates with Additional Support Needs*. Project Report to SQA. CALL Centre, University of Edinburgh

[14] Nisbet, P., Shearer, N. Balfour, F., Aitken, S. (2006) *SQA Adapted Examination Papers in Digital Format: Feasibility Study 2005 – 2006: Final Report*. Submitted to Scottish Qualifications Authority. October 2006. CALL Centre. http://www.callcentrescotland.org/digitalexams/

[15] Nisbet, P.D. (2007) *SQA Adapted Examination Papers in Digital Format: 2007 Pilot Project Report*. Submitted to Scottish Qualifications Authority. September 2007. CALL Centre. http://www.AdaptedDigitalExams.org.uk

[16] Nisbet, P.D. (2009) *SQA Adapted Examination Papers in Digital Format: 2008 Report*. Submitted to Scottish Qualifications Authority. February 2009. CALL Centre. http://www.AdaptedDigitalExams.org.uk



The digital PDF is exactly the same as the printed paper, and can be magnified and re-sized; background and text colours can be changed.

PDFaloud reads out and highlights the text, for candidates with reading or visual difficulties

The candidate types answers on-screen.

Any tool that produces text can be used, such as word prediction, speech recognition, on-screen keyboard, IntelliKeys board, etc

PDF Standard Grade English Reading Paper

Figure 12: Screenshot of Digital Question Paper

Which disabled candidates might need Digital Question Papers?

Digital Question Papers are used by candidates with a range of difficulties. The largest groups of pupils are those with dyslexia or other specific learning difficulty (Figure 13).

Candidates with:

- physical disabilities or handwriting issues can use the computer, with or without additional assistive technologies, to write their answers on-screen;
- moderate visual impairment can magnify the screen or use text-to-speech to read the paper (this is in most cases satisfactory on a 15" screen for candidates who need up to N18 font size[17]);
- more severe visual impairment can use screen magnification software such as SuperNova Magnifier[18] or ZoomText[19];
- reading difficulties or dyslexia can change the font and background colours, and use text-to-speech software to read the paper;
- Asperger's Syndrome or those on the Autistic spectrum may be more comfortable using ICT than working with a reader/scribe;
- moderate learning difficulties in some cases seem more comfortable with the on-screen question and answer format.

The papers are digital versions of assessments which were originally designed to be completed on paper, and so some questions do not 'translate' well to the digital medium. For example, while questions that require

[17] Nisbet, P.D. (2009) Accessibility of SQA Adapted Digital Question Papers for Candidates with Visual Impairment. Report to SQA.

[18] Dolphin SuperNova Magnifier, http://www.yourdolphin.com/

[19] ZoomText, http://www.aisquared.com/

candidates to draw graphs, complete charts, or generate mathematical or scientific notation can be completed on screen, many candidates find it easier to draw these by hand on the paper copy.

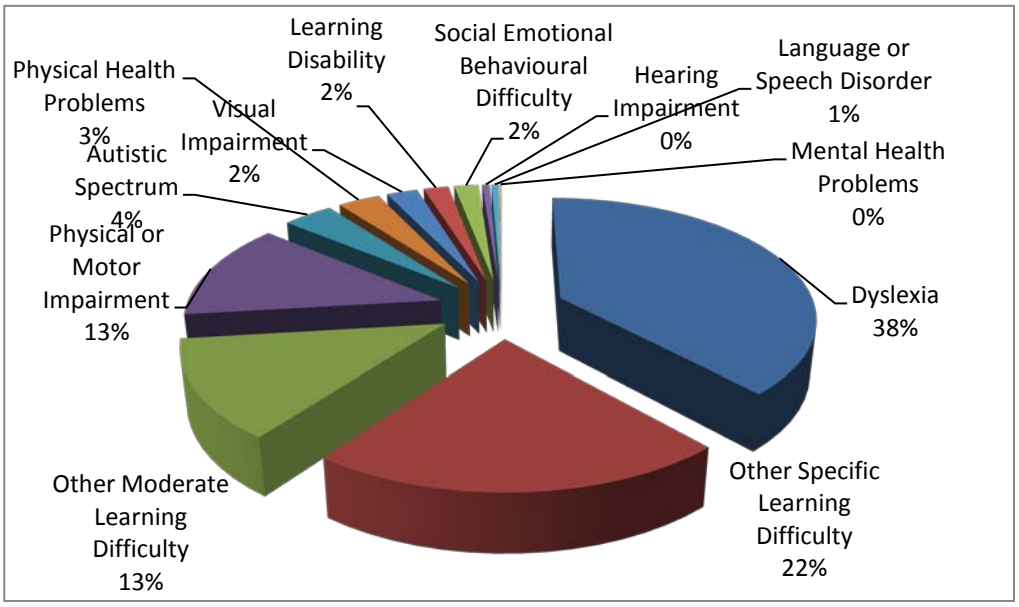
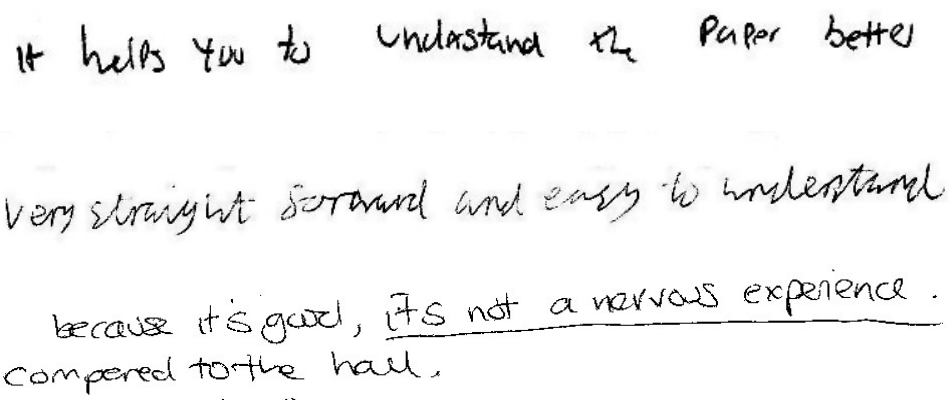


Figure 13: Digital Paper requests by pupil difficulty, 2010

Some feedback from candidates is given below.



Writing for long periods is painful. My writing is illegible - even to myself! It avoids the need for a scribe. I don't like using a scribe.

Easy to do. You can see both the questions and the text at the same time.

It is much easier to use than a reader

What is the current understanding among stakeholders regarding use of Digital Question Papers in assessments?

The rapid increase in the number of requests since the papers were introduced in 2008 indicates that understanding of the use of Digital Papers by centre staff is relatively good. CALL Scotland and SQA have comprehensive web sites with information and guidance, and CALL has delivered training and CPD both as part of the CALL CPD programme and also as Inset for schools and local authorities.

There are several reasons why schools and centres have adopted the Digital Question Papers. These factors are relevant to the use of other types of Assistive Technology and AAC in assessments and so are worth exploring here:

- the technology (PDF) appears to be reliable;
- costs are low – the papers can be accessed using free Adobe Reader software, and the recommended text-to-speech tool (PDFaloud) is £295 for a site licence;
- efficiency: fewer staff and rooms are required, compared to the current most common methods of support (reader/scribes);
- costs in terms of staff are therefore lower than for reader/scribes;
- candidates are more independent than when relying on reader/scribes;
- many (but not all) candidates prefer digital papers to other methods of support.

Although the Digital Question papers have been welcomed by candidates, centres and parents, it is however important to remember that they are one of many Assessment Arrangements available and the digital papers may not suit some pupils or some subject assessments. The papers are accessible to the majority of candidates, but there are some exceptions. For example:

- Some candidates lack the necessary ICT skills, or are not confident about using ICT.
- The Digital Papers are best suited to subjects where a text or multiple choice response is required: mathematical or scientific expressions cannot be easily typed into the digital papers on screen. Similarly, while it is possible to draw and create charts and graphs on the digital papers, the drawing tools are relatively crude and basic.
- The papers are not generally suitable for candidates with severe visual impairment or blindness who use screen reader programmes, such as Jaws[20] or SuperNova Screen Reader[21]. These candidates require digital text versions of the papers adapted to suit their needs.
- Students with more severe physical disabilities (for example, who use switches and scanning – see Scanning and switch access on p. 52) may not be able to access digital papers on their devices and may require a different digital format, or the paper adapted in some other way.

The success of the digital papers suggests that new assessments in National Qualifications at SCQF Levels 3, 4 and 5 should be available in this or another equally accessible and flexible digital format. There are however some areas in which improvements can be made to further include candidates with disabilities. These are:

- greater use of question and answer format which will allow interactive PDF assessments;
- use of desktop publishing or authoring software that can generate tagged, accessible PDFs, which will be more accessible for blind students;
- ensuring that all text can be read out with text-to-speech software if necessary (for example, text embedded in images cannot be read out).

[20] Jaws, http://www.freedomscientific.com/

[21] SuperNova Screen Reader, http://www.yourdolphin.com/

e-Assessment

SQA and other qualification bodies are exploring and investing in technologies for e-Assessment, and it is beyond of the scope of this report to review developments: refer to the documents on the SQA web site[22] for an up to date summary of the field. SQA already have e-Assessments available or piloted across a range of subjects and levels (e.g. SOLAR, Computing e-NABs, e-Portfolios) and plan to develop these further.

Which disabled candidates might need e-Assessment?

e-Assessment techniques are potentially accessible to all pupils with disabilities, provided *both* the e-Assessment (i.e. the web site) and the learner's personal access tool (i.e. the computer, the browser, and any other additional assistive technologies) are accessible. The features that comprise an accessible e-Assessment system will, perhaps not surprisingly, be similar to those already seen in Digital Question papers. Necessary facilities include:

- user adjustment of font, font size, font and background colour, and line spacing;
- keyboard shortcuts for all assessment tasks;
- option of large and talking menus and controls;
- text-reader for learners with reading difficulties and visual impairment;
- compatibility with screen magnification software for students with visual impairment;
- compatibility with screen reader software for blind users;
- option of embedded audio and video;
- option of recording spoken responses;
- option of symbolising text.

What is the current understanding among stakeholders as to e-Assessment?

SQA, as a key stakeholder, has developed and tested a number of e-Assessment tools and some of these are now in use by schools and centres. It is likely that staff in schools and centres, and learners and parents and other stakeholders are aware of e-Assessment but it is not clear whether educationalists understand and have expertise regarding its use, both in terms of administering e-Assessments provided by SQA or in designing their own for internal assessment. The accessibility of e-Assessments is also a key concern: it is essential that e-Assessments are accessible to all learners both to meet the aspirations of curriculum for excellence, and to fulfil legal obligations under disability equality legislation. It is important that SQA e-Assessment products maintain or improve the standards of accessibility set by, for example, Digital Question Papers.

[22] SQA E-assessment, http://www.sqa.org.uk/eassessment

Text-to-speech software

Text-to-speech is one of the most useful tools for enabling access to digital resources for students with disabilities. Text-to-speech software converts text on the computer screen into synthetic speech. There is a very wide range of tools available including basic text-to-speech tools built in to Windows and MacOS computers.

Text-to-speech programs require one or more synthetic voices to be installed on the computer: the text-to-speech program cannot function unless there is a voice installed on the computer. Windows and MacOS computers are usually supplied with two or three free voices, which are reasonably intelligible and generally have American accents. Higher quality voices in British English accents are supplied with the commercial text-to-speech programs, and pupils and students in Scottish schools and further education institutions can download Heather, a high quality voice with a Scottish accent, free of charge from CALL Scotland's web site[23].

Voice quality and accent are important factors for the accessibility of assessments in digital formats. The better voices are more pleasant and also more accurate in terms of pronunciation and intonation.

Text readers

Some programs are 'text-readers' (e.g. WordTalk[24], Read and Write Gold[32]) designed for candidates with reading difficulties while others are 'screen readers' (e.g. HAL[25], Jaws[26]). It is important to appreciate that text readers are quite different to screen readers: the former rely on the user having some sight, while screen readers are designed for blind users or those with significant visual impairment.

Text readers vary greatly in terms of functionality, quality and cost. Cost does not necessarily equate to effectiveness: WordTalk, for example, is free to download and is an excellent tool.

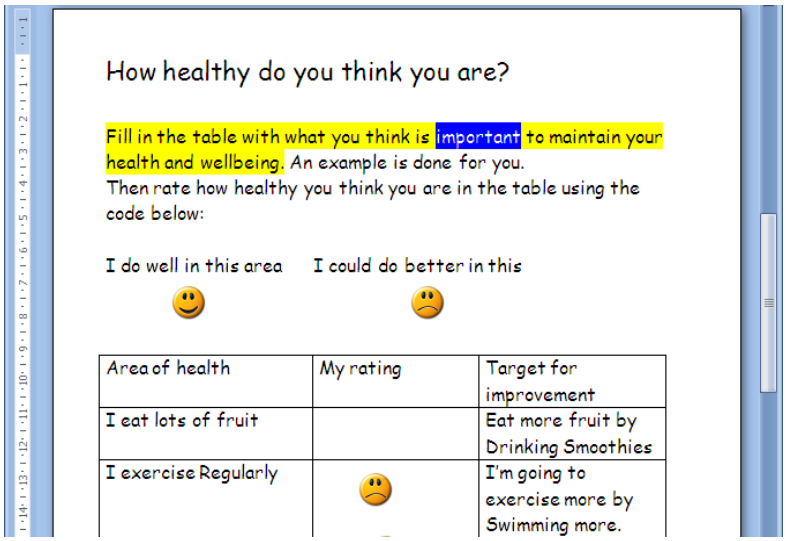


Figure 14: WordTalk reading an assessment sheet from Kirkcudbright Academy (from http://www.ltscotland.org.uk/assessmentexemplars/)

Generally speaking, the user clicks or selects text on screen, and then the text reader reads it out.

Most text-to-speech programs such as WordTalk and Read and Write Gold can read out the text sentence by sentence, and/or paragraph by paragraph, and highlight each word or sentence as it is spoken to help the reader to follow the text. Different programs can read from different applications: for example, WordTalk only

[23] Heather, the Scottish Voice, http://www.thescottishvoice.org.uk/

[24] WordTalk, http://www.wordtalk.org.uk/

[25] HAL, http://www.yourdolphin.com/productdetail.asp?id=5

[26] Jaws, http://www.freedomscientific.com/products/fs/jaws-product-page.asp

reads from Microsoft Word; PDFaloud (£295 site licence) only reads in Adobe Reader; ClickSpeak (free) only reads from the Firefox web browser; Read and Write Gold (£320 single user) and ClaroRead Plus[27] (£159 single user) can read from almost any program.

Adobe Reader, which is used to access the SQA Digital Question Papers, has a free built-in Read Out Loud text-to-speech facility, but it is quite basic and so CALL Scotland recommend PDFaloud, which costs £295 for a school licence through Learning and Teaching Scotland.

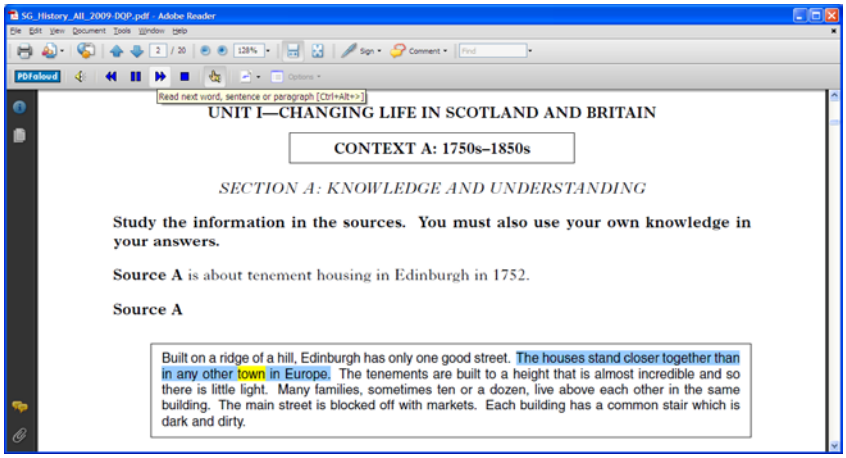


Figure 15: Standard Grade History paper read with PDFaloud

Figure 16: Revision web site accessed with Read and Write Gold

Screen Readers

Screen reader programs are relatively complex tools because they have to be capable of providing spoken access to a wide range of applications (word processors, spreadsheets, databases, web browsers, email etc) and file formats (DOC, PDF, etc) and also to convey spoken information about the layout and position of the elements on the screen. Consequently, most screen readers are relatively expensive, and users require training and support to become proficient in their use. The number of students who use screen readers is relatively small (reflecting the low incidence of blindness and significant visual impairment) compared to the number of users of text reader software.

Popular screen readers are Thunder[28] (free), Jaws[20] and SuperNova Screen Reader[21].

[27] ClaroRead, http://www.clarosoftware.com/index.php?cPath=355

[28] Thunder, http://www.screenreader.net/

Voice Output Communication Aids

A third use for text-to-speech is for personal communication using a voice output communication aid. Here, a person with a communication impairment uses text-to-speech to speak out messages that they have typed or constructed on a computer or an electronic communication device.

Which disabled candidates might need text-to-speech?

Candidates with dyslexia, reading difficulties, learning difficulties and visual impairment as well as some learners on the autistic spectrum and pupils with English as a second language use **Text Reader** software to read text from for example, textbooks.

Blind candidates or those with severe visual impairment use **Screen readers** to navigate the computer and read text.

Learners with communication impairment may well also use text-to-speech software on a **voice output communication aid**, for personal communication.

Text-to-speech tools not only help learners read the assessment; they also assist with the writing process. Candidates with reading and writing difficulties benefit from text-to-speech to review their work; to help identify spelling errors, and to improve grammar and sentence construction. Learners with sight loss may rely on text-to-speech while typing, for feedback and confirmation. Learners who use a communication aid may dictate to a scribe via their voice output device as their main means of writing.

What is the current understanding among stakeholders regarding use of text-to-speech in assessments?

Text-to-speech software for reading digital learning resources is becoming increasingly common in Scottish schools, due in part to the availability of free software such as WordTalk and the free Scottish voice. Stakeholders are in most cases aware of the technology and understand its use in assessments. However, human readers are still used far more often in external assessments than digital papers and text-to-speech. There are several possible reasons for this:

- some candidates find text-to-speech to be slower and less flexible than a human reader;
- some staff may think (in some cases correctly) that human readers provide better support and therefore that results will be superior;
- the use of a computer with text-to-speech program requires a reasonable level of ICT skill, and the ability to use keyboard, mouse or other access device;
- lack of awareness and expertise with the technology;
- habit: schools have used readers for many years and have processes in place.

Text-to-speech systems will occasionally mis-pronounce words or use unnatural intonation. However, it is not clear whether this is an issue in terms of comprehension: more research is required. The designers and setters of assessments require some understanding of this type of technology when creating the assessment, in order to make them accessible using text-to-speech tools. For example, text-to-speech software cannot read images and so it is important that any text that is to be read is rendered as text, not an image of text.

