Accessibility of SQA Adapted Digital Question Papers for Candidates with Visual Impairment

This paper reviews the use and accessibility of Scottish Qualifications Authority Adapted Digital Papers in PDF format for candidates with visual impairment.

Summary

1. Trials and experience to date have shown that the SQA Adapted Digital Question Papers in PDF are accessible for the majority of candidates with additional support needs, but other digital formats may be required for candidates with significant visual difficulties or severe physical accessing issues who use screen reading software.
2. Candidates with visual impairment who require small levels of magnification (equivalent of font size of approximately N18) are likely to be able to access most of the SQA digital papers in PDF by using the built-in Acrobat accessibility tools.
3. Candidates who require greater levels of magnification are likely to be more efficient and effective using their preferred specialist screen magnification program to view the PDF question papers. Experience so far suggests that candidates can use screen magnification software to access the existing PDF papers. It may be necessary to alter the layout or graphical content of some papers to improve access for users who need high levels of magnification.
4. Candidates who use screen reader programs such as Jaws or Hal are likely to have difficulties with the PDF question papers. For these candidates, the most accessible and efficient solution is for SQA to save or convert the question paper to a text-only format, and to edit and adapt the text file. Question-only papers or papers with passages of text are straightforward and are accessible in a variety of formats such as DOC or plain text. Interactive question and answer papers, where the candidate has to read the question and type an answer present technical challenges because of the need to prevent accidental alteration or deletion of the question while at the same time giving control and efficient methods for the candidate to record an answer in the correct location on the paper. There are several possible technical solutions but more work is needed to determine the optimum approach.

SQA Assessment Arrangements

Assessment Arrangements (previously 'Alternative Assessment Arrangements' and 'Special Arrangements') are intended to 'ensure that all candidates have an equal opportunity to show that they can achieve the national standards required for Units and Courses'[1]. Schools and centres who present candidates for examinations may request the use of appropriate assessment arrangements to meet the specific needs of the candidate and the assessment. In 2009, there were 45,612 requests on behalf of 13,041 candidates. Requests were made for arrangements in 6.2% of all examinations and on behalf of 8% of the total number of candidates. The type of Assessment Arrangement requested should reflect the difficulty faced by the candidate when tackling the particular assessment: the same candidate may therefore use different types of support (or none) depending on the nature and format of the examination. Candidates can request for example extra time, use of reader/scribe, use of ICT (word processor and/or digital question paper), papers in a different format including Large Print, Braille, Adapted Print, printed on a different colour, transcription of the paper, modification of language used in the paper, or use of sign language. Table 1 lists the types of arrangements and the number of requests for each that were made in 2009.

SQA Adapted Digital Question Papers

SQA Adapted Digital Question Papers were first trialled by learners in 2005, and, following positive feedback, used by thirty-four candidates during the 2006 examination diet[2]. The successful pilot was repeated on a larger scale in 2007[3], when 80 candidates in 12 presenting centres used the digital papers in 200 examinations.

The two pilots were evaluated by means of questionnaires to staff and candidates, and the response was extremely positive. The young people who chose to use the papers preferred them to traditional methods of support such as reader/scribes and the interactive 'question and answer' format was felt to be much easier and more efficient to use compared to a word processor. Staff felt that candidates were more independent and that staffing and accommodation requirements were lower for the examinations sat with digital papers than with reader/scribe support. The quality assurance procedures developed by SQA produced digital papers that were reliable, and the delivery of papers and communication with Centres seemed to be effective.

Following these pilots, SQA decided to offer the papers to any candidate who required Assessment Arrangements and in 2008, 46 Centres made 515 requests on behalf of 204 candidates[4]. The number of requests for 2009 more than doubled, to

[1] Introduction to Assessment Arrangements, SQA, November 2008. http://www.sqa.org.uk/assessmentarrangements

[2] 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, The University of Edinburgh. http://www.adapteddigitalexams.org.uk/

[3] Nisbet, P.D. (2007b) SQA Adapted Examination Papers in Digital Format: 2007 Pilot Project Report. Report to Scottish Qualifications Authority. December 2007. CALL Centre, The University of Edinburgh. http://www.adapteddigitalexams.org.uk/

[4] 2008 report

1,167 requests for Adapted Digital Papers from 73 centres on behalf of 422 candidates.

The papers have proved popular with staff and pupils. Candidates seem to like them because they can work independently and the papers are easy to use, while staff appreciate the greater independence offered and because administering examinations using digital papers requires fewer staff and accommodation than readers/scribes or transcription of the paper.