Text-to-speech software is not suitable for every candidate who has visual or reading difficulties, but it does enable candidates to work more independently than using a reader, it is a more useful life skill, and it is more efficient in terms of staff and accommodation, since several candidates can work in the same room with headphones rather than requiring separate rooms and individual readers and invigilators. Evidence from schools and centres that have introduced digital papers and text-to-speech software indicates that use of the technology increases year on year, once it has been made available.

Section 3 on Augmentative and Alternative Communication (p. 56) covers text-to-speech for communication.

Digital Assessments with embedded audio or video

At time of writing in 2011, SQA Digital Question papers can be read out by the computer, using text-to-speech software. This technology, coupled with the high quality Scottish computer voices available from CALL Scotland, can provide a means of access for many learners with reading and visual difficulties. An alternative method of using audio to support learners is to insert or embed audio (and/or video) recordings within assessments. Audio and video clips can be embedded into most digital formats including Microsoft Word, Microsoft PowerPoint, Adobe PDF, Textease and of course the world wide web.

SQA does not currently embed audio or video recordings and further research is required to determine how best to design assessments, which learners need the particular support, and the practical implications for examinations and assessments.

Which disabled candidates might need Digital Assessments with embedded audio or video?

Audio

Embedded audio recordings would be most helpful for candidates with reading difficulties or visual impairment, as an alternative to text-to-speech software. Audio recordings of text passages or questions could be inserted into PDF digital papers and assessments and the candidate would then can click on a button and listen to it. The advantage of this facility, compared to text-to-speech, is that the candidate can listen to a human voice rather than the synthetic voice. The disadvantages are that the learner has less control over the playback than he or she has with text-to-speech software, and it takes time to record and insert the narrations and prepare the assessment.

Video

Embedded video recordings would be most helpful for learners with hearing impairment who use sign language, but could also be useful for candidates with physical disabilities who have difficulty operating video players. Researchers at the Scottish Sensory Centre, CALL Scotland and Heriot Watt University are currently exploring embedded British Sign Language video in SQA digital papers.

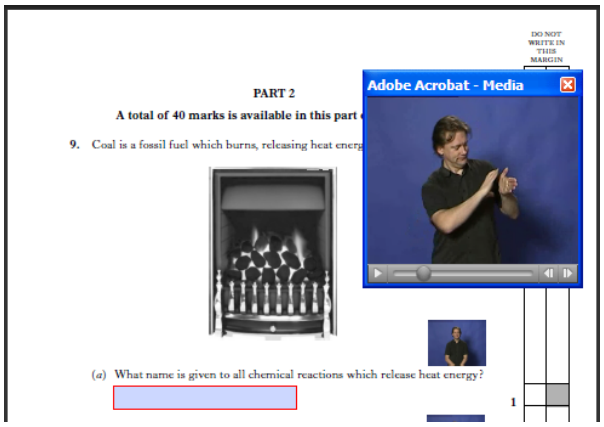


Figure 17: Standard Grade Chemistry paper with embedded BSL video translation

What is the current understanding among stakeholders regarding use of Digital Assessments with embedded audio and video?

Use of multimedia and audio resources to support learners with disabilities is becoming more common in schools and centres and users of SQA Digital Papers have suggested that audio recordings of text passages, and video recordings (for example of the video clips for Physical Education) might be beneficial. There are of course a number of issues to consider in assessment contexts: for example it may compromise an assessment of Close Reading in a modern language if the text passage is available as an audio recording and can be played back by the learner.

Spellcheckers

Next to a word processor, spellcheckers are one of the most useful tools for supporting pupils with disabilities when responding in assessments. Spellcheckers are available in two main forms: hand-held standalone devices, and as software programs either built in to a word processor or as a separate support tool.

Figure 18: A hand-held spellchecker and dictionary

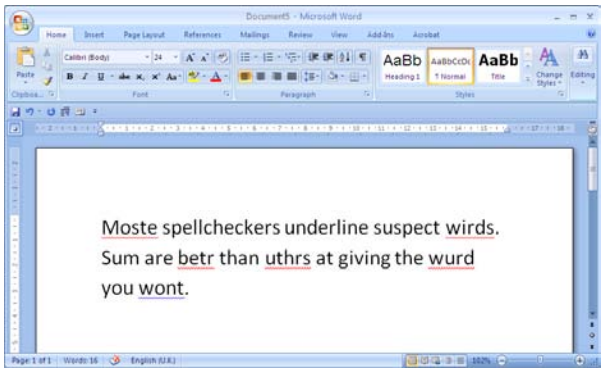


Figure 19: Microsoft Word spellchecker

Most spellcheckers, such as the one in Microsoft Word, underline or mark suspect words. This draws attention to words which are likely to be mis-spelt, but perhaps more importantly it helps confirm correctly spelled words: many dyslexic candidates waste time going over words which are correctly spelt.

Candidates with writing difficulties use spellcheckers because they:

- highlight possible mis-spellings and (may) offer correctly spelled suggestions;
- confirm correctly spelled words.

An electronic spellchecker works by comparing words typed with the words in its dictionary. If the word is not recognised, the spellchecker offers a list of likely alternatives. If the correctly spelled word is in the list, the writer either copies it down from the handheld spellchecker, or in the case of a computer, selects it by clicking with the mouse or via the keyboard.

If the spellchecker does not recognise the word, it does not necessarily mean it is wrongly spelled – it may just not be in the dictionary (as in names of people or places). Secondly, the checker may ignore words which are mis-spelled because they are homonyms – for example *sum* for *some*, *her* for *hear*, or *who* for *how*. Research suggests that 26% to 40% of spelling errors made by writers with spelling difficulties are not identified as an error by the spellchecker (MacArthur, 1996[29]), because they are homonyms. Some spellcheckers designed for writers with spellcheckers do check homonyms as well as mis-spelled words.

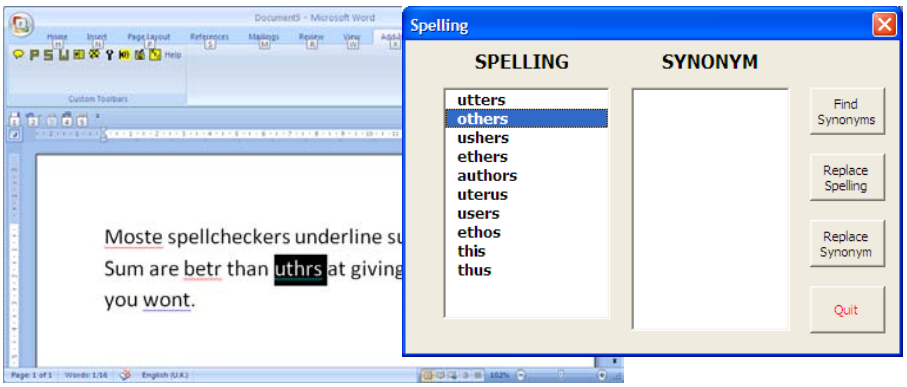
Spellcheckers vary in both the method of operation and their effectiveness. In one study (Nisbet et al, 1999[30]), twenty-two different spellcheckers were tested on their ability to offer the correct spelling for 150 mis-spelled words. The least effective checker could only offer the correct word for 35% of the errors, while the best

[29] MacArthur, A., Graham, S. Hayes, J. A. & De La Paz, S. (1996) *Spelling checkers and students with learning disabilities, Performance comparisons and impact on spelling.* The Journal of Special Education 30, 1, 35-57.

[30] Nisbet, P.D., Spooner, R.W.S., Arthur, E., Whittaker, P. (1999) Supportive Writing Technology. Ed. Nisbet, P.D. CALL Centre, University of Edinburgh, ISBN 1 898042 13 6

managed over 70%. According to a study by James and Draffan[31], the Microsoft Word spellchecker can identify and correct most (over 94%) of simple errors but is less effective when dealing with more severe errors of the type made by many writers with dyslexia. Specialist programs such as Read and Write Gold[32] and Ghotit[33] are more effective in these situations.

Assuming the spellchecker does offer the correct word, the writer must be able to identify it in the list. Some pupils with reading or word recognition difficulties have difficulty choosing the correct word from the list and benefit from having the word read out by the computer. A good option here is Rod Macaulay's WordTalk program which is free from CALL Scotland (www.WordTalk.org.uk).



A candidate may not always be able to identify the correct spelling in the spell checker window, so some programs (e.g. WordTalk, Read and Write Gold) can speak out the words in the spell checker list.

Figure 20: WordTalk talking spellchecker

Because spellcheckers:

- may ignore homonyms;
- do not always offer the correct spelling for an error;
- and the candidate may not identify the correct word in the list offered by the checker;

only a proportion of spelling errors will be corrected. MacArthur reported that just 36% of the writers' errors were successfully corrected by using a spellchecker.

However, 36% is better than 0%, and next to a word processor, a spellchecker is the most basic tool used by candidates with specific spelling difficulties.

Another study found that use of spellcheckers by students with spelling difficulties resulted in significant reductions in the number of spelling errors, but spelling accuracy was still not comparable to work by students[34] who do not have spelling difficulties.

Which disabled candidates might need spellcheckers?

Most writers benefit from using a spellchecker but candidates who benefit most are those with spelling difficulties.

What is the current understanding among stakeholders regarding use of spellcheckers in assessments?

Since most candidates who are handwriting in assessments do not have access to spellcheckers, SQA's policy is that "all software such as spellchecks, predictive software etc, must be disabled, unless it has been approved

[31] The Accuracy of Electronic Spell Checkers for Dyslexic Learners, http://www.dyslexic.com/spell-checker-accuracy

[32] Texthelp Read and Write Gold, http://www.texthelp.com/page.asp?pg_id=1263

[33] Ghotit Spellchecker, http://www.ghotit.com/home.shtml

[34] McNaughton D, Hughes C, Clark K. (1997) The effect of five proofreading conditions on the spelling performance of college students with learning disabilities. Journal of Learn Disabilities, 1997 Nov-Dec;30(6):643-51.

by SQA."[35] Spellcheckers and word prediction are regarded as 'linguistic support', like readers and scribes, and so can only be used by learners who have a specific spelling or language difficulty due to, for example, dyslexia, and where poor spelling is likely to impact on their ability to demonstrate their knowledge and skills.

Centres can request to use spellcheckers or other tools that support reading or writing in any subject apart from the assessment of writing in Modern Languages and Gaelic because "the overall quality of the written language, particularly spelling accuracy, is being assessed"[2].

Although this guidance from SQA is readily available, feedback and questions from staff at CPD sessions run by CALL suggests that the policy on use of spellcheckers is not always well understood by staff in schools, and so clearer guidance may be helpful.

Since spellcheckers and other linguistic support tools may not be permitted for some learners, one practical issue is disabling them so that they cannot be used. It is possible to switch off access to the spellchecker in Microsoft Word, for example, by using Options and Tools, but if a pupil knows how, they can be switched back on. There are more permanent techniques that involve removing the Proofing Tools completely or renaming the dictionaries, which require technical expertise. Another alternative is to use a text editor without spellchecking facilities.

[35] SQA 2008, Assessment Arrangements Explained, p.8, http://www.sqa.org.uk/assessmentarrangements

AutoCorrect (Automatic Spelling Correction)

Some programs (e.g. Microsoft Word and Texthelp Read and Write) have a facility to correct a spelling or typing mistake automatically. The mis-spelling and correct spellings are added to a dictionary and the program replaces the error, as it is typed, with the correct spelling. AutoCorrect suits writers who make consistent spelling mistakes - for example, always spelling *enough* as *enuf* or *anuf*. It can also be used to correct idiosyncratic errors such as *yooshaly* (*usually*) which may not be recognised by the spellchecker.

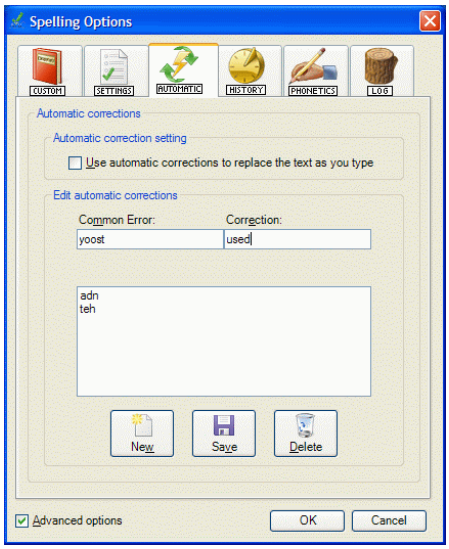


Figure 21: Read and Write Gold AutoCorrect

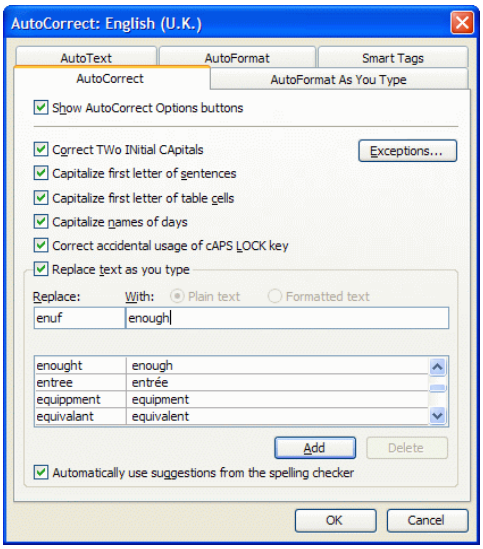


Figure 22: Microsoft Word AutoCorrect

Some dyslexic candidates have no problems spelling common words but have great difficulty in correctly spelling longer words of several syllables, or technical or topic-specific words, such as *constitution*, *parliament*, *photosynthesis*, etc. Often, because the word is complex, standard spellcheckers cannot offer the correct spelling and auto-correct is not suitable because the candidate makes different attempts each time the word is attempted. In this case, the words can be added to the dictionary under a short abbreviation (for example, cn. for *Constantinople*, br. for *Brontosaurus*) so that when the writer types the abbreviation, the word is inserted, correctly spelled, into the text. This technique works well although it does require the candidate to remember abbreviations for all the words, and so there is a limit to the number of words that can be abbreviated.

Which disabled candidates might need AutoCorrect?

AutoCorrect is helpful to most users or word processors but can be particularly helpful for candidates with persistent spelling difficulties and who have an understanding of their difficulty and how to address it using this type of tool. Correctly spelled words have to be added to the AutoCorrect dictionary by hand, and usually built up over an extended period of time.

AutoCorrect is also useful for learners who are less accurate typists.

Use of AutoCorrect for abbreviation expansion can be helpful for candidates who have physical disabilities because it reduces the number of keystrokes required for writing.

What is the current understanding among stakeholders regarding use of AutoCorrect in assessments?

Although AutoCorrect part of Microsoft Word, it is not a commonly used tool compared to the standard spellchecker. This may be partly because of a lack of awareness, but it is also because of issues setting up and accessing the AutoCorrect dictionary on school managed networks.

Thesaurus, dictionary and research tools

Most standard word processors have electronic thesaurus, dictionary and research facilities. Similar tools are also offered by specialist programs for learners with spelling or language difficulties, such as Read and Write Gold and ClaroRead. The main advantage of the latter is that they have text-to-speech facilities to read out the definitions. Read and Write Gold also has useful 'Fact Finder' and 'Fact Mapper' features which learners can use to collect and organise information from the internet.

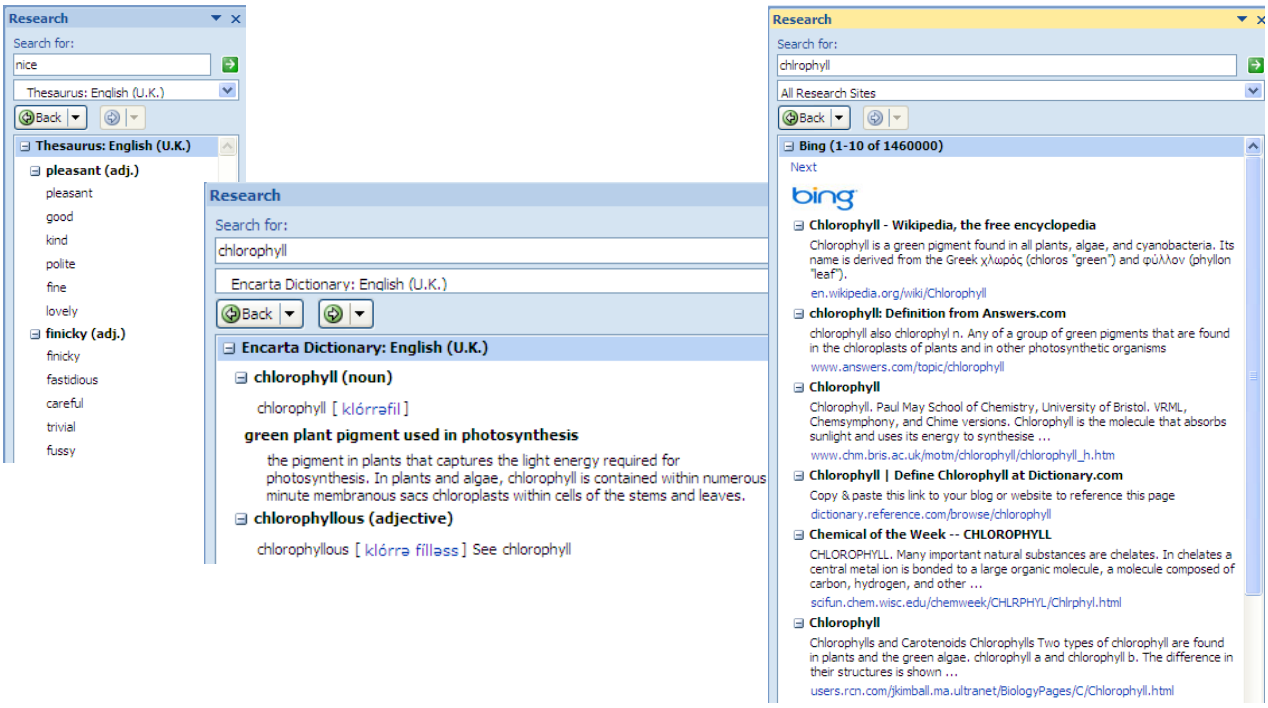


Figure 23: Microsoft Word Thesaurus, Dictionary and Research tools

Which disabled candidates might need thesaurus and research tools?

Thesaurus, dictionary and research tools are useful for all learners including those with disabilities. They are particularly helpful for pupils who have difficulties with language or vocabulary.

What is the current understanding among stakeholders regarding use of thesaurus and research tools in assessments?

Evidence from participants on CALL Scotland CPD courses suggests that many staff and pupils are unaware of the research tools that are available in mainstream word processors such as Microsoft Word. However, given that most stakeholders are aware of the issues in assessment with other support tools, such as spellcheckers, it should be clear to most stakeholders that there are also issues regarding the use of these tools in assessments. The research tool, for example, could give pupils a clear advantage in an assessment. It would therefore be necessary to prevent access to the internet (so that the dictionary and research tools will not work) and to remove the Proofing Tools using the Word installer so that the Thesaurus does not work.

Word banks

Word banks are lists of words or phrases presented on screen. The learner selects an item with the mouse, keyboard or switch, and the word or phrase is typed into the word processor or added to a phrase to be spoken out by the computer or communication aid. Most word bank programs have speech output so that the writer can listen to the word to confirm it is the correct one, before selecting it.

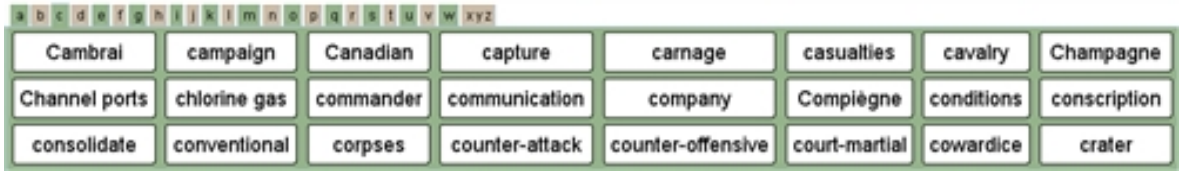


Figure 24: WriteOnline Wordbar for writing about the Western Front

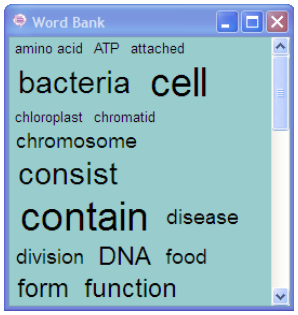


Figure 25: Co:Writer 6 Biology Word Bank

Some writing programs (e.g. Textease, Clicker 5 and WriteOnline) are word processors with built-in word bank facilities, while others, such as Co:Writer, work alongside standard word processors. Text-based and mixed symbol & text based communication aids (see Communication Technology ('High Tech' AAC) usually have word and phrase banks so that users can generate common language quickly and easily.

Which disabled candidates might need Word Banks?

Writers with spelling difficulties can use word banks to write longer or more difficult words. The word bank can also help to generate ideas, encourage the use of new vocabulary and can remove anxieties about spelling.

Candidates with difficulties in spelling, or physical difficulties resulting in slow laborious typing, can work faster by selecting whole words or phrases.

Candidates with speech and language difficulties who use text-based voice output communication aids benefit greatly from word and phrase banks to increase rate of communication.

The use of word banks in assessments requires careful consideration because some candidates may be given an advantage in the assessment. For example, if the word bank acts as an aide-memoire rather than helping the learner to overcome specific issues with spelling or fatigue, then it may not be reasonable or acceptable to use it in the examination. In these cases, other tools such as spellcheckers or word prediction may be more suitable.

What is the current understanding among stakeholders regarding use of Word Banks in assessments?

Word and Phrase banks, or other methods of text storage and retrieval, raise a number of issues in assessment contexts. There is mixed understanding among key stakeholders.

Disabled candidates with spelling or language difficulties

Tools for writers with spelling and language difficulties increasingly provide word banks alongside other tools such as word prediction, and their use is becoming more commonplace in the classroom.

Key stakeholders may have concerns about whether this type of support is acceptable in assessment contexts because clearly word banks may 'prompt' the learner to choose a term as well as ensure that it is spelled correctly.

If we regard word banks as another type of linguistic support, then it could be argued that word banks are not giving any greater support than would be provided by a scribe. To use a word bank successfully, the candidate must be able to find and identify the correct word from the bank, which for many candidates is more challenging than dictating to a scribe.

However, if a candidate uses word banks to, for example, organise terminology and aid categorisation, or create lists of quotations for use within History or English, then this may confer an unfair advantage and the word banks should not be used in the assessment.

Candidates with physical disabilities and/or communication impairment

There are different issues when word banks are being used by candidates with significant physical and/or communication impairments.

Consider a learner with for example quadriplegic cerebral palsy who uses an eye-gaze access system such as a MyTobii P10[36] (Figure 26). The user looks at items on the screen (which may be letters, words, phrases, pictures or symbols), the device tracks the focus of the gaze and the item is selected as though the user had clicked with a mouse. The learner can generate text letter by letter, but this is laborious and slow, and so the software offers banks of words and phrases to speed up the rate of writing and communication (Figure 27).

Figure 26: A learner using an eye-gaze voice output communication aid

In this context, the learner may not need or use the word bank for linguistic support: it is used purely to increase the rate of communication and reduce fatigue.

Stakeholders may not be clear about whether the tool is acceptable in assessments, because although the learner may not *need* linguistic support, it is still available.

A further issue is that to be efficient, the communication aid or access system must help the pupil access the vocabulary required for the assessment as quickly as possible. This means in some cases that the vocabulary may need to be added to the device in advance of the assessment, which immediately raises a number of issues:

- Does the candidate need specific vocabulary added to the system, or can he/she manage without it? Will speed of accessing be too slow and fatigue too great if the necessary vocabulary is not available?
- Can staff access the assessment in advance to add the vocabulary to the system?
- What vocabulary is needed? How should it be organised?

Some of these issues are explored later in Section 3 on p. 56.

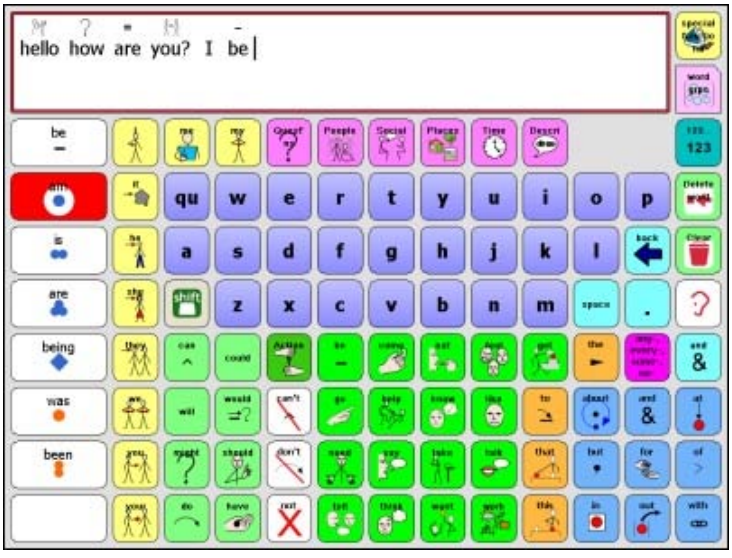


Figure 27: WordPower communication vocabulary with letters, words, symbols and word prediction

[36] Tobii Assistive Technology, http://www.tobii.com/assistive_technology.aspx

Word prediction

Word predictors analyse text as it is typed on the computer, and try to 'predict' the words that the candidate is most likely to want, from a dictionary or lexicon of words. The candidate types or selects a letter and the program offers a list of the most common words beginning with that letter. If the required word is on the list, the candidate selects it with mouse, keyboard or other access tool. If the word is not on the list, the candidate types the next letter and a different choice of words is offered.

There are many word prediction programs available and the most commonly used in Scottish schools are Co:Writer, Penfriend and Read and Write Gold. A number of local authorities have authority-wide licences for these packages.

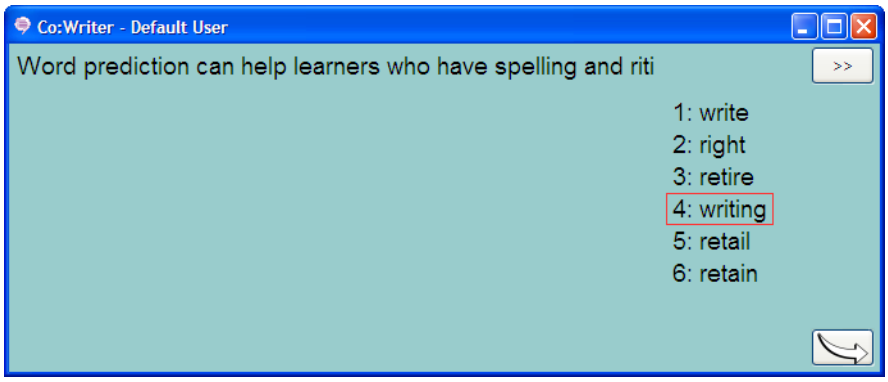


Figure 28: Co:Writer 6 word prediction

Which disabled candidates might need Word Prediction?

Word predictors can reduce the number of keystrokes needed to type by up to 50% and so candidates with physical disabilities use them to reduce effort and increase endurance and therefore the amount that can be written in one sitting.

Word prediction can also help people with spelling difficulties because the writer only needs to type the first few letters of the word and then select it from the list of words offered.

Some literacy skills are necessary to be successful with word prediction. The writer must type the first one or two letters of the word correctly (although Co:Writer's *Flexspell* facility accepts common letter substitutions such as 'fotograph' for 'photograph') and then recognise the word in the list. Some writers cannot get the first letters right; others may miss the word when it is offered in the list or choose a different one by mistake. Some pupils also find that shifting attention between the text, the keyboard and the predicted list interrupts their flow of thought and slows them down.

What is the current understanding among stakeholders regarding use of Word Prediction in assessments?

Use of word prediction in assessments is less common than spellcheckers, for example, but nonetheless key stakeholders in most cases will be aware of the technology. Staff and pupils may not be clear when and if word prediction can be used in assessments, however.

Word predictors are most likely to benefit two distinct (albeit overlapping) groups of candidates:

- those with physical impairment who are using prediction to reduce keystrokes and increase communication or writing speed;
- and those with spelling difficulties who are using word prediction to improve accuracy.

In both cases, the issue is whether word prediction can help the candidate demonstrate their knowledge and understanding in the assessment, which would otherwise be hindered by their disability.

Word prediction used purely to overcome physical disability is essentially the same as using a keyboard and so there are few issues with use in assessment. The situation is slightly more complex where a candidate uses word prediction to support language or spelling, and so is therefore a form of spellchecking. Note that because the candidate has to:

- know which term they wish to use;
- start typing the word correctly;
- identify the correct word in the list;

we suggest that the level of linguistic support provided by the word predictor is considerably lower than, for example, a scribe.

The effectiveness of the word predictor relies on the words the candidate needs to use being stored in the predictor's dictionary. Therefore, before the predictor is used in an assessment, the dictionary should be expanded or adapted with technical or topic-specific words. If the word predictor has previously been used for classwork, then the dictionary should already have been adapted with the necessary vocabulary. New words are added to the dictionary either as they are typed, or a text file about the subject can be loaded into the word predictor which will then extract new vocabulary.

One objection to the use of such topic specific dictionaries is that the candidate will be given extra support. However, we do not think that this is a valid objection. If a candidate uses word prediction as their main writing support, then the extra advantage of being offered correctly spelled technical terms is insignificant. In order to produce grammatically correct English, the candidate must first be able to compose and choose vocabulary, start spelling the technical term correctly, and then identify the correct word from the predictor list. Without these skills, the candidate will produce nonsense, albeit littered with correctly spelled technical terms. Therefore, there should be no distinction between the use of basic word prediction dictionaries compared with adapted word prediction dictionaries.

Speech recognition

Speech recognition software has been used by people with disabilities for many years. It can be effective for writers who have problems with a standard keyboard due to, for example, arthritis, repetitive strain injury, or spinal injury. Speech recognition is also used by writers with reading or spelling difficulties, and visual impairment. Speech recognition programs at the present time are designed for adult voices, and therefore do not usually work well with children younger than about 9 or 10.

The most common program in use is Dragon Naturally Speaking[37], although Windows Vista and Windows 7 now have satisfactory speech recognition supplied free with the operating system.

The suppliers of modern speech recognition programs suggest that the software can be used 'out of the box', but in our experience, results are not good enough and most users will have to train the program to recognise their speech. The basic training process in most cases is quick and involves the user reading a short passage of text into the computer.

Experiences in schools with speech recognition programs have been mixed: some pupils have found the systems extremely beneficial, while others have found them extremely frustrating and of very little use.

Over time, the software is becoming more accurate and computers are becoming faster and so the basic accuracy and efficiency of speech recognition packages is steadily improving. This should mean that it becomes a more reliable and commonly used method of writing.

Which disabled candidates might need speech recognition?

Candidates with physical writing and keyboarding difficulties, as a result of, for example, spinal injury or muscular dystrophy can benefit from using speech recognition software. The programs can control most operations on the computer (opening windows, printing, formatting text, controlling menus etc) and so provide a 'hands-free' method of access.

The other major group of users of speech recognition software are candidates with dyslexia or other specific learning difficulty who have severe spelling or writing difficulties.

Research[38] indicates that speech recognition is most likely to be successful with students with:

- good oral communication skills;
- good word processing and IT skills;
- high motivation to learn to use the system.

To use speech recognition, a student must be able to:

- think of what they want to say;
- compose their thoughts into written English sentences;
- speak reasonably clearly;
- recognise and correct errors in the written text appearing onscreen.

If a student has significant learning difficulties, or major motor speech impairment and is not able to compose and/or speak clearly, speech recognition is unlikely to be successful.

[37] Dragon Naturally Speaking, http://www.nuance.com/

[38] Nisbet, P.D. (2002) Introducing Speech Recognition in Schools: Final Report to Scottish Executive Education Department. CALL Centre, University of Edinburgh. http://www.callscotland.org.uk/About-Us/Projects/Speech-Recognition/

What is the current understanding among stakeholders regarding use of speech recognition in assessments?

Although dictating with speech recognition might appear to be the same as using a scribe, in practice it is quite different. Most pupils initially find dictating to a scribe easier and more flexible than using a speech recognition system. The scribe makes few mistakes, and when mistakes are made it is easier to ask the scribe to correct them. Successful use of speech recognition requires better technical skill and also more and higher level linguistic skills than dictating to a scribe.

Having said that, a skilled user of speech recognition can dictate and correct text far quicker than a scribe can write, and so the software does have considerable potential. Learning and using speech recognition requires greater effort than working with a scribe and so the challenge is to ensure that candidates have the necessary skills to make use of the technology.

It takes considerable practice and use to become confident in the use of speech recognition. The program adapts to the user's voice and so in an assessment situation, the candidate must either use the same computer that is used for classwork, or the candidate's voice model must be copied on to another computer. There is a risk that the stress induced by the assessment situation may affect the user's voice and therefore the accuracy of the recognition.

Like word prediction programs, speech recognition systems have a dictionary of words that they understand. While the dictionaries are large, they may not include all the technical terms that are required for particular subjects. As a result, before speech recognition is used for an assessment it may be necessary to load a text file with specialist vocabulary into the speech recognition program which will then extract new terms and add them to its dictionary.

Separate accommodation and invigilation is required for candidates using speech recognition in assessments. If the candidate is likely to experience a significant number of recognition errors (so that the marker, who is unaware that the work was dictated with speech recognition, is faced with a document with incorrect, but correctly spelled words) it may be necessary to refer the script to the Principal Examiner.

Stakeholders are generally aware of speech recognition and its potential in assessment, and candidates have used the software in examinations, but as far as we are aware, the number of candidates who use the software is very small compared to the number who use scribes. It is currently much more complex to commission the ICT, train candidates to use it, and administer the technology in an assessment situation, than it is to organise a scribe.

Voice Notes

Audio and video recordings of text and questions can be embedded into digital assessments (see Digital Assessments with embedded audio or video) and this technique can also be used by learners to complete the assessment.

Voice notes and comments can be easily inserted into many writing and authoring programs, including, for example, Microsoft Word 2003 (but not so easily with Word 2007/2010)[39], Microsoft PowerPoint, Textease and Adobe Reader. The learner clicks a button on the toolbar (e.g. ), speaks, and the recording is inserted in the document, marked with a suitable icon (e.g. ). The voice note can be played back by the learner by double clicking on the icon. The learner can insert multiple voice notes in response to different questions, can copy and paste voice notes, and can delete and re-record responses. The answers are stored when the assessment is saved and can be played back by the marker.

The advantage of voice notes compared with speech recognition is simplicity: the facility is available free in mainstream software, is very reliable, and is easy to use. Speech recognition software is technically more complex and requires a higher level of literacy in order to check and correct errors. Voice notes relies on a human being to listen and interpret a response and is therefore more flexible: the marker can make allowances for hesitation and accent, for example.

Which disabled candidates might need Voice Notes?

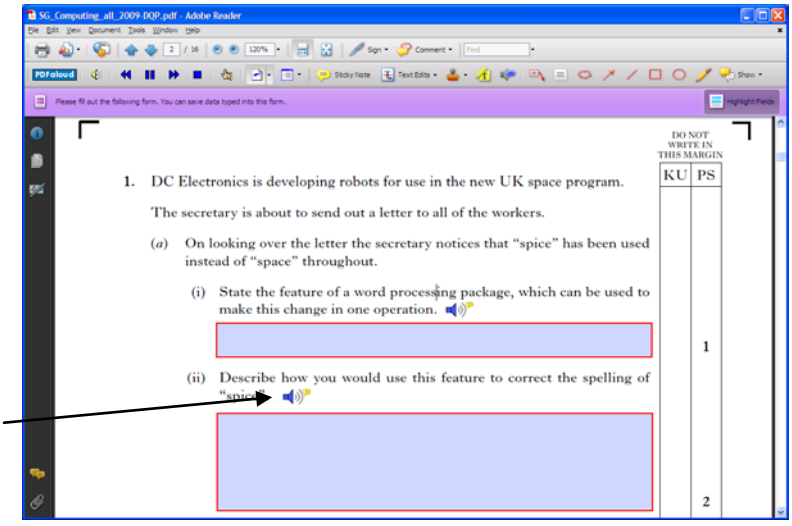
Learners who have difficulty writing, typing or spelling as a result of dyslexia or other specific learning difficulty; visual impairment; or moderate learning difficulty can use voice notes to demonstrate knowledge and understanding. Learners must obviously be able to speak reasonably clearly to use voice notes.

What is the current understanding among stakeholders regarding use of Voice Notes in assessments?

The use of audio and voice notes is becoming very popular in schools and centres because it is a very simple and reliable technique that enables learners who have difficulty with writing to use their oral skills. Many pupils like it because it is empowering and frees them from constraints placed on them by their writing and spelling difficulties.

The current understanding among stakeholders regarding use in assessments is not clear, however, and guidance from SQA would help.

Voice notes are not currently approved as an SQA Assessment Arrangement, but given that tape recorders can be used by pupils in external assessments to record responses, then there seems to be no reason in principle why voice notes could not be used as well.



Computing Digital Question paper with voice notes recorded by the student. The responses can be heard by the marker by doubling clicking on the blue loudspeaker buttons.

[39] Creating Voice Notes in Word 2003, http://www.callscotland.org.uk/Resources/Quick-Guides/Microsoft-Word/

Equation editors

The production of mathematical and scientific expressions can be a challenge for candidates with physical disability, visual impairment, or handwriting difficulties. It is possible to use a standard word processor such as Microsoft Word to lay out expressions (for example, by using the *Insert Symbol*) command, but it is a slow process and good results are difficult to achieve.