The advantages of the PDF format are:

- the papers are accessible to the majority of pupils who require Assessment Arrangements;
- the Adobe Reader software to access the papers is free, which has been an important factor in encouraging uptake by schools; pupils can also access past papers at home;
- the papers are interactive so that candidates can answer questions on screen;
- assistive technologies such as spellcheckers, word prediction, on-screen keyboards and speech recognition can be used;
- candidates can use tools such as highlighter, stick and text notes and drawing tools to help navigate the paper;
- the production cost to SQA is very low since papers are already prepared as PDF for sending to the printers;
- the format and reader software is well proven and reliable;
- the digital versions look exactly like the hard copy papers so that candidates can use both.

The main disadvantages of the PDF papers are:

- the PDF papers are untagged (see later) and lack structure and a defined reading order;
- the font style or spacing cannot be altered by the user;
- the papers are exact copies of the hard copy paper, and so some questions may not be easily answered on screen;
- techniques for candidates to insert algebraic and scientific expressions into the papers on screen are limited.

Use of SQA Adapted Digital Papers by candidates with visual impairments in 2009

Figure 1 gives the number of requests for digital papers broken down by the underlying reason for requesting Adapted Digital Papers in 2009. The single largest group of requests were on behalf of candidates are those who are identified by presenting centres as dyslexic (41%), the second largest group are those with another specific learning difficulty (21%) while the percentage of requests for pupils with a visual impairment is 3%.

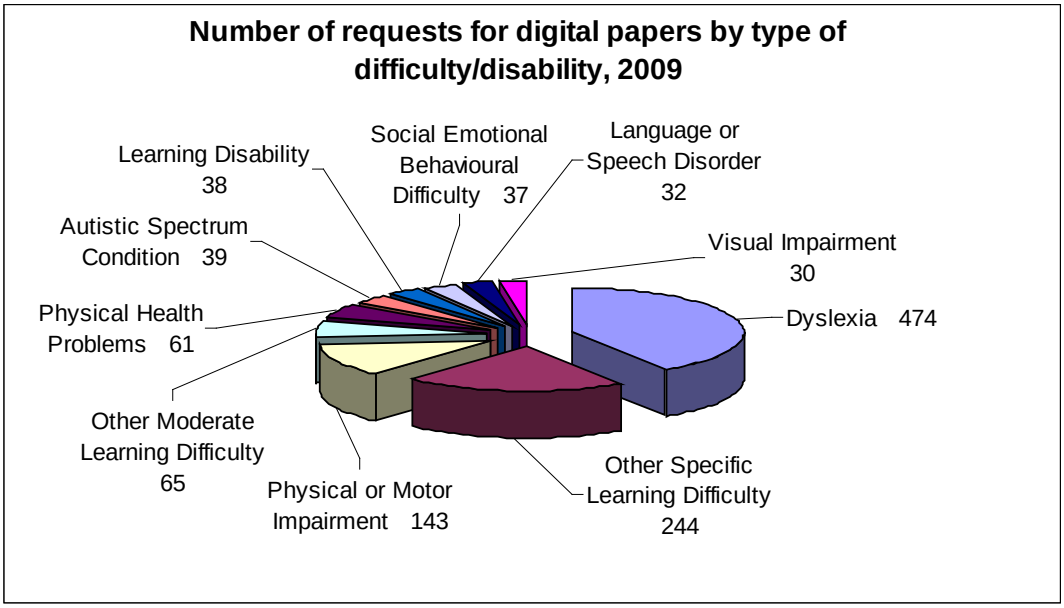

Figure 1 Number of requests for Digital Papers by type of difficulty or disability, 2009

The total number of requests for Assessment Arrangements in 2009 was 45,612 (Figure 2), of which 1,856 requests (4.1%) were on behalf of pupils with a visual impairment, and 30 (0.1%) were on behalf of blind pupils. Again, the largest groups of pupils requiring arrangements were those with dyslexia (44% of the 45,612) and specific learning difficulties (16%).

Comparing the percentage of requests for digital papers for visually impaired pupils (3% of all requests for digital papers) with the percentage (4.2%) who required any arrangement in an examination may suggest that the digital papers are less suitable for this population. However, because of the small numbers of requests (30 out of 1,167) and the even smaller number of pupils, it is just as likely that other factors (such as whether the school had decided to offer digital papers, or not) could be underlying the smaller uptake.