A much better option is to use an Equation Editor, which is available within Microsoft Word and also OpenOffice. These provide quick and easy ways to lay out complex mathematical and scientific expressions. (See the Quick Guide at http://www.callscotland.org.uk/Resources/Quick-Guides/Microsoft-Word/).

$$s = \sqrt{\frac{\sum (x - \bar{x})^2}{n-1}} = \sqrt{\frac{\sum x^2 - (\sum x)^2 / n}{n-1}},$$

Figure 29: Equation drawn with Microsoft Equation Editor

Alternatives to the free editors provided with word processors are commercial editors such as MathType[40] or Efofex[41]. These are typically faster and easier to use, and the Efofex range includes tools for generating drawings, graphs and chemical formulae and structures. Most of the Efofex functions can be performed using the keyboard and so it is a good option for candidates with physical difficulties. Efofex also provide free software licences for pupils with disabilities.

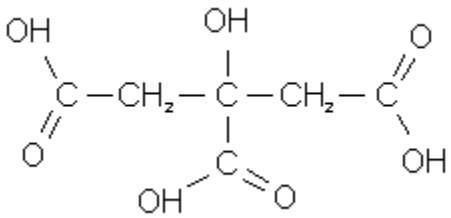


Figure 30: Chemical structure drawn with Efofex ChemStruct

Note that the answer fields within the SQA Digital Question Papers can accept standard text characters, or symbols pasted in, but they do not accept images. Since equation editors produce images, they cannot be used to insert equations into the digital papers at the present time.

Which disabled candidates might need equation editors?

Learners with physical disabilities or conditions such as dyspraxia are the most likely to benefit from using equation editors. Pupils with visual impairments may also use these tools in conjunction with screen magnification, but many pupils will prefer to use a Braille keyboard to generate mathematical expressions.

What is the current understanding among stakeholders regarding use of equation editors in assessments?

Stakeholders with an interest in the subject area (i.e. maths and science teachers) use these tools to generate resources for pupils, but they and support staff may not be aware of or understand that equation editors can also be used by pupils with disabilities.

[40] MathType, www.dessci.com/MathType

[41] Efofex, http://www.efofex.com/

Art and graphic design

A huge range of illustration, graphic design and computer-aided design software packages are available and these can be used by candidates who have difficulty, as a result of physical disability, with traditional drawing and painting tools.

Some examples are:

- Textease Paint and Textease Draw (part of the Textease Studio[42] suite used in many primary schools);
- Adobe Freehand and Illustrator; Corel Painter (mainstream design and illustration tools);
- AutoDesk AutoCAD (mainstream computer aided design);
- FX Draw[43] (suitable for pupils at secondary; free licences are available for pupils with disabilities);
- AccessMaths[44] (a drawing package specifically designed for learners with physical disabilities who cannot use a mouse).

Standard and alternative mice (see Mouse alternatives) can be used to control the mouse pointer for drawing, but the most effective tool (provided the candidate can use it) is a graphics tablet.

Figure 31: Graphics tablet

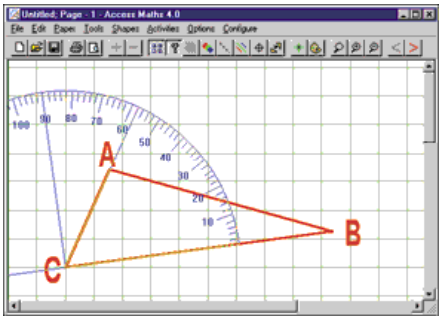


Figure 32: AccessMaths on-screen measuring tools

Which disabled candidates might need art and design software?

The main group of learners who would benefit from art and design software are those with a physical disability that impacts upon their ability to use manual drawing tools. This might include pupils with for example, cerebral palsy, spinal injury, muscular dystrophy, arthritis, restricted growth, arthrogryposis or brittle bone disease.

What is the current understanding among stakeholders regarding use of art and design software in assessments?

Computer-aided graphics is part of the Graphic Communication course and so stakeholders are probably aware of the use of art and design software in coursework. Since the external assessment usually involves manual drawing, however, they may not be aware of the possibility of using ICT in the examination.

Art and design software can be used in Art and Design courses but the emphasis is usually on manual drawing, painting and illustration skills and so stakeholders again may not be aware of the possibilities offered by ICT for learners who have physical difficulty with manual drawing.

[42] Textease Studio, http://www.textease.com/

[43] FX Draw, http://www.efofex.com/fxd3base.php

[44] AccessMaths 4.2, http://www.ace-centre.org.uk/index.cfm?pageid=FA3CAE7D-3048-7290-FE2985ADA29FC0AA

Simulation and modelling software

Modelling and simulation packages enable learners and staff to explore practical experiments and reactions in subjects such as chemistry, physics, electronics and mechanics. For example, Crocodile Clips[45] offers a range of simulation tools for mathematics, science, technology and ICT and computing. This software is often used by subject teachers for class teaching on an interactive whiteboard, but it can also be used by individual students on a laptop or PC. The Yenka packages from Crocodile Clips are free for pupils to use at home.

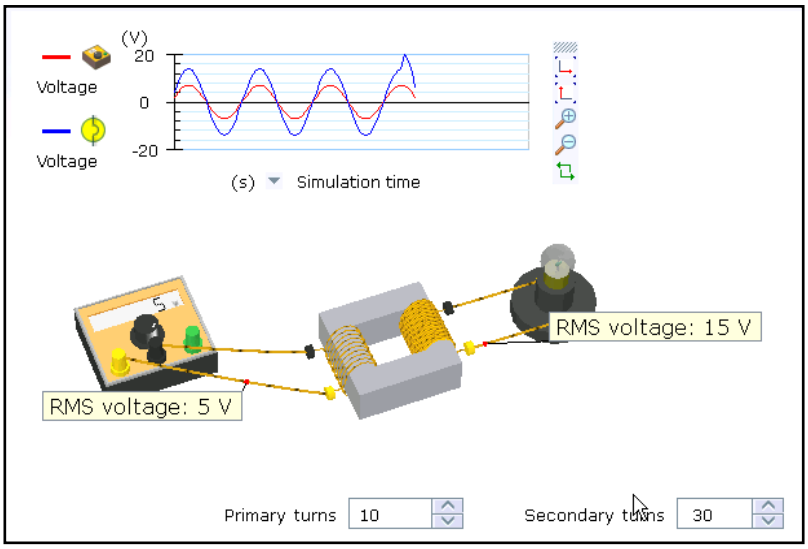


Figure 33: Yenka circuit simulation

Which disabled candidates might need simulation and modelling software?

Pupils with physical disabilities who have difficulty manipulating equipment in for example science practical assessments can use modelling and simulation software instead.

What is the current understanding among stakeholders regarding use of simulation and modelling software in assessments?

We are not aware of schools or pupils who have used modelling and simulation software to permit pupils with disabilities to work more independently and inclusively in practical sessions.

[45] Yenka, http://www.yenka.com/

Special Access Tools and Methods

Some candidates have difficulty accessing ICT and AAC devices using the standard keyboard and mouse, due to physical disability, visual impairment, or learning difficulties, and may require alternatives. *Special Access Technology*[46] gives a fuller description of these access tools.

Alternative Keyboards

Candidates with....	***might use....***
Physical coordination difficulties	keyguards or keyboards with larger keys
Limited reach or muscle weakness	compact keyboards
Visual impairment	keyboards with high contrast or large print keys
Repetitive strain injury	ergonomic keyboards
Physical disability	on-screen keyboards accessed by mouse, mouse alternative, touch screen or by switch and scanning, or eye gaze Speech recognition

Figure 34: Ergonomic keyboard

Figure 35: Miniature keyboard

Figure 36: Large Key lower case keyboard

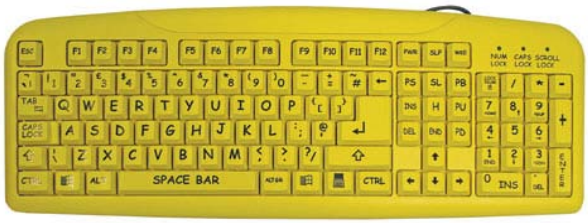


Figure 37: High contrast keyboard

Case example

Peter has just finished S3 and is taking eight Standard Grade courses. He has cerebral palsy, which affects his motor control. He is an expert electric wheelchair drive. Peter accesses his laptop computer using a 'head pointer' which he wears on his head. Using the head pointer, he types on a compact keyboard and for short passages can achieve up to 15 words a minute. He cannot hold two keys down at once with his pointer and so uses 'Sticky Keys', which is built in to the Windows Accessibility Options. Peter can control the mouse pointer using the white number pad, via 'Mouse keys', which again is in the Accessibility Options.

[46] Special Access Technology, http://www.callscotland.org.uk/Resources/Books/#Special-Access-Technology

Peter uses his laptop for virtually all his work. He can read digital textbooks which have been obtained from the publisher, or scanned into the computer[47], and he can access resources and worksheets created by subject teachers. For unit tests, he uses interactive PDFs similar to the SQA Adapted Digital Papers[48]. By using ICT, Peter can access learning materials and write and record independently.

Mouse alternatives

Candidates with....	***might use....***
Physical coordination difficulties	trackball, touchpad or joystick
Small hands	compact mouse, trackball or touchpad
Limited reach or muscle weakness	trackball or touchpad
Repetitive strain injury	ergonomic mouse or graphics tablet
Blindness or sight loss	keyboard shortcuts
Physical disability	keyboard shortcuts speech recognition on-screen mouse operated by switches head-controlled mouse eye-gaze system

Figure 39: Marble Mouse trackball

Figure 40: Roller II trackball

Figure 38: Cirque Glidepad touchpad

Figure 41: SmartNav head-operated mouse

Figure 43: Roller Joystick

Figure 42: Anir vertical mouse

'On-screen' keyboards and dynamic displays

'On-screen' keyboards enable people with more severe physical difficulties to access assistive technologies and AAC devices. On-screen keyboards can also be useful for pupils with visual impairment and dyslexia because the keyboard is beside the text and so the user does not have to continually shift gaze or focus up and down between the screen and the physical keyboard.

[47] See CALL Scotland's Books for All web site for more on books in accessible formats, http://www.books4all.org.uk

[48] SQA Adapted Digital Papers, http://www.adapteddigitalexams.org.uk and http://www.sqa.org.uk/assessmentarrangements

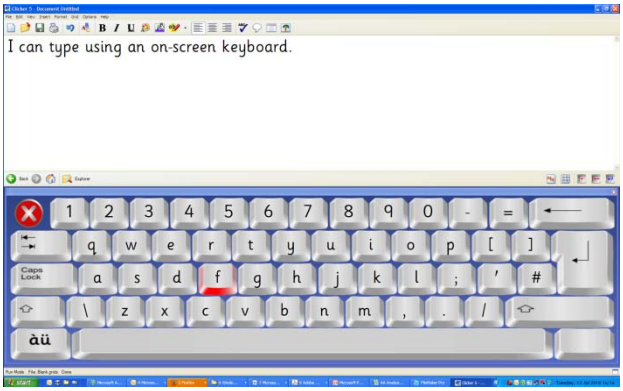


Figure 44: Clicker 5 on-screen keyboard

The simplest method of accessing an on-screen keyboard or display is via a mouse, touchscreen or other pointing device. This method is usually termed 'Direct Selection'.

The learner uses the touchscreen or pointing device to point at items on the screen and selects either by clicking with the mouse button or a switch, or with 'dwell select'.

A select switch might be activated by the learner's hand, head, chin, foot, knee, etc.

With Dwell Select, the user holds the pointer still for a set time (the 'dwell time') and the item is selected automatically.

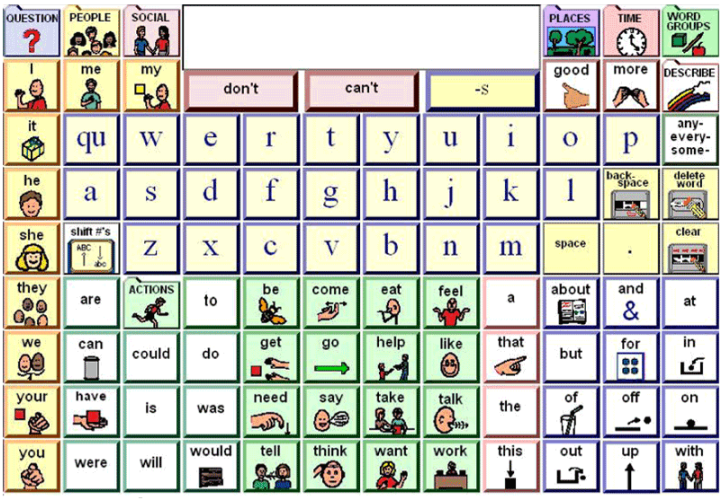
Case example

Mike is fourteen years old and has a C2 spinal lesion, which means that he is almost completely paralysed. He can move his head slightly and operates a joystick with his chin. The joystick controls the mouse pointer on a tablet PC and he clicks the mouse buttons by activating two small switches beside the joystick, with his tongue. Mike is as fast and accurate with this access method as most people are with a mouse. He can type with an on-screen keyboard; play computer games; browse the internet and send emails; read eBooks; take photos and videos with a motorised web camera and then edit the results; and play DVDs and music.

On-screen keyboards do not always look like physical qwerty keyboards, they may be laid out in any format required by a specific user. Many learners benefit from simplified keyboard layouts with the basic minimum of keys. Users of eye gaze or switch and scan systems may be quicker or more accurate with keyboard layouts that have only a very few items on screen and that involve screen changes to reach each intended letter.

Switch and scan users will often write much faster if their keyboard letters are laid out in a 'frequency of use' layout, (e.g. most commonly used letters such as vowels, and S,R,T etc. bunched up in the top left hand corner, to cut down the number of row and column scans), rather than a standard QWERTY layout. See the following section on Scanning and switch access for further discussion of this access method.

Users with particular visual field difficulties may need onscreen keyboard layouts that use only the user's effective visual field and that omit the damaged area (e.g. bottom half of screen).



On-screen keyboards can also, potentially, display more than just individual letter keys: the display can offer whole words, phrases, picture, symbols and photographs. They therefore offer both a means of access and a means of communication for pupils who do not easily read text and spell, but who may nonetheless use letters for emergent spelling efforts and to access alphabetically-organised word banks. We looked at on-screen Word Banks earlier, and AAC is discussed in more detail later.

Figure 45: *Picture WordPower* dynamic screen communication display

Scanning and switch access

Some people with more severe physical disabilities who cannot access a physical keyboard or use direct selection may use switches and 'scanning' to select items from the screen display.

There are several different scanning methods, but typically the user of a 'single switch' system with 'row-column scanning' presses a switch (with hand, finger, head, arm, knee, foot, etc) and then each item on screen is highlighted ('scanned') in turn. When the desired key, word or item is highlighted, the user presses the switch again, and the selected item is typed into the word processor, or added to the AAC display.

Figure 46: A switch and USB switch interface to connect it to a computer

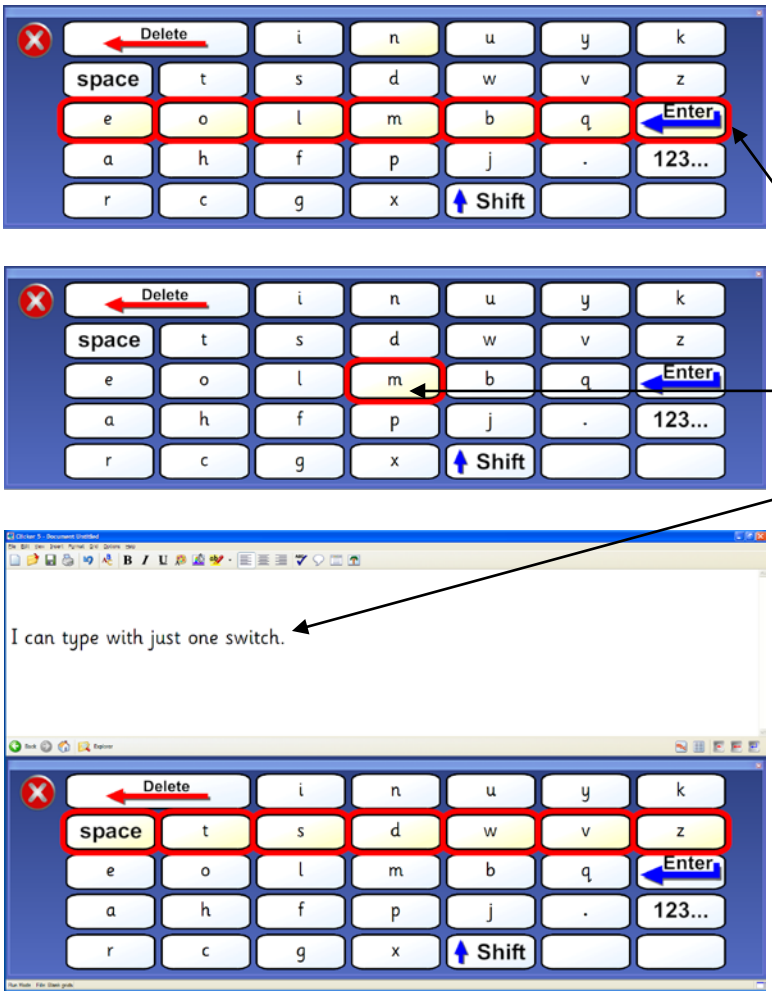


Figure 47: Clicker 5 Scanning and switch access

Figure 47 shows a Clicker 5 on-screen keyboard, arranged in a frequency of use layout (the most common letters are in the top left corner so they can be scanned and selected first).

The user presses a switch and each row of the on-screen keyboard is scanned (highlighted in red) in turn.

When the correct row is reached, the user presses the switch and the red box moves along the row.

When the desired letter is reached, the user presses the switch again to select it and it is typed into the Clicker word processor.

Scanning and switching is a slow process, compared to typing on a keyboard. It is possible to change the scan delay (the length of time that each item is highlighted) from 0.1 seconds to up to about 10 seconds. Some very skilled users can operate a scanner with a 0.1 second delay, which is remarkable given the average human reaction time is over ½ a second. Most scanner users are much slower, for example 2-5 seconds. If the timing is set wrongly, the switch user may fail to select accurately, even though he/she knows which letter he/she wants.

For a switch user who is blind or visually impaired, 'auditory scanning' or 'auditory prompting' would be switched on, so that each row and each letter would be spoken out by the computer as the scanning box lands on each in turn, so that the student can select the intended letter just by listening and timing his/her switch press. (A similar form of auditory scanning can be operated by a human communication facilitator – no ICT involved – see Low Tech Communication Methods (Low Tech AAC)).

The Clicker 5 keyboard illustrated in Figure 47 saves time by locating the most commonly used letters in the top left corner so they can be reached first.

Other ways of increasing the speed of use are:

- word banks (arranged by topic, or alphabetically, so the user can click to select a whole word);
- phrase banks (so the user can click to select a whole phrase);
- word prediction (where words are offered and selected from a list by the program as the user types);
- abbreviation expansion (where abbreviations are automatically expanded by the program).

Which disabled candidates might need special access tools?

Special access tools and techniques are mainly used by learners with physical and/or visual impairments. For example:

Candidates with....	***might use....***
Dyspraxia	keyboard, mouse or trackball
Cerebral palsy (minimal involvement)	keyboard, large keyboard, keyguard, mouse, trackball, joystick, speech recognition
Cerebral palsy (more severe involvement)	head operated mouse, eye-gaze system, switches and scanning
Repetitive strain injury	ergonomic keyboard, ergonomic mouse or graphics tablet
Arthritis	keyboard, compact keyboard, trackball
Spinal injury (tetraplegia)	keyboard, compact keyboard, trackball, joystick, speech recognition. People with C1-4 lesions are more likely to use head-operated mice, eye-gaze and switches.
Muscular dystrophy	compact keyboard, trackball, joystick, speech recognition, head/eye-gaze, switches.

In many cases they offer access to a computer and/or communication aid for learners who might otherwise have no viable independent means of writing or speaking. In spite of carrying out this powerful function, they can still be cumbersome and slow ways of writing, and they may not solve all the difficulties faced by students with complex support needs. As a result, learners using such access methods may also need to use other forms of support as well.

What is the current understanding among stakeholders as to use of special access tools in assessments?

At one level, understanding is relatively good: where a candidate requires minor adjustments to the computer, or perhaps the use of a different keyboard or mouse, then there are relatively few issues in an assessment context. Provided the young person can generate text and/or language at a realistic rate, it is a similar situation to anyone using a mainstream computer.

Where understanding is less complete, is in situations where candidates are using slower and less common methods of access, such as scanning and switching.

The biggest challenges faced by pupils who use these more specialist Access Tools and Methods in assessment contexts, are speed, accuracy and fatigue. Almost all of the access methods listed above (with the exception of speech recognition) are far slower and require greater physical effort and concentration than traditional keyboard and mouse. If a non-disabled pupil used these methods, they would immediately be disadvantaged because the access methods are inherently slower and/or more difficult. Disabled users, such as those with athetoid cerebral palsy, are doubly disadvantaged: not only are they using access techniques which are slower and harder, they are also struggling to maintain visual and/or auditory concentration in order to time their

selection accurately, and to maintain physical control over their bodies in order to operate their selection method. These factors must be taken into account when designing reasonable assessments for learners who use Assistive Technologies and AAC.

For comparison, approximate mean handwriting speeds of pupils from S1 to S4 are given in Table 5[49].

Table 5: Mean handwriting speeds of school pupils (from PATOSS)

	S1	S2	S3	S4
Mean handwriting speed – words / minute	13.9	14.6	15.7	16.9

This suggests that an acceptable typing speed for pupils using ICT, Assistive Technology or AAC and working at SCQF Levels 3, 4 and 5, is therefore 13 to 17 words per minute. Many disabled candidates cannot achieve anything like this speed of text production and will require a significant amount of additional time, and rest periods, to complete assessments.

Typing one letter at a time on an on-screen keyboard, with a mouse or other pointing device, is typically slower than typing with two hands on a standard keyboard. DeVries et al report maximum typing rates of between 5 and 7 words per minute for two users with spinal injury[50] using a mouthstick on a physical keyboard and a HeadMaster head-controlled mouse with on-screen keyboard. Trnka et al[51] report speeds of 5.5 words per minute when directly selecting letters from a Wivik[52] on-screen keyboard. Since 'non-contact' pointing devices, such as head-controlled and eye-gaze systems, are generally slower methods of access than a standard mouse[53] or touchscreen, then users of these technologies are likely to be even slower.

Switch-and-scan selection is generally agreed to be slower than direct selection with touchscreen, mouse or pointing device. Koestler and Levine[54] report average rates of between 3.6 words per minute and 8.4 words per minute across different users and access methods. These speeds seem high compared with physically disabled students known to CALL, where output of 1 or 2 words per minute, using only letter by letter typing, could be a real possibility. The extra time required to sit an exam on this basis might run to hours and possibly days, which is neither practicable nor physically endurable. Additional support methods would need to be explored, for such candidates, including use of all the accelerator tools mentioned above, such as word banks, prediction, phrase storage, abbreviation expansion, a multiple choice exam format, and acceptance of telegraphic answers rather than full essays.

Lastly, the fastest access method is not necessarily the best. Speed, accuracy and fatigue are inter-related: Man and Wong[55] compared four different access systems and reported that the two participants with cerebral palsy chose a switch-and-scan tool for mouse control (CrossScanner) because it was more accurate and more comfortable than the other methods, even though it was not the quickest.

[49] Handwriting Speed Assessment, PATOSS, http://www.patoss-dyslexia.org/Handwriting_speedtest.html

[50] DeVries, R. C., Deitz, J., & Anson, D. (1998). A comparison of two computer access systems for functional text entry. *American Journal of Occupational Therapy, 52,* 656–665.

[51] Keith Trnka , John McCaw , Debra Yarrington , Kathleen F. McCoy , Christopher Pennington, Word prediction and communication rate in AAC, Proceedings of the IASTED International Conference on Telehealth/Assistive Technologies, April 16-18, 2008, Baltimore, Maryland

[52] Wivik on-screen keyboard, http://www.wivik.com

[53] MacKenzie, I. S., & Jusoh, S. (2001). An evaluation of two input devices for remote pointing. *Proceedings of the Eighth IFIP Working Conference on Engineering for Human-Computer Interaction - EHCI 2001*. pp. 235-249. Heidelberg, Germany: Springer-Verlag.

[54] H.H. Koester and S. P. Levine, "Learning and Performance of Able-Bodied Individuals Using Scanning Systems with and without Word Prediction," *Assistive Technology* **6**, No. 1, 42-53 (1994)

[55] Man, D. W. K., & Wong, M.-S. L. (2007). Evaluation of computer-access solutions for students with quadriplegic athetoid cerebral palsy. *American Journal of Occupational Therapy, 61,* 355–364.

SECTION 3: AUGMENTATIVE AND ALTERNATIVE COMMUNICATION (AAC)

Introduction to Augmentative and Alternative Communication (AAC)

For the purposes of this Report, the term augmentative and alternative communication (AAC) is used to refer to any form or method of expressive communication used by people who cannot make themselves understood effectively through ordinary oral speech.

AAC can be 'high tech', involving the use of specialised communication technology. AAC can also be 'low tech', involving very basic materials such as laminated paper charts or symbol books. Much AAC is 'no tech', for example, use of vocalisation /speech attempts, facial expression, eye pointing, head movements, gestures etc[56].

People who use AAC generally employ two or even all three methods, i.e. no tech, low tech and high tech methods, often within the same episode of communication. For example, a student may wish to mainly use whatever speech capability he/she has, but this may be unintelligible to less familiar communication partners, or when unexpected or specialised vocabulary is used (e.g. scientific terms, names in history, geographical references etc.) so a back up system is required.

People who need AAC for personal interaction also tend to need it (and/or other ICT) to record their work and write, in educational contexts and in assessment situations.

Which AAC systems are currently in use in schools and colleges?

Although the number of students who use Augmentative and Alternative Communication (AAC) is small overall, the approaches and technologies required to meet the needs of each are necessarily highly individualised. Therefore, there is a range of different AAC equipment and approaches in use in schools and colleges, currently. The following sections outline the main types of system and specific devices that are suitable for use in assessment situations.

A common factor - and the primary function of all communication technology - is to 'give users a voice'. For this reason, devices are often known as 'VOCAs' – voice output communication aids, or sometimes simply as 'Talkers'.

Another fundamental overall aim of communication aid technology is to increase the independence of the child or young person using it, as well as enhancing their communication abilities and skills generally.

Features of communication devices

Most communication aid technology is characterised by:

- high quality speech output, with a range and choice of voices;
- good built-in amplifier and speakers, giving high volume;
- long battery life (8 hours);
- specialised software, highly customisable;
- robustness, for all-day, every-day use;
- design offering good portability / wheelchair mountability;
- wide range of input methods and accessibility settings.

Speech, language and communication impairment almost always has an underlying neurological cause, so in most cases physical or motor control impairment - often severe - is likely to be present as an additional disability, which will affect a pupil/student's ability to access or operate their communication technology. There may also be sensory impairments. Communication aid technology can compensate for these difficulties by providing alternative ways for users to do things. This allows devices to be tailored to specific needs.

Options include alternative:

[56] An element of manual signing (e.g. Makaton, Signalong) can form part of some users' package of communication strategies, but AAC as a term does not include BSL signing by deaf people.

- Access methods – how the user selects items to communicate e.g. key presses, pointing, touch, or using a switch and scanning through an array.
- Selection sets - the vocabulary or symbols available to a user for communication. These may be presented visually, aurally, or in tactile form,
- Rate enhancement techniques – because AAC is slower than speech (or ordinary writing or typing) a number of options may be provided to speed up output, for example, pre-storage of whole phrases and messages that will be commonly used. Rate enhancement can include techniques used also in writing aids, such as word banks, prediction, abbreviation-expansion.
- Output options – that is, different ways in which information is passed to the communication partner, via a communication aid. This can include visual (message screen, print-out); auditory (e.g. synthetic or recorded/digital speech); tactile (e.g. Braille paper printout). (It can also include the communication aid sending information to a computer, a phone or other electronic devices.)

Which disabled candidates might need AAC?

Students who use AAC are those who cannot make themselves understood adequately through ordinary oral speech. This is a functional disability of neurological origin rather than a medical diagnosis. Such students are often referred to as having complex communication support needs.

The conditions most commonly associated with severe speech, language and communication impairment include:

- Cerebral palsy (CP);
- Severe dyspraxia;
- Learning disability (various syndromes);
- Autistic Spectrum Disorders (ASD);
- Traumatic brain injury (TBI);
- Reading and spelling difficulties;
- Acquired progressive neurological conditions such as multiple sclerosis, motor neurone disease, stroke (may be relevant in the case of mature college students).

However, the need to use AAC is seldom a single disability:

- Severe speech impairment may mask an underlying language disability (receptive and/or expressive), or a social-pragmatic communication disorder.
- Literacy difficulties in particular are a well-recognised feature of complex communication support needs. Many students who need communication technology will often also require linguistic support (see **Error! Reference source not found.**, p. **Error! Bookmark not defined.**).
- Difficulties with vision or visual processing, hearing or auditory processing, and attention control are also common in students with neurological impairments.
- A significant proportion of students with complex communication support needs will also have physical impairments, often severe, affecting hand function, head control, mobility etc. and will therefore also require access technology along with communication technology (For specific examples of access technologies, see Special Access Tools and Methods, p. 49).

As with other types of Assistive Technology, it is important to recognise that there is no direct 1:1 ‘mapping’ of communication aid technology to type of disability. One would not think in terms of ‘a communication aid for children with cerebral palsy’ or ‘a communication aid for children with autism’. Assessing learners for the most appropriate communication aid is a complex feature matching exercise, taking into account each individual’s age, mobility, sensory and cognitive abilities, hand function, language level, educational, other technologies in use, and much more.

What is the current understanding among stakeholders regarding current use of AAC in assessment?

Very low. People who use AAC are few and far between (most ordinary people will never have come across a person who uses AAC) and communication technology is a relatively new and highly specialist field. To date, few users of AAC have achieved an educational level such that they would be presented as candidates for formal assessment. Exam arrangements for students who use AAC have so far been very much 'one-offs'.

Parents of children and young people who use AAC, and staff who work with a particular pupil on a day to day basis obviously have a much clearer understanding of the methods and equipment involved in AAC use, but may not see the full implications of its use in the context of assessment.

Independence and the Role of Communication Facilitator

An important point, which is currently poorly understood, is that even if a student is a successful user of communication aid technology and perhaps other ICT, he/she is usually not 100% independent, and will therefore require special arrangements in the form of human support (e.g. as well as use of technology and extra time). Students who prefer to use low tech AAC will always require a human support with communication. In an assessment situation, a student who uses AAC may need not one but two helpers:

- ***Communication Facilitator***
  One person who knows the candidate very well and is used to their communication method(s) is needed to 'facilitate' their communication as necessary, and to 'translate' idiosyncratic or unconventional utterances. We will refer to this person as a 'communication facilitator'. While the role may seem similar to that of a 'reader', it is probably more like a BSL interpreter, but with one notable difference. With BSL, both the candidate and the interpreter share a common code (BSL sign language) and the task is mainly one of 'translation' to and from spoken English. With AAC, there is an asymmetrical linguistic relationship between communication partners. For language input, the facilitator may not be needed at all (or may be used just for page turning etc., or straightforwardly as a reader[57], turning written text into spoken English), as the student's language comprehension may be relatively unimpaired. However language output, from the student to the facilitator, is different; student output may be idiosyncratic and considerable interpretation may be required from the facilitator. For example, if the student's AAC system is missing relevant vocabulary, the student has to describe something or use an approximation rather than directly name it. Considerable linguistic support may also be needed as part of the facilitation process, for example to create grammatical phrases or sentences from a series of key words. The role of the communication facilitator is highly skilled: they do not create language FOR the student, but rather 'co-construct' language with the student, by constantly expanding key words, questioning and cross-checking to confirm that their interpretation is what the student meant.
  Scribe
  Another person (who can be less familiar) to act as a scribe in the normal way, i.e. transcribing the answers generated by the student (with the help of the communication facilitator). We will refer to this person here as a 'scribe'.

Exactly how the communication facilitator functions will necessarily vary depending on how different individual students communicate, so it is difficult to define this too closely.

In an assessment context, the role and scope of the facilitator, and the method and degree of interpretation must be carefully considered and monitored to ensure that the end result of the process is the candidate's own work.

The function of the scribe remains more clear-cut, although a set of transcription 'ground rules' may need to be agreed in advance with the assessing body so that there is a clear record of what the student generated independently, what was co-constructed or negotiated between the student and facilitator, and what was supplied by the facilitator.

[57] It is possible, depending on individual circumstances, that the scribe may take on the role of both Reader and Scribe, leaving the Communication Facilitator to focus exclusively on interpreting and transmitting the candidate's answers.

The fact that two separate people are needed to support a student using AAC can provide a counterbalance to mitigate the possibility of undue 'partner influence'.

Similarities and Differences – Case Stories

As an illustration, we might consider three students with physical disabilities in the same class in a Special School. They all have cerebral palsy, they all use the same communication aid hardware and software, with the same core vocabulary (selection set) with a symbol interface, but there are nonetheless significant differences between the three of them in terms of how they use their systems.

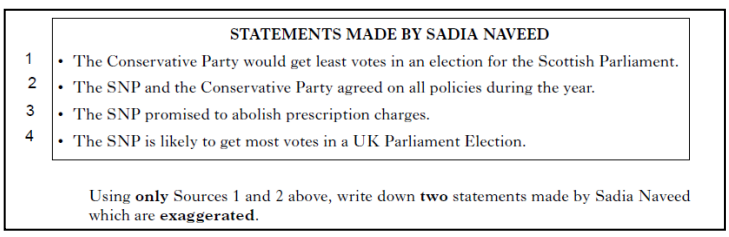
As none of them can use a standard keyboard or mouse, they each require a different special access system. Another difference between them is that one student has a more advanced level of literacy.

- Annie can point quite accurately on the smallish touch screen of her semi-portable AAC device. This makes her a relatively fast communicator, potentially, but she tends to use quite a small sub-set of the vocabulary available to her as her linguistic abilities are limited and she has to be taught new vocabulary before she can use it herself. She demonstrates her knowledge by using, mainly, key words, and she relies on her communication facilitator to order these into grammatical phrases or sentences, when necessary.
- Her classmate Andrew has a visual impairment and less accurate pointing skills, so he needs the larger screen size model of the AAC device (wheelchair mounted), with a special keyguard fitted over the screen, in order to guide his finger and avoid mis-hits. His output is significantly slower, but he is more literate and can use spelling as well as symbols, and text-based rate enhancement techniques, which both speeds him up somewhat and also gives him access to a wider vocabulary. Andrew's communication aid can be connected to a word-processor on computer, so he can save his output as a text document, and print it out. He may use his communication facilitator mainly to help to set up his equipment and monitor that it is working properly.
- Their other classmate Julie is even more severely involved physically, and cannot use direct point/touch on the screen, so she uses the same communication aid but set up for access via a switch and scan system (see Scanning and switch access). This makes her much slower in terms of what she can output, so she often chooses to use 'telegraphic' language (i.e. single words rather than full sentences) in order to save time and physical effort - even though she has the cognitive ability for more complex linguistic structures. She will use her communication facilitator to fill in the missing 'little words' to support the creation of longer sentences, when necessary. Even then, her output will be significantly shorter than that of her classmates, in a given time period.

Issues with assessment

It should be clear that there are multiple challenges for learners who use AAC, and for staff, in assessment contexts, because of the complexity of the student's learning needs:

- Many pupils have very slow rates of communication that require significant physical and cognitive effort. For example, it is simply impossible for some pupils to complete two examination papers in the same day.
- Candidates who use AAC may find it more difficult to answer questions which require extended answers: multiple-choice questions or those requiring short answers are much easier.
- It can be helpful for the Communication Facilitator to add navigation markers to the paper: for example, this Modern Studies question in has been adapted so that the candidate just has to say the number of the statements rather than type out each sentence in full. This approach can be used for identifying paragraphs, lines and even individual words.



STATEMENTS MADE BY SADIA NAVEED

1 • The Conservative Party would get least votes in an election for the Scottish Parliament.
2 • The SNP and the Conservative Party agreed on all policies during the year.
3 • The SNP promised to abolish prescription charges.
4 • The SNP is likely to get most votes in a UK Parliament Election.

Using **only** Sources 1 and 2 above, write down **two** statements made by Sadia Naveed which are **exaggerated**.

Figure 48: Adapted Modern Studies Standard Grade question

- Navigating around hard copy papers is challenging for candidates with severe physical and communication impairments: they may not be able to turn the pages of the paper, nor easily ask the reader, scribe or facilitator to do so for them. Digital papers can be helpful here, but navigation would be quicker if all papers were in question and answer format, with hyperlinks to allow the candidate to quickly go from a question to the relevant text or source. Or, it would be helpful to have all the maps, graphs and diagrams on a separate document or page (with hyperlinks in the digital version) so that candidates can more easily navigate between the question and the illustration. This is a particular issue with papers with graphs, illustrations and maps, where the question may be on a different page to the relevant illustration.
- Any assessments which require drawing or production of mathematical and scientific notation are challenging where candidates both cannot physically use drawing tools, and also have communication impairment that restricts their ability to instruct a scribe. Again, the SQA digital question papers do offer some options but the drawing tools that are available in Adobe Reader are relatively basic and are not accessible for some candidates with more severe disabilities.
- Schools indicated that it would be helpful to have guidance for invigilators, particularly regarding the role of the Communication Facilitator, because it is so different to that of the more commonly used scribe.