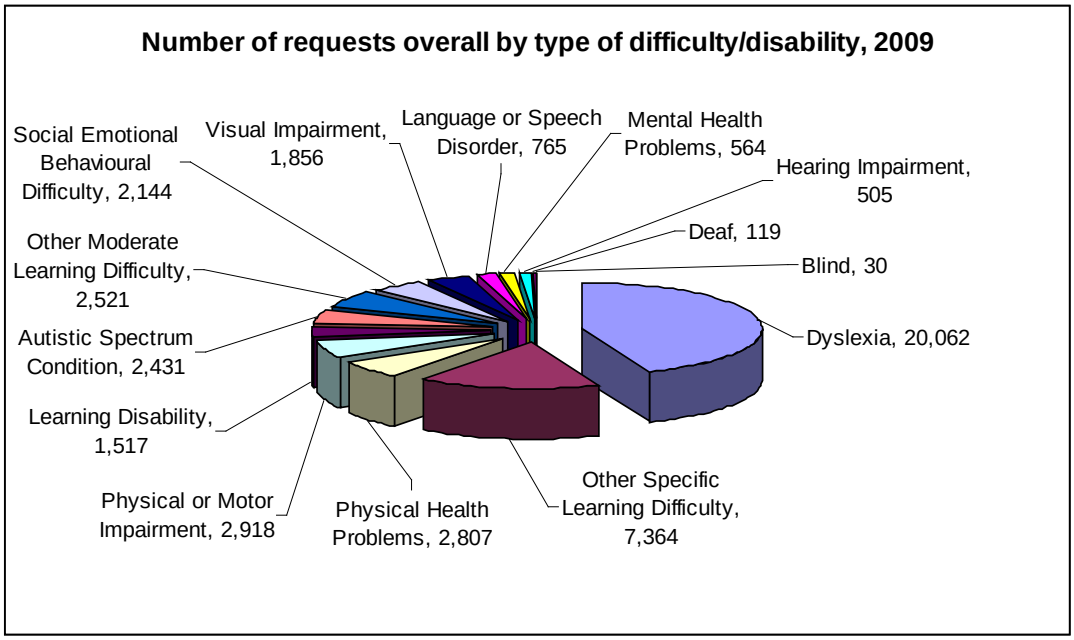

Figure 2 Number of requests overall by type of difficulty or disability, 2009

Table 1 gives the number of requests for each of the different types of Assessment Arrangement offered by SQA. A breakdown of the type of requests made for pupils with a visual impairment is not available, so we do not know how many of the 1,305 requests for Enlarged Print, or the 16,554 requests for a Reader, for example, were for pupils with a visual impairment. We cannot therefore compare the use of digital papers with other types of support for the visually impaired population.

Table 1 Number of requests for types of Assessment Arrangement, 2009

Extra Time	35,636	Digital Question Paper	1,167
Separate accommodation	26,381	Calculator	660
Reader	16,554	Transcription without correction	626
Scribe	14,197	PA referral	540
Use of ICT	6,253	Modified content	277
Prompter	2,099	Adapted certificate	119
Coloured Paper	2,050	Paper signed to candidate	57
Rest Period	1,434	Candidate Signs Responses	42
Enlarged Print	1,305	Tape recorder for responses	37
Transcription with correction	1,179	Braille	31

So far then, we know that the Adapted Digital Papers were requested by a small number of visually impaired pupils but further investigation is required to determine the reasons why the pupils used the papers, the subjects, the advantages and disadvantages of the papers, and what features and facilities are required to improve them.

Accessibility of Adobe Reader

The SQA Adapted Digital Papers are provided in Adobe PDF format. Some partially-sighted candidates are able to access the SQA digital question papers in PDF by using the facilities and features in Adobe Reader.

For example:

- the PDF digital paper can be magnified (by up to 6400%, via the Adobe Reader toolbar);
- foreground and background colours can be altered to give high contrast colours (Adobe Reader can either use the colours set in the Windows Display Control Panel, or colours can be specified);
- Adobe Reader settings can be adjusted so that the PDF can work more effectively with screen readers such as Jaws[5], or screen magnification programs such as ZoomText[6].
- keyboard shortcuts are provided for most operations.

Adobe Reader has basic text-to-speech functionality but it is basic and of limited utility for reading the "untagged"[7] PDF exams.

Instead, CALL Scotland recommends the PDFaloud[8] text reader for users with dyslexia or reading difficulties. PDFaloud is a text reader rather than a screen reader and is designed for readers with sight; it works best when the user can see the text and click on it to have it read out. It is less effective at reading a complete paper mainly because the papers are untagged and the reading order is not specified and so text elements on each page may or may not be read out in the correct order. We consider the reading order of the PDF papers later.

Nevertheless, PDFaloud can provide support for some candidates with visual impairment. The application:

- highlights the text as it reads so that the reader can follow the text;
- can read each word, sentence or paragraph;
- has keyboard shortcuts and a toolbar for controlling the speech;
- gives control over voice parameters such as speed and pitch.

PDFaloud is available to Scottish schools from Learning and Teaching Scotland for £295 for a school licence[9].