In summary, provision of Assessment Arrangements for candidates who use AAC is complex, requiring detailed consideration of a number of factors around the candidate and the assessment. This report has raised some of the issues but we suggest that further research is required to investigate how these learners could be supported in assessments. This should involve fieldwork with staff and pupils for example at Ashcraig School in Glasgow (who kindly provided comments and suggestions for this report). It is likely that interactive digital assessments have potential, but that assessments will need modified to meet the needs of candidates who use AAC. SQA already provide modified papers (for example, Braille papers for blind candidates) and so the principle has already been established. The issues therefore are to do with the exact nature of the modifications that are required.

Digital question papers and e-Assessment techniques offer many possibilities, but it is not yet clear which techniques are required, whether they have implications for the accuracy of assessments, or whether they are feasible to produce and practical to use in schools.

AAC systems and Assessment Arrangements

The remaining sections of the report detail the three main classes of AAC system and their use in assessments. Table 6 summarises some of the key points and highlights some similarities and differences between the three main classes of AAC system.

Table 6: AAC systems and Assessment Arrangements

AAC System	***Possible Assessment Arrangements***
"High Tech" complex Voice Output Communication Aid (VOCA) • Open-ended vocabulary • Accessed using text or mixed symbol & text	• Reader / helper to access printed or digital question paper • Basic Digital paper on computer or VOCA • Adapted digital paper on computer or VOCA • VOCA direct text output to computer • VOCA speech output transcribed by scribe verbatim • VOCA speech output interpreted by Communication Facilitator into grammatical format and transcribed by scribe • Extra time + rest periods
"Medium tech" pre-programmed VOCA • Restricted vocabulary – may require vocabulary pre-prepared to suit assessment • Accessed using symbols or text	• Reader / helper to access printed or digital question paper • Device pre-programmed with vocabulary for assessment • Basic Digital paper on computer or VOCA (unlikely but possible) • Adapted digital paper on computer or VOCA • VOCA speech output interpreted by Communication Facilitator into grammatical format and transcribed by scribe • Extra time + rest periods
"Low tech" letter, word or symbol board or book	• Reader / helper to access printed or digital question paper • AAC output transcribed by scribe verbatim • AAC output interpreted by Communication Facilitator into grammatical format and transcribed by scribe

Communication Technology ('High Tech' AAC)

Communication aid (or 'AAC') technology is divided here into two main categories:

1. **Complex** – i.e. Voice Output Communication Aids (VOCAs) capable of generating an unlimited number of unique utterances/messages. Usually built on an existing computer operating system such as Microsoft Windows, Windows CE, Windows Mobile, Apple iOS etc. although these platforms may be mounted within a custom-built portable device with additional features such as extended battery life and amplified speakers giving high volume output. These systems include a text to speech engine and use synthetic voice: they usually offer a choice of different voices [58]. Complex devices may be text-only based, or symbol-based, but the majority will be 'mixed', i.e. offering a combination of both text and symbol-based features.
2. **Pre-programmed** – i.e. you get out only what has been put in. These devices are not capable of generating an unlimited number of messages, nor of generating spoken and written text. VOCAs in this category use recorded (digitised) speech. While all in this group tend to be somewhat lighter, simpler, and more limited than the complex systems described above, there is a continuum of devices in this category ranging from the sophisticated to the very simple. At the simplest end of the continuum is a sub-set of devices referred to as 'simple communication tools' i.e. extremely limited devices with one or two messages that can be added to other high or low tech AAC systems, to provide a very specific function – limited, but potentially very useful.

A complex AAC system does not come 'off the shelf' as a single device, Rather, it is a highly individualised 'package' composed of the four main components (Table 7).

Table 7: Components of AAC systems

Hardware & Operating System	Software	Vocabulary	Language Representation system
For example:	*For example:*	*For example:*	*For example:*
PC laptop	**The Grid 2** **DynaVox**	**Word Power**	**Text and/or symbols**
Swivel screen PC tablet /netbook	**The Grid 2**	**Picture Word Power**	**PCS symbols**
DynaVox V, V Max+, or Maestro	**DynaVox**	**CALLtalk**	**Widgit symbols**
Tobii C8, C12	**Tobii Communicator** **The Grid 2**	**Fully custom-built vocabulary**	**Symbol Stix**
Springboard Lite	**Dedicated OS**	**Unity**	**Symbols (Clarity symbols or PCS) and text**
iPad, iPod Touch, iPhone	**Proloquo2Go**	**Proloquo2Go**	**PCS symbols**

With some of the devices, each of the components can be changed singly, leaving the other three selected - a bit like a fruit machine. Not quite every example in every column can be combined with every other, but a good deal of 'mixing and matching' is possible.

Decisions as to which system is right for an individual student will be based on assessment by a specialist professional and/or team (not just educationalists, but usually including speech and language therapist and maybe other health professionals such as occupational therapist). Many factors will influence the decision,

[58] In many cases, although it would not be built-in, the Scottish Voice Heather (which is a Windows SAPI 5 or Apple OS X voice) can be installed for use in a complex VOCA. However, as there is only a female voice and not (yet) a male voice, this would only benefit female AAC users.

including in particular the student's physical accessing ability. For example, if the student has limited vision, poor hand function and needs to operate his/her communication technology using a single head switch, the choice of hardware will be determined by size of screen; the software by the range of suitable switch scanning options; the vocabulary by screen layout based on fewer cells and frequency of use locations.

What Complex Text-based Communication Systems are currently in use in schools and colleges?

The following are all examples of types of talking word processors, using text to speech output, word banks, word prediction and various keyboard layouts (onscreen and/or external).

Figure 49: A student using a DynaWrite

Some devices are 'dedicated' (i.e. designed specifically as communication aids and carrying out that main function) while others may be mainstream platforms (such as a Windows PC) running specialised communication software.

Dedicated Devices

Lightwriter

Lightwriters are small, robust, portable British text-to-speech communication aids specially designed to meet the needs of people with speech loss. The Lightwriter is popular and the most widely used device of its type, in schools and colleges in the UK. Lightwriters have high-legibility dual message displays, one facing the user and a second out-facing display allowing natural face-to-face communication. This gives the user the opportunity to maintain eye contact, facial expression, and body language with their listener / conversation partner.

Figure 50: Lightwriter text-based AAC device

The Lightwriter includes rate enhancement features such as phrase storage, prediction and abbreviation expansion. It also has SMS texting,

and infrared remote control of electrical appliances in the environment.

Access-wise, it has various keyguard options. The latest version is not switch accessible but alternative models are.

Figure 51: Lightwriter with switch access

Other similar dedicated devices – though less used in schools and colleges in the UK – are the **Allora** and the **DynaWrite** (pictured below, left to right). These also offer voice output, prediction, pre-stored phrases, and infrared environment control, and, additionally, upload and

replay of MP3 files of a recorded voice, for personalised phrases. The DynaWrite has a spell-checker, offers single and dual switch scanning options, and can connect to a PC to act as a keyboard emulator.

Figure 52: Allora

Figure 53: DynaWrite

Non-Dedicated Devices: Specialised software on mainstream ICT devices

AAC software packages can be installed on a range of mainstream hardware, such as tablet and laptop computers, netbooks, and handheld mobile devices such as the iPod and iPad.

Figure 55: Fizzbook Spin tablet PC

Figure 54: Windows CE 'palmtop'

Clicker 5

Clicker's talking word processor comes with a selection of fonts, simple tools, and quality speech output that motivates and supports students' writing. Clicker also comes with a selection of onscreen keyboard layouts for different users, and personalised layouts can be created

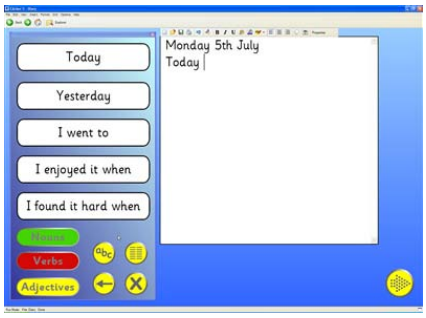


Figure 56: Clicker 5

Speech feedback helps students to preview words they want to write and to review text they have written and Clicker Grids supports students' writing by providing point-and-click access to whole words, phrases, and pictures. You can create 'word banks' of useful vocabulary and Clicker 5 includes the Crick Picture Library, containing over 1800 curriculum pictures for visual support.

Additional picture sets can be linked in to Clicker, for example, a set of communication symbols, so that an AAC system made up of personalised communication grids can also be produced for individual pupils to 'give them a voice' as well as to record their work. (This is usually at the introductory / training stage, rather than using Clicker as a full-scale communication aid permanently.)

WordPower Vocabulary (in Grid 2, or DynaVox or Minspeak software)

WordPower provides access to core vocabulary, and additional words by means of the fewest possible selections. Language studies have shown that all speakers re-use a small number of words very often in everyday language use, often referred to as our "core vocabulary". WordPower places this core vocabulary on the top screen / main grid, so these words are readily available in a single selection.

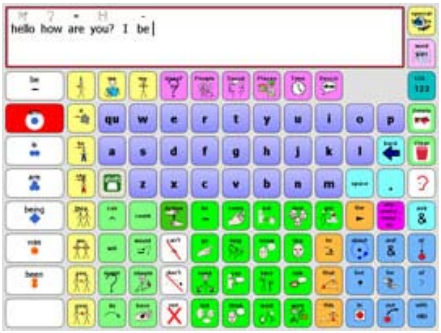


Figure 57: WordPower

To find words that are not included in the core vocabulary, you can type (with the support of word prediction) or go to one of the vocabulary pages arranged by topic.

The Grid 2 versions of WordPower use features such as verb morphology and spelling support. Picture WordPower displays symbols next to the words to aid word-finding. Symbols are also displayed in prediction cells.

Alternative versions of WordPower are available for switch users in some communication aid software. These offer the possibility of re-arranging the screen layout to increase the efficiency of scanning the grids and keyboards, and also use block-scanning to make cell selection easier.

In addition to the above, there is a range of alternative software for text-based AAC purposes such as Windbag (Sensory Software, UK) and EZ Keys (Words+, from USA).

These are in some ways very similar to writing programs that offer prediction, but with enhanced options for accessibility, rate enhancement, and speech output options.

Apps are starting to appearing for iPad / iPod Touch and iPhone that offer an onscreen keyboard and word prediction and speech output. For example, iMean, and Assistive Chat (via iTunes, App Store). Again, this is likely to be an area of rapid new development.

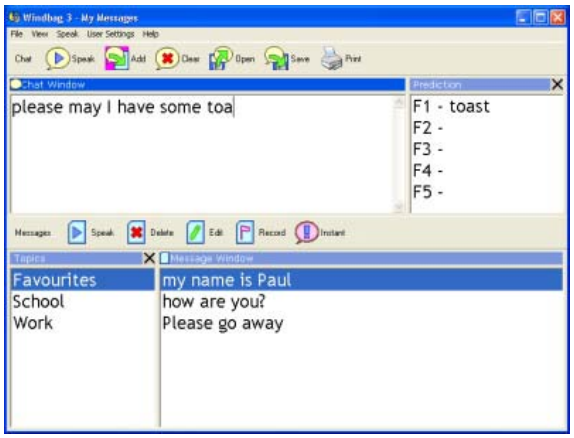


Figure 58: Windbag

Which disabled candidates might need Complex Text-based Communication Systems?

Any of the various disabilities that need AAC as a replacement or a backup for ordinary oral speech could be a user of text based AAC, ***if*** the individual has an adequate literacy level. Users of text-based AAC tend to be the most cognitively able and the most literate of all AAC users. They are looking for voice output to support personal interaction, and features that provide rate enhancement (as letter by letter typing would be unacceptably slow) and possibly some linguistic and spelling support. For a user with reasonable accessing ability and speed and whose literacy level is adequate[59], text-only systems offer the greatest access to an unlimited vocabulary and the most flexibility.

Users of such technology, like all users of AAC, will include those with acquired, progressive and congenital conditions such as Cerebral Palsy and Dyspraxia.

As a sub-group of the overall group of students who use AAC (see Which disabled candidates might need AAC?), the most common users who favour text-only systems specifically might be:

- Students with good language and literacy.
- Students who have an acquired disability, having previously already developed language ability and literacy.
- Students who have some functional speech, using this as their primary means of communication and requiring voice output device mainly as a 'backup' when they are understood (e.g. by new people).
- Students who have been used to (or who still also use) a low-tech letter-based system (alphabet board, or typewriter) or who use computers a lot and are already keyboard and word-processor oriented.

What is the current understanding among stakeholders regarding current use of Complex Text-based Communication Systems in assessment?

Text-based communication technology is perhaps the most commonly used and most well known of all AAC systems. The medium of text – letters, words, sentence building - is similar to mainstream language production methods, so is easily understood by other people in general.

Because devices are letter-based (whether using a conventional keyboard, or on-screen keyboard display) they seem familiar. However, text-based communication technology is not just a 'talking keyboard' used for writing, but is principally an aid to personal communication. As letter-by letter text-production would be too slow to be

[59] If access and literacy are not adequate, then forcing a user to use a text-only based system is inefficient and inappropriate, whereas a symbol based or mixed system would be much better.

an effective means of personal communication, most text-based AAC systems include 'hidden' features facilitating message retrieval and message construction, which may not be so familiar to all stakeholders.

Some of these text-based options have already been described in detail earlier, where their advantages were highlighted as supports for writing (for non AAC users, i.e. students who can speak). In the context of AAC, these same features are also useful for rate enhancement. For example:

- Word Banks (arranged by topic, or alphabetically)
- Alternative dictionaries (by subject)
- Abbreviation expansion
- Prediction (word, and grammatically based sentence prediction)
- Phrase storage

(Professor Stephen Hawking uses all of these features (though most listeners might not be aware of this)).

Users of text-based AAC are amongst the most independent of all AAC users, but even skilled users may need a very long time to construct responses, using this type of communication technology. Furthermore, even if they have a SAVE facility and/or a printer attached directly, users are not necessarily fully independent and are still likely to need a scribe in attendance to record their spoken responses, in an exam or other assessment situation.

Because of the slow speed of communication, users of this kind of technology may choose to talk/write in 'key words' and short phrases, rather than in long and fully formed sentences. This may lead to misinterpretation of the student's responses and/or underestimation of the student's ability and subject knowledge.

Case Example

Paddy has cerebral palsy. He attended a mainstream Primary and Secondary school and although he was provided with various AAC devices and systems over the years, he preferred to use his own speech (although this is really unclear and difficult to understand) and managed to 'get by' with staff and local friends who knew him really well. As he approached transition from school to college (in a different town), an AAC specialist (CALL Scotland) worked with the local authority ICT and ASN development officer to try and get Paddy to use the portable Lightwriter that he had been supplied with. He would be meeting many new people, including staff, who were not used to his unclear speech, didn't have the time to get used to it, and who would be inclined to underestimate his overall abilities based on his poor communication skills.

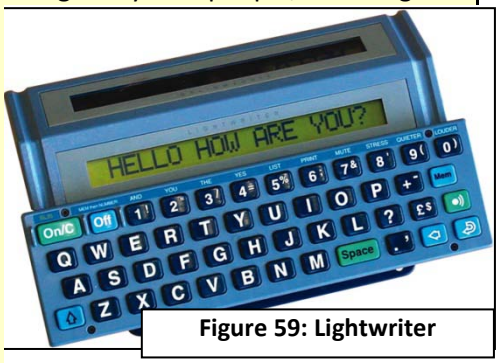


Figure 59: Lightwriter

Paddy has now finished his 'link year' with part-time school and college attendance, and is entering a three-year course focusing mainly on business and IT subjects. His college tutors are encouraging him to use the Lightwriter more, and are expecting it to be used in assessment situations, primarily for independence. Staff are trying to tailor his educational programme to include time to work on building up, personalising and practising the pre-stored phrases feature. Staff can see that coming across as a competent independent communicator will be crucial for Paddy's chances of employment in the future. Paddy also uses a special rollerball and large size keyboard for computer work, as the standard keyboard and mouse are a struggle for him.

Complex symbol-based or mixed text/ symbol AAC

As above, these devices can be either dedicated communication aids, or computers that have been adapted for use as communication tool and can also be used for other functions. Devices vary in size and weight, as well as in the amount of vocabulary they can store (and in the way it is stored and displayed). They also vary in the way the user can access their messages, including the use of direct selection of a screen or keyboard with a body part or pointer, adapted mice or joysticks, eye gaze, or indirect selection using switches and scanning. The specific access method will depend on the skills and abilities of the communicator.

What Complex symbol-based AAC is currently in use in schools and colleges?

A variety of symbol-based AAC systems and devices are in use in Scottish schools and colleges, with vocabulary design and size ranging from the very sophisticated to the more basic. They all generate synthetic speech output and most can be connected to a printer. This paper does not attempt to describe in detail all of the available systems, but just a few from each category.

Dedicated Complex Symbol-based AAC Devices

Static Display Devices have a single keyboard (or, more accurately, an array of button switches). The user interacts not with the keyboard directly but with an overlay (paper / plastic covered) on top of the keyboard, which displays coloured symbols (also showing letters and numbers). This overlay is static so all the symbols are constantly displayed on the device.

Figure 60: PathFinder

A **PathFinder** is an example of a static display communication aid. These were fast and popular devices, but they are being phased out in favour of dynamic screen devices (see below), although the underlying concept remains of how they organise and generate language for the user.
The user creates his/her message by selecting a short sequence of icons from the overlay. This is in essence a special 'language' or 'code', sometimes called 'Minspeak'. Language programmes (or Minspeak Application Programmes = MAPs) provide the overlay of multi-meaning icons and a communication vocabulary organised by semantic concepts and grammar. The user can generate messages using the icons, key linking, and spelling with word prediction. Messages appear on the screen and are spoken out. These devices have a large memory and allow the student relatively rapid access to a very large and open-ended vocabulary.

Because they require the user to learn and retain a new 'code' for retrieving stored messages – almost like learning a new language, albeit a simple one - such systems tend to be used by more cognitively able students.

Dynamic Display Devices have a touch screen. Multiple pages of symbols are possible, and thus only a small portion of the symbols available are visible at any one time. The user accesses different messages and words by navigating from page to page through a large set of linked pages/screens.

The newer Minspeak devices from Liberator Ltd. have dynamic rather than static screens. This mean they can offer both the fast method of using icon codes (e.g. for frequently use core vocabulary) and also the method of displaying individual vocabulary items on linked screens of conventional single meaning symbols (often for more fringe vocabulary).

On the conventional type of dynamic screen AAC devices, vocabulary is organised by frequently used or 'core words' and by topic. For example, the user may select a "feelings" symbol. The screen will then change to a number of new symbols that represent feelings. Each time the person selects one of these symbols the device speaks a message aloud using synthetic speech. Stored messages may be represented using symbols and/or words. Keyboard/text based layouts with word prediction can also be used by more literate pupils to communicate.

Figure 61: DynaVox Xpress

There are many other examples of dynamic screen communication aids. These can be roughly grouped by size:

- Larger size - DynaVox Series 4, DynaVox V Max+, Liberator Vanguard, Liberator Eco 2, Tellus 3+, Tobii C12
- Smaller size – Liberator Vantage/Lite, DynaVox V, DynaVox Xpress, Springboard Lite, Tobii C8, Tellus Mobi
- Handheld size: Tellus Smart, Jive!, Say it Sam, Chat PC II

Non-dedicated Complex Symbol-based AAC Devices

Many of the latest generation of complex symbol-based / mixed communication aids are actually full-scale Windows PC computers but in a specialised hardware case, and running specialised communication software (which offers a range of special access methods, e.g. switch). You can choose to set them up 'locked' - so that the user can only access the communication aid software (and, potentially, link to other applications only through the communication aid software), or 'open' - so that the user can have free access to all the installed applications (including internet browser etc.)

Figure 62: Tobii C12 communication aid/computer

Mainstream Devices: Communication aid application (apps) for devices like the iPod Touch and iPad are now becoming available. These are highly affordable (for example, for parents) and easy to use. This is a rapidly developing 'growth area'. Similar developments may be anticipated for Windows Mobile, Android, and future mobile device platforms.

These are accessed via the touch-screen, can offer text, symbols and/or mixed text and symbol, with both built-in vocabulary and the facility to add in new words, phrases and messages.

Of the currently existing AAC applications for iPod, **Proloquo2Go** is the best designed and the most extensive and highly finished. It was designed specifically for users with communication disabilities, particularly children with autism who may have excellent vision and hand function.

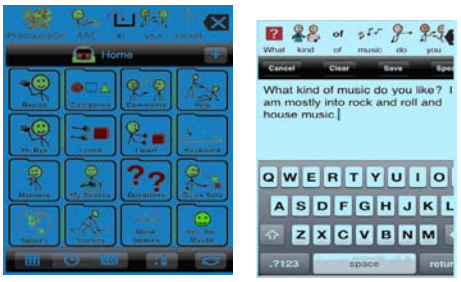


Figure 63: Proloquo2Go

With Proloquo2Go, pupils use picture communication symbols called SymbolStix to represent words (or they can use text only). Symbol supported messages appear in the display and a synthetic voice is produced. You can have between 1 and 36 symbols per grid/screen or have a traditional iPod 'list view' for the symbol vocabulary. Newer versions will also include switch access and prediction.

Which disabled candidates might need Complex symbol-based AAC?

As a sub-group of the overall group of students who use AAC, the most common users of symbol-based and mixed systems might be:

- Students with no speech at all, so no experience of imitation or expressive language use other than through a vocabulary set that has been provided for them.
- Students with learning and/or literacy difficulties-requiring symbol support for text.
- Students with slow or difficult accessing, for example using switch and scan selection rather than direct pointing.

Most students who use symbol-based communication technology can access a very wide vocabulary. Depending on age and ability and when they received their communication aid, they may be at an early stage of learning to combine words into sentences or they may be well on the way to building and sequencing phrases and sentences. If they have some reading and spelling, they can extend their vocabulary even further by text missed in with their symbol-based vocabulary, leading to an open-ended, if not unlimited vocabulary.

Users of symbol-based and mixed AAC systems need voice output and also rate enhancement (as letter by letter typing would be unacceptably slow). They may require linguistic support - either from the AAC system in the form of stored phrases and /or prediction (symbol supported predictive text is available in some though not all of the AAC devices mentioned above) and/or from a human communication facilitator, in the form of re-ordering key words and phrases into more grammatical connected language.

What is the current understanding among stakeholders regarding current use of Complex symbol-based AAC in assessment?

Very low indeed. Seeing the pictorial/symbol interface, some staff may underestimate the overall cognitive ability of students, not realising that symbols can be a powerfully efficient coding system that speeds up communication (i.e. not just evidence of a failure to use text).

On the other hand, many stakeholders may have unrealistic expectations and believe, wrongly, that a student just needs to be 'plugged in' to a Talker and will somehow magically just start communicating more or less normally. They may be unaware that it takes many years of learning and practice to use such a system, just as it would if we were expecting a student to express him/herself in a foreign language.

People often underestimate the cognitive and educational ability of a student who is a switch and scan user, just because of the very slow speed of message generation. Students are often not given enough time to compose an answer - the time they require is generally under-recognised. Students often use 'telegraphic' language not because they are language-impaired, necessarily, but because it is the most efficient strategy for transmitting information under the restrictions of slow speed and high physical effort.

Case Example

Morag has cerebral palsy and no functional speech at all. She has used communication aids since she was in Nursery. She is now in S2 and uses a DynaVox DV4 operated by a single chin switch, running the CALLtalk dynamic screen vocabulary which provides topic based banks of vocabulary, and also a keyboard and prediction, built-in. She is working on Access Maths and enjoys 'interviewing' peers in mainstream using her Talker, as part of her Health and Well-being programme, to develop social communication skills.

Pre-programmed / Medium Tech AAC devices

Communication aids in this class are simpler and more limited than the complex systems described in the section above. They are all 'dedicated' communication aids, with only one main function. They all require someone to record speech into the device, which then produces 'digitised speech', either in single words or whole messages. Their software allows them to play back spoken messages, but not to process text or print out.

Within these overall constraints, this class of communication aid contains many different devices, on a continuum from highly featured to very simple and limited. The main differences between them, apart from the obvious size, weight and robustness of build, include things like:

- use of 'static' symbol-based paper overlays or screen-based dynamic displays
- number of message locations per level / screen (from 4/ 8 or 9/ 12/ 16/ 20/ 32/ or even, in one case, 128 cells)
- whether they have a message screen or not, and if so, what appears in it (i.e. just text, or text + symbol?)
- whether they come 'blank' or offer pre-organised vocabularies (or rather, personalisable vocabulary 'starters')
- total length of recordable message time available?
- direct press only, or switch and scan access option?

The main point about this class of device, as regards assessment situations, is that all vocabulary inside them has to be pre-programmed. In practice, this means that the student is entirely dependent on their helpers having made the effort to think through and programme in / update important vocabulary. We know from experience that some students may be better served in this respect, than others. It also means that person programming has to try and programme in all the vocabulary that the student will need, without 'leading' the student and prompting the correct answer by displaying it. This is a thin and poorly defined line that could be easy to cross inadvertently. For this reason, to maintain fairness, multiple-choice style of questioning will be better suited to users of pre-programmed communication aids than 'open' questioning.

Dynamic screen pre-programmed AAC devices

Figure 64: Springboard Lite

These are the most highly featured of the pre-programmed communication aids, and outwardly behave and look outwardly similar to the complex VOCAS. These have a screen and require navigation from page to page. They can use both symbols and text. However, they have 'digitised speech' and therefore all vocabulary is pre-stored and they do not have spelling or word prediction capabilities. This makes the vocabulary and language production more limited than complex VOCAS. The vocabulary is organised in terms of core and topic vocabulary. Examples include:

- Liberator Springboard / Springboard Lite
- DynaVox M3

Additionally, there are some new recorded/ digitised speech communication applications (Apps) now available for the touch screen iPhone, iPod Touch and iPad (and even the Nintendo / Nintendo Lite). However these are very basic and would be used mainly only to request specific wants and needs.

Static overlay pre-programmed AAC devices

Figure 65: Tobii 32

These vary in the number of cells or buttons available for the pupil to access. Some devices come with a number of different levels for storage of topic based vocabulary. Paper-based symbol overlays are printed and put into the device and spoken messages are recorded into the device. These have a more limited memory (a number of hours) than the Dynamic screen devices and so have more limitations in the amount of vocabulary and language available. Other examples are the Go Talk (4+ 9+ 20+ Express 32), Tech Talk 8, 32, Listen To Me, Message Mates.

Which disabled candidates might need pre-programmed AAC devices?

These very simple devices are commonly used by learners functioning at a very basic 'beginning communicator' level, often as their first ever experience of any voice output aid. However, such devices are so easy to use that they can often be used by more experienced users for particular communication tasks, such as assessments that can be undertaken using restricted vocabulary.

What is the current understanding among stakeholders regarding current use of pre-programmed AAC devices in assessment?

Low. Many non-experts are not clear about the distinction between complex communication aids (which generate synthetic speech and therefore can output a theoretically unlimited range of utterances), and pre-programmed medium tech communication aids that have had messages recorded into them.

It is indeed not necessarily easy to recognise the difference between the two classes of communication aid just by looking at two devices.

In assessment situations, the distinction is extreme – a user of a complex device could in theory generate answers to questions that are long – essay length – and grammatically correct using a full range of functor[60] words. We say in theory because to do this would require many hours of extra time allocated because the rate of production of novel text is far slower than is production of stored text. A pre-programmed device on the other hand requires the right messages to be stored and for the candidate to then select from these messages. Novel text can, at a stretch, be generated by combining pre-stored messages in novel ways and relying on someone else to transcribe what was meant. This would depend on a high degree of partner influence.

[60] Generally small words like *by, with, from but* whose inclusion make for text that is easier to read.

Pre-programmed devices are problematical in the exam or external assessment situation. To be able to respond to open questions, the correct answer (perhaps along with some incorrect distracters) must have been pre-stored.

Pre-programmed devices offer significant strengths in multiple-choice questions. By presenting the candidate with a limited range of options to choose from the potential for partner influence is much reduced. Invigilators would find it relatively straightforward to check if the response transcribed matched that spoken by the device.

Alternatively, the device could be used at a very simple level, with pre-stored spoken responses of, say 1,2,3,4,5,6, and the user would choose to 'say' a number to correspond with the answer numbers on a multiple choice quiz sheet.

Pre-programmed Single or Sequenced Message Communication Aids

These are very simple tools that carry out one two very basic communication functions.

BIGmack (and Littlemack) and equivalents[61]

These are big (or little) buttons that allow you to speak in and quickly record one message (of up to about 20 seconds in length). Each time the button is pressed thereafter, it will repeat that same recorded message out loud. Because it is so simple, it is quick to use and can save effort.

Messages can be changed quickly and easily, as the situation changes and if a new recorded message is required.

Figure 66: BIGmack

In assessment situations, this alone could not meet all communication needs, but used alongside other communication approaches and technology, could have a useful role to play. For example, a BIGmack or equivalent could be used to allow the candidate to quickly and easily use a message relating to personal comfort, thus saving time and avoiding distraction (i.e. no need to divert away from the vocabulary pages already in use on a more complex communication aid for answering questions within a particular academic topic):

- signal discomfort or pain
- ask for a break
- request drink or toilet etc.
- say something like 'I don't understand, please can you repeat the question?'

Conceivably, in a multiple choice test, a BIGmack or equivalent could also be used to say ''that one!' to select a particular answer choice as each of the options are read out in turn (i.e. instead of the usual 'Yes' signal which would generally be normally quicker and easier). In such circumstances the potential for partner influence would be monitored, to avoid unintentional 'clues' such as intonation or volume change as the possible options are presented by the communication facilitator (e.g. "possible answer…possible Answer…POSSIBLE ANSWER!")

Step by Step (and equivalents)[62]

These devices store a series of short recorded messages one after the other, either in a set sequence or, with some devices, to be repeated randomly. In assessment situations they might conceivably be used as an alternative to the single message device described above, to give a choice from a wider range of possible messages. For example, all the possible 'quick messages' needed by a

Figure 67: Step-by-Step

[61] BIGmack is just one brand name amongst many, but as the market leader has become almost a generic name for all devices of this sort. Other similar / equivalent devices are manufactured and marketed by various different suppliers under various different names, eg. LITTLEmack, Partner/Plus, Big-Point, Go Talk Express One, Lex, and others.

[62] Step by Step, Sequencer, Stepper, Step Pad, Randomiser

candidate could be stored in a Step by Step, and the candidate could then press repeatedly to quickly step through all the messages until he/she gets to the required message. Again the potential for partner influence is high as the communication facilitator could provide unconscious cues as to which of the series of messages is correct. One option is to include distracters.

Which disabled candidates might need pre-programmed Single or Sequenced Message Communication Aids?

These very simple devices are most commonly used by very young children or learners of any age functioning at a very basic 'beginning communicator' level, often as their first ever experience of any voice output aid. However, such devices are so practical that they may still be in use by non-speaking pupils who are very cognitively able, alongside a much more complex communication aid, or as just one part of a communication system made up of a range of different high and low tech components.

What is the current understanding among stakeholders regarding current use of pre-programmed Single or Sequenced Message Communication Aids, in assessment?

Low. If people are aware of this range of communication aids at all, they are likely to perceive them as a 'starter' level communication aid. Using any AAC in assessment situations is new, and even staff who are very familiar with a pupil may not have had the idea of using a device like a BIGmack - which is normally used daily for, say, carrying News between home and school – in a different way, within assessment.

Case Example

Benny is 14, has cerebral palsy, attends his local secondary school, and is being assessed at Access 1, and later 2, in PSE, and Personal Care. He uses several methods of communication, more or less all together. When answering questions and demonstrating his knowledge, both he and school staff prefer to use the simplest and most straightforward methods possible, which are often also the quickest. Many of these rely on the communication facilitator following agreed procedures for presenting the questions. For example:

- To answer closed questions, he uses a no tech signal – 'Yes'= head nod; "Don't Know'= head/eye roll: 'No'= head down + slight shake
- To choose an answer, he can point with his finger to specific pictures and symbols displayed before him, in a large composite picture or in a grid of possible answers. (see 'Low Tech' section, below).
- To choose between 2 or three possible options presented to him, he will point or eye point to either left, middle, or right - depending on where the communication facilitator gestures as each option is read out.
- To answer multiple choice question papers, he uses the 'Number Page' on his DynaVox M3 voice output communication aid to answer 1,2,3,4 or 5 and thus select his chosen answer from the list of options read out to him.
- To express discomfort or distress quickly, he uses a BIGmack single message button pre-programmed with a message that says "Help, I need a break now, can't go on!"
- Having used that message to obtain a break, in order to explain what is wrong he responds to questioning by signalling Yes/No as above, or by pointing on a low-tech symbol chart to one or more messages on a set that has been pre-prepared for the assessment session. (He could also, if required try to use his M3 to explain in his own words what is wrong / what he needs.)

Low Tech Communication Methods (Low Tech AAC)

Low Tech communication systems do not involve technology or give the option of voice output or visual output to a computer or printer. The student relies on a communication partner to 'read' what they are indicating using their letter, word or symbol chart and to translate or 'interpret' their responses. Students who use a high tech communication aid such a Lightwriter or DynaVox usually also have a low-tech communication system to use as a backup e.g. if their high tech device encounters technical problems. There are also certain situations when having a communication partner to 'interpret' their responses enables the student to communicate their ideas and opinions more fully and effectively. Some communication impaired students only use low-tech communication and prefer not to use high tech communication aids at all.

In the case of deaf students, the person who supports communication is called a 'BSL Interpreter.' However, as stated on p57, with AAC the person 'co-constructs' language with the student rather than 'translates' and so we are referring to them as a 'communication facilitator.' The role of the 'communication facilitator' is particularly important for a student using Low Tech AAC and would require further investigation and specific guidance for exam situations.

An important issue to take into account for candidates using low-tech communication methods is the degree of 'Partner Influence.' Ensuring a high quality 'communication facilitator' who has received guidance on maintaining low Partner Influence on the candidate's responses in an exam situation would be viewed as good practice.

Strengths of low tech/Why low tech is useful

Some students who use AAC and have a high-tech device may nonetheless prefer to use a low tech AAC method in an exam setting, as human 'interactive or co-constructed' responses may be quicker than 'computerised' responses, thus being viewed as a rate enhancement technique. Low tech methods may also be less effortful and tiring for a student who has physical disabilities, therefore giving them less of a disadvantage in the 'timed' exam conditions.

In particular, candidates may choose to use low tech communication if they require alternative methods of accessing both ICT/high tech AAC (e.g. switch or joystick) and likewise their low tech letter/symbol board e.g. 'partner assisted scanning' and find low tech methods of access preferable in high pressure situations.

A reason for this could be that a 'communication facilitator' can 'adjust their settings' e.g. speed of presentation of the letters or symbols more flexibly than a computer and 'technical hitches' are less likely to occur. Using a low-tech system could prove to be less stressful and enable the student to achieve their potential in an exam situation.

Successful interaction between the candidate and 'communication facilitator' is vital in ensuring that the answers being expressed are both understood properly by the facilitator and communicated as quickly and fluently as possible by the candidate in an exam situation.

To use such access methods, the student needs to be able to indicate in some way to their facilitator what word, letter or symbol is being selected. They may be able to do this by pointing. However students with more severe physical disabilities may not be able to do this. There are a variety of methods of accessing or selecting a word, letter or symbol from a low tech display, which require more partner 'facilitation.' These alternate methods of access will be explained further in the 'Low Tech Access Methods' section below.

Some of the access methods used for 'output' of responses from the candidate's low tech communication system could also be used by the communication facilitator to present or 'input' the exam paper itself, making it accessible to the candidate when presented in a suitable format. This will also be suggested in the 'Low Tech Access Methods' section below.

Low tech Access Methods

Output of responses

A person who uses a low-tech communication system needs to somehow indicate which symbol, letter or word they wish to select. They may be able to do this by pointing or 'direct selection.' However, students with more severe physical disabilities may not be able to do this.

There are several different ways of alternately accessing or selecting a letter, word or symbol from a low-tech display, which will be described below. These methods are called 'indirect selection.' We will also suggest how some of these methods could be used to enable access to some of the existing exam paper formats or some sections of an exam paper, for students with physical disabilities. The degree of Partner Influence needs to be taken into account when using indirect methods of selection.

Direct Selection

This is when a person simply points to or touches the letter, word or symbol they have selected. It is usually done by finger or fist pointing, but other parts of the body can also be used e.g. elbows or feet. This is a common method of access and is most familiar to us as we do it all the time e.g. typing on the keyboard, pointing to a written word.

As well as using this access method to communicate their responses on a low-tech communication system a candidate could use this method to point to answers on an exam paper (e.g. multiple choice). There is low Partner Facilitation involved and the potential for Partner Influence is low.

Direct selection - eye pointing

If a student does not have a reliable way of directly accessing with any other part of their body, eye pointing may be used. Eye pointing is when a student directs their gaze at the desired object or symbol on the display. Objects, symbols, words or letters may be attached to an eye-pointing or ETRAN frame so that the person can communicate and make choices.

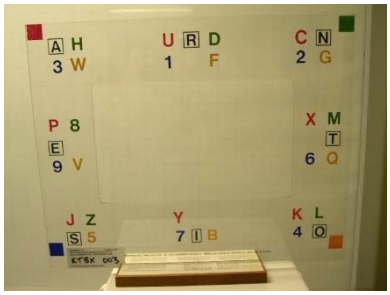


Figure 68: Eye-gaze E-tran frame

In multiple choice format papers, A, B, C or D or 1,2,3 or 4 could be put on an eye-pointing frame or on a desk or tray so that the candidate could eye point to their chosen answer. The communication facilitator needs to be very sure which answer is being chosen, as the response could be quite fleeting.

This method involves high Partner Facilitation and the potential for Partner Influence could be high.

Indirect Selection - scanning

Simple scanning

Scanning with a low-tech system is usually called 'partner assisted scanning' or 'listener scanning.' This means that the communication facilitator indicates the items on the display one by one or group by group.

The student selects the group, then the item they want, by signalling with an agreed action e.g. nodding, smiling or eye-blinking.

Auditory Scanning

Blind, visually impaired and students with processing difficulties can benefit from auditory (as well as) visual prompts. The communication facilitator speaks out the items as they go through them and the person 'signals' when they hear the one they want.

Use of scanning in assessments

This method would be used by the student to access his or her communication board or book to compose an answer, but there would be very few opportunities to use this method to access the exam paper itself.

The communication facilitator would need time to look over the paper beforehand and decide how to present it (as provided for sign communicators).

It is possible that this technique could be used for example when the candidate has to identify a specific word in a paragraph in an English question, e.g.: "which word describes how the thief escaped?" The communication facilitator would point to each word in a passage or excerpt until the candidate signalled their answer: for example, by nodding. Auditory scanning would mean that the facilitator would also speak each word for the candidate as they pointed and the candidate would again signal when they heard the answer they wanted.

This technique could also be used in multiple choice papers, when the candidate is not able to directly point to the answer A, B, C or D or 1,2,3 or 4. The communication facilitator would point to each option until the candidate signalled their answer with a nod or gesture. In auditory scanning they would also speak each option as they pointed to each in turn and, to select, the candidate would again give a single response signal.

This method also involves high Partner Facilitation and the issue of potential Partner Influence would need again to be addressed.

Row Column Scanning

'Row/column' scanning can be faster and more efficient than simple scanning. This would be used with the student's communication book and is not applicable for accessing an exam paper format itself.

Manual scanning - when the communication partner points to each row until the person indicates the correct row has been reached. They then move along the row item by item until the student indicates the symbol/word/letter that he/she wants.

Auditory scanning - when the communication partner speaks out the first item in each row until the person indicates the correct row. They then speak out each item on that row (the columns) until the person indicates the symbol/word/letter that they want.

Examples of Low Tech AAC options for candidates

The most common types of Low-tech AAC systems are charts, boards or books with letters, words or symbols. The learner uses one of the access methods previously described to choose single letters, whole words, or symbols (with a text glossary).

Candidates with……..	**Might use……..**
Literacy Skills, Physical difficulties but with some fine motor control (finger or fist pointing)	An alphabetic layout letter/word board A qwerty layout letter/word board
Literacy Skills, severe physical difficulties which require alternative access methods	A frequency of use layout letter/word board used with indirect access e.g. simple scanning (communication facilitator points to each symbol)
Emergent literacy skills and some fine motor control	Symbol communication book used by direct access (finger, knuckle)

What Low-Tech Letter/Word Boards are currently used in schools and colleges?

Low-tech letter and word boards require the student to be literate in order to spell out words or select whole words from word lists. They are usually QWERTY, alphabetic or frequency of use layout, depending on the student's needs.

QWERTY - a student who uses this layout for text to speech on their communication aid and who has learned to spell using their computer may have a querty letter board. This is the most popular configuration of letters, used on mainstream computer keyboards, and is the most familiar layout in general.

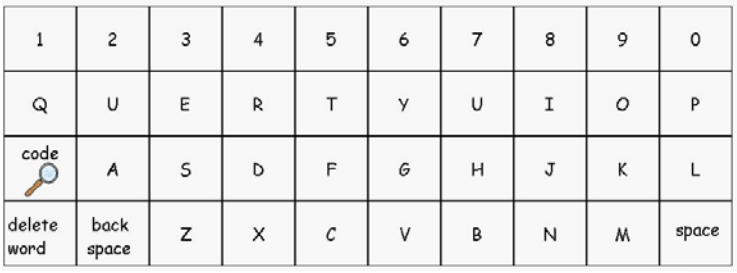


Figure 69: Qwerty letter board

Alphabetic - letters or words are grouped alphabetically to be accessed by the student. This layout would tend to be used by students who have some hand function and can indicate directly (using a finger, knuckle, fist etc.) or by someone who accesses using an indirect method but is more used to alphabetic spelling than any other layout. Students may also use pre-agreed 'codes' for abbreviation expansion as a rate enhancement technique: for example, the student might indicate "CM" to stand for 'cell membrane' in Biology.

Common words and phrases are often added to the board for speed of communication along with a 'code' symbol. The candidate might use the code symbol to indicate to the communication facilitator that they are about to use an abbreviation expansion and not misspelling a full word.

Frequency - frequently used words or letters are grouped together in a way that allows them to be accessed quickly and more easily by a student with physical difficulties, using direct access such as a head-pointer or an indirect access method such as scanning.

The frequency of use layout illustrated below is an example of a low tech row/column scanning layout and has the most frequently used letters in English (a,e,t,n) in the position that is fastest to access when scanning (top left corner) and the least used letters (v, j, x, z) in positions that take longer to access. The vowels are on the top row, which can also be helpful for spelling. Some common 'exam phrases' have been added to the first row so that they are quick to access when required.

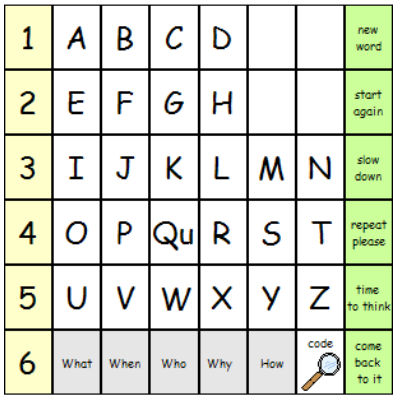


Figure 71: Alphabetic letter board

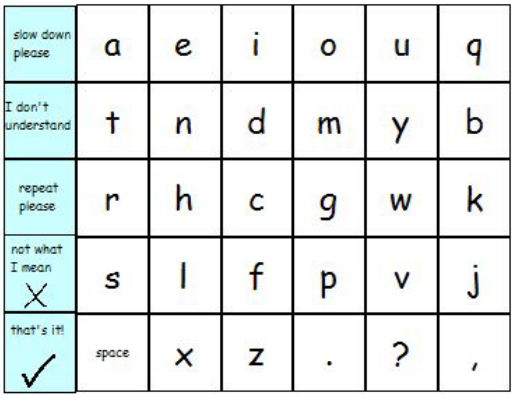


Figure 70: Frequency of use letter board

Which disabled candidates might need letter/word boards?

Students who have physical disabilities, no speech and good literacy skills, who are able to spell out words, select words or phrases, use abbreviations and make use of short codes for frequently used words or phrases. Students who have an acquired disability, having already developed language and literacy skills, would also make use of these strategies. There are also some students who have unintelligible speech and may need to use a letter board to give an initial letter prompt for the word they are trying to communicate. Some low-tech strategies can greatly enhance the rate of communication in both everyday and 'high pressure' situations, such as exams. For students with adequate literacy skills, low-tech text- based systems offer access to unlimited vocabulary and have the most flexibility for an exam situation.

What is the current understanding among stakeholders as to use of letter/word boards in assessment?

Awareness and use of high tech letter and word-based systems (e.g. using text to speech) is gradually becoming more widespread in education, and with its similarities to spelling, is relatively well understood. However, low-tech methods of indicating letters and words are not as widely understood, as they rely on a 'partnership' between the student and the communication facilitator, which is highly individualised. The communication facilitator needs to be familiar with the candidate's rate enhancement techniques and, while interpreting their responses as fully as required, must be careful not influence the candidate's answers in any way.

Issues in assessments

- There is a reliance on the 'communication facilitator' to accurately translate/interpret the candidate's responses in the exam situation.
- There may also be a need for a second person ('scribe') to record the responses, as the 'communication facilitator' is involved in the complex translation process.
- The 'communication facilitator' needs to be familiar with the candidate and their method of low-tech access in order to give a fair and accurate translation of their responses. They need to have had scheduled opportunities for 'practice exams' with the candidate as well as being very experienced in communicating with them.
- 'Short cuts' or 'codes' (abbreviation expansions to represent whole words such as CM for Cell Membrane) need to be devised, agreed and be made available to the communication facilitator beforehand.
- The 'communication facilitator' could possibly be seen as affecting the credibility of the examination process. To avoid this, the centre or school should have gathered evidence that the support does not give the candidate an unfair advantage in the assessment.
- When the candidate is using direct access to a letter/word board in an exam, the required Partner Facilitation and potential for Partner Influence is low, because the candidate has direct access to unlimited vocabulary.
- Using indirect access, the Partner Facilitation is high and the issue of Partner Influence requires more attention.
- One option is to use video recording of the assessment to provide evidence. The learner may need to practise communicating in front of the video camera.

Case Example (SCQF level 4)

John has mild cerebral palsy, which affects his fine motor skills (for writing and typing) and speech. He attends a mainstream secondary. His speech can be understood by familiar staff and pupils, although it becomes very unclear and difficult to understand in unfamiliar or stressful situations. It is important to John that he 'fits in' with the other students at school and he is not keen to use high tech AAC in case he stands out from his peers. So he prefers to get by with a QWERTY letter board that he points to with his finger, when needed. However, John loves technology and particularly multimedia such as music, photos and videos. He uses the computer for some short writing tasks, but has limited hand function and uses an adapted keyboard, which is both tiring and time consuming.

John has been referred to an AAC Specialist (CALL Scotland) and has agreed to try out a mobile handheld device, with both text to speech and pre-stored phrases, which will give him clearer voice output in unfamiliar settings and with new people i.e. teachers, students and external agencies. In the meantime, he is most comfortable using his low-tech letter board to augment his speech when the listener does not understand certain words.

John is sitting Intermediate 1 English and will use his QWERTY letter board to augment his speech, in this tense exam situation. His communication facilitator is familiar to him and is aware of agreed codes for the abbreviation expansions he uses to speed up his communication when using his low tech AAC. She has also had opportunities for practice exams with Jack in timed conditions. A scribe will also be present to record John's answers in the exam, as spoken out by the communication facilitator as she 'reads out' his answers, step by step.

What Low-Tech Symbol-based communication boards/books are currently used in schools and colleges?

'Symbol systems' are a way of representing written and spoken language and there are many types available. The most common symbols to be used by exam candidates in Scotland are graphic symbols such as Bliss,

DynaVox Mayer Johnson Picture Communication Symbols (PCS) - often referred to as 'Boardmaker symbols - and Widgit Literacy Symbols (WLS).

These systems are used either by students with emerging literacy skills who need symbols to support the written word or by students who use graphic/pictorial symbols as a quicker method of communication and representation than spelling out individual words. Some students may use a combination of symbol layouts and alphabetic layouts; referred to here as a mixed system.

This type of low-tech system usually comes in the form of symbol boards/charts or books. They can have various layouts but usually include 'Core Vocabulary' or frequently used words such as *I, you, what, when* and 'Fringe Vocabulary' or topic words such as countries, colours, animals, planets in order for symbol-based sentences to be constructed by the student.

Boards

Some boards might have a layout based on some knowledge of grammar. The Fitzgerald Key, for example, has a left to right order of people/subjects-verbs-adjectives-objects and is colour coded to encourage consistency of the symbol organisation.

The vocabulary is set out all on one 'page' or 'chart' so is reasonably quick to access. Such boards may be attached to a student's wheelchair tray, so that they are accessible at all times.

Figure 72: Communication board

Books

Symbol books can hold a larger vocabulary of items, but can be difficult to use if the student has physical difficulties that make it hard for them to turn the pages independently. Books need to be well organised and have a consistent layout to be functional. The student needs to know where certain vocabulary is stored and needs to be able to navigate to the correct page and then indicate to the communication facilitator what symbol they are selecting. This takes time, especially if a student is using an indirect access method such as scanning.

Figure 73: Communication book

Which disabled candidates might need symbol boards/books?

Students who have physical disabilities and poor accessing ability, learning difficulties, visual impairment or emergent literacy skills requiring symbols to support their written and spoken language.

What is the current understanding among stakeholders as to use of symbol boards/books in assessment?

Understanding of the use symbol-based low tech AAC in assessment is very low. Many people see the use of symbols as an indicator of low cognitive ability, when in fact it may have been chosen for use as a rate enhancement technique for communication.

Many people are also not aware that a symbol system takes years of learning and practice, like an additional language and, particularly in its low-tech form, requires an experienced communication facilitator to interpret or translate the student's symbol-coded responses accurately.

One important point, that is often misunderstood, is that if a student uses symbol-based communication, it does not mean that they require examination papers to be symbolised. Symbol users are 'bi-lingual' – they will take in information in ordinary spoken English, so the questions can be read out to the candidate during the exam by a communication facilitator or reader/scribe. Then they output their own answers via a symbol display.

Issues in assessments

- It is not easy to produce novel words or sentences (no spelling or prediction), so the candidate has to rely on the vocabulary pre-stored in their board/book. This means that they might not have the correct words available in order to communicate their answers exactly, or that the possible responses would need to be pre-stored for the exam.
- Therefore, the 'communication facilitator' may need to 'think laterally' about what the candidate is trying to communicate using their symbol board/book in order to co-construct their responses. For example, the pupil might point to the symbols for 'water' and 'big' to indicate 'ocean.'
- This poses questions about the format of questions in examinations. Whereas a multiple choice A, B or C or 1,2 or 3 response would be easy to give using low-tech symbol systems, more complex 'open' answers requiring unusual 'fringe' vocabulary that the candidate wouldn't necessarily already have in their board/book, would need to be pre-stored before the exam. This could be seen as an 'advantage' in the examination (see Figure 74).
- Particularly with symbol-based communication, there may be issues around the communication facilitator's potential to affect the credibility of the examination process.

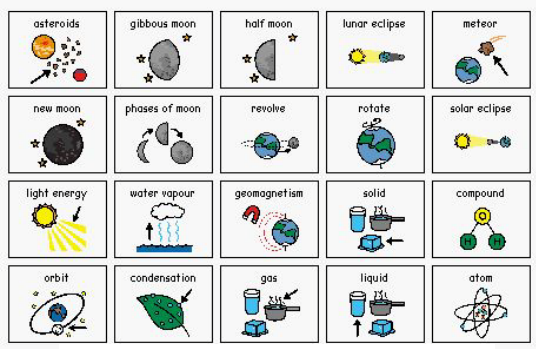


Figure 74: Communication board with topical vocabulary

When the student uses direct access to a symbol board/book, the need for Partner Facilitation is low. However the potential for Partner Influence is still quite high, as an element of decoding and lateral thinking may be required to interpret symbol coded responses.

When using an indirect access method to access symbol materials, the need for Partner Facilitation is high and the potential for Partner Influence could also be seen as high.

Case Study (SCQF level 3)

Suzie has severe cerebral palsy and moderate learning difficulties and uses a low-tech symbol-based communication system with partner assisted row/column scanning to communicate at home and in her special school environment. She has tried using high tech AAC but, as her physical accessing is so difficult and variable, she has not found a high tech method of communication that suits her.

Suzie uses her low-tech symbol system very effectively. She has a symbol communication board attached to her wheelchair tray, which has 'core' or frequently used words as well as personalised 'fringe' or topic vocabulary. In addition she uses a collection of 'topic' boards with vocabulary specific to certain areas e.g. business studies, history, and geography. Suzie is sitting Access level 3 Business Studies.

As her 'communication facilitator' points to the symbols on Suzie's boards, she waits until the correct pre-stored item is reached and then signals this by an eye blink to communicate her response to open questions. Suzie can also use this method to give her answers to closed multiple-choice questions. As her 'communication facilitator' points to the answer choices, Suzie will eye-blink when her choice of answer (A, B, C or D) is reached. This is a time consuming process and Suzie and her facilitator also require breaks during the exam situation.

For Further Information on Alternative and Augmentative Communication (AAC)

Specialist Contacts in Scotland

- **CALL Scotland** www.callscotland.org.uk
- **Augmentative Communication in Practice: Scotland** http://www.acipscotland.org.uk/
- The **network of specialist services/centres and practitioners in Scotland** can be found here
  http://www.acipscotland.org.uk/whoarewe.html
- **Royal College of Speech and Language Therapists: AAC in Scotland**
  http://www.rcslt.org/news/aac_scoping_scotland
- Augmented Communication Systems section, **School of Computing, University of Dundee**
  http://www.computing.dundee.ac.uk/ac_research/themedetails.asp?id=5&gi=28

Useful Information Resources

- **SpeechBubble,** a searchable online database of all the current communication aids
  http://www.speechbubble.org.uk/
- **Communication Matters,** UK charity, www.communicationmatters.org.uk
  CM's '**Focus On….**' series are good information leaflets introducing AAC
  http://www.communicationmatters.org.uk/publications
- **International Society for Augmentative and Alternative Communication (ISAAC)**
  http://www.isaac-online.org/en/home.shtml
- **CALL Scotland** www.callscotland.org.uk
  For a list of further AAC links, go to Information / Useful Links / and search on AAC
- **Wikipedia,** useful definitions and example
  http://en.wikipedia.org/wiki/Augmentative_and_alternative_communication
- **Youtube** - these days, there are lots of video clips available of different types of users with different types of communication aid – seeing one in use can be easier than reading about it.
  www.youtube.com Search for 'AAC', or 'communication aid' or 'communication device' , or 'switch scanning' or the name of a specific communication device

SECTION 4: REFERENCES

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Curriculum for Excellence, http://www.ltscotland.org.uk/understandingthecurriculum/index.asp

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Hodder and CALL Scotland now have a scheme to distribute textbooks in accessible PDF for pupils with print disabilities, http://www.books4all.org.uk/Finding-Books/Books-from-CALL/About-the-Service/

Islay High School http://www.futurelab.org.uk/resources/publications-reports-articles/web-articles/Web-Article903

Islay High School http://www.guardian.co.uk/education/2008/jan/08/link.link2

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Special Access Technology, http://www.callscotland.org.uk/Resources/Books/#Special-Access-Technology

SQA 2008, Assessment Arrangements Explained, http://www.sqa.org.uk/assessmentarrangements

SQA 2010 Progress Report: Literacy and Numeracy Curriculum Area. May 2010. p. 2

SQA Adapted Digital Papers, http://www.adapteddigitalexams.org.uk and http://www.sqa.org.uk/assessmentarrangements

SQA E-assessment, http://www.sqa.org.uk/eassessment

The Accuracy of Electronic Spell Checkers for Dyslexic Learners, http://www.dyslexic.com/spell-checker-accuracy

Wivik on-screen keyboard, http://www.wivik.com

ICT resources and suppliers

AccessMaths 4.2, http://www.ace-centre.org.uk

ClaroRead, http://www.clarosoftware.com/index.php?cPath=355

Dolphin SuperNova Magnifier, http://www.yourdolphin.com/

Dragon Naturally Speaking, http://www.nuance.com/

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