[5] PDF Files and JAWS with Adobe® Reader 7, http://www.freedomscientific.com/Training/training_PDF_and_Adobe_Reader_7.asp
[6] Questions and Answers about reading PDF documents in ZoomText 9.0 and 8.1, http://www.aisquared.com/Support/KBdetail.cfm?ID=120
[7] A "tagged" PDF has structure, logical reading order, form fields and images with meaningful text descriptions, while an "untagged" PDF has none of these.
[8] PDFaloud, http://www.texthelp.com/
[9] http://www.ltscotland.org.uk/aboutlts/resources/software/school/index.asp

Built-in Adobe Reader Magnification

The actual size of the text and images of a digital PDF question paper on a computer screen are determined by the physical size of the screen, the screen resolution, the display font and the magnification setting in Adobe Reader.

One of the issues about magnifying the paper on screen is that the full width of the page may no longer be visible across the screen. This requires the user to scroll the paper left and right, which adds extra complexity and makes it much more difficult to navigate around the paper.

The most common size of a laptop or monitor screen in schools is 15" with a resolution of 1024x768. Under these conditions an SQA digital paper in PDF can be magnified up to about 150%, which is approximately equivalent to N18, before horizontal scrolling is required.

This is not to say that all digital papers viewed at 150% will be accessible to all candidates who need this size of font (for example, at this level of magnification diagrams may not be displayed close enough to the corresponding question, which means that the candidate will have to scroll up and down or open a new window and swap between the two) but it suggests that most candidates who require font size up to N18 should be able to access most digital papers in PDF.

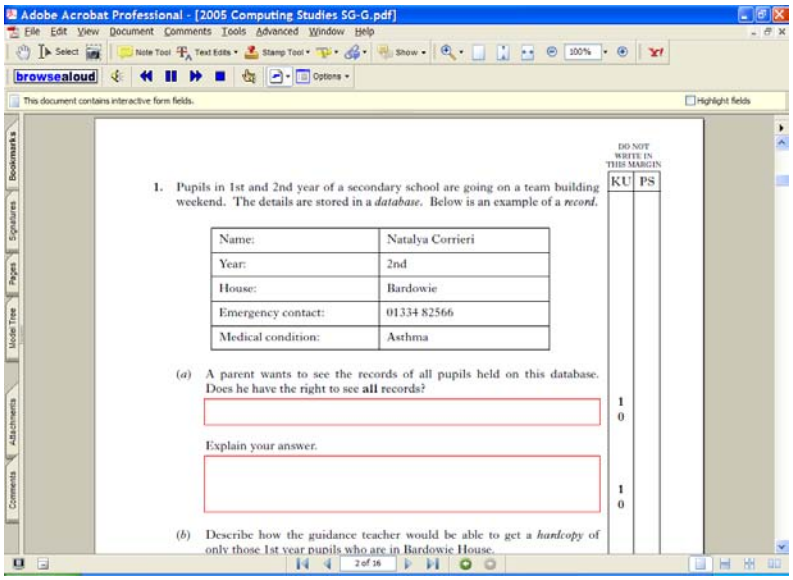

Figure 3 Digital paper at 100%, approximately N12 on 15" screen

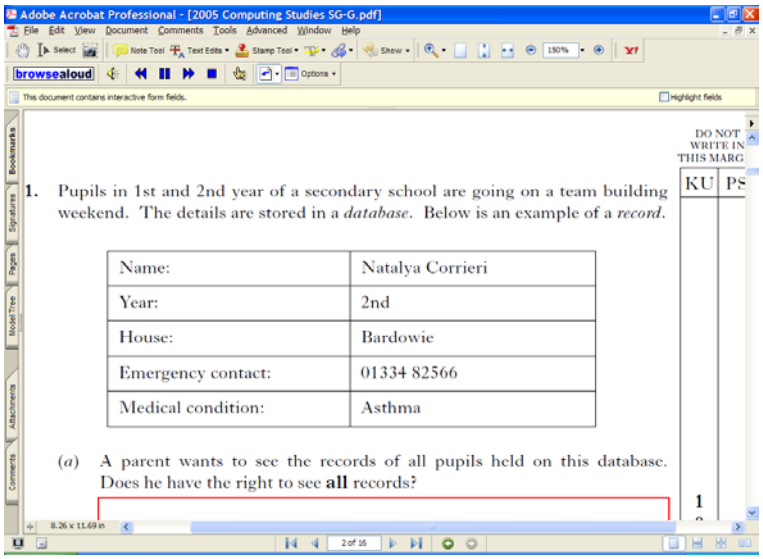

Figure 4 Digital paper at 150%, approximately N18 on 15" screen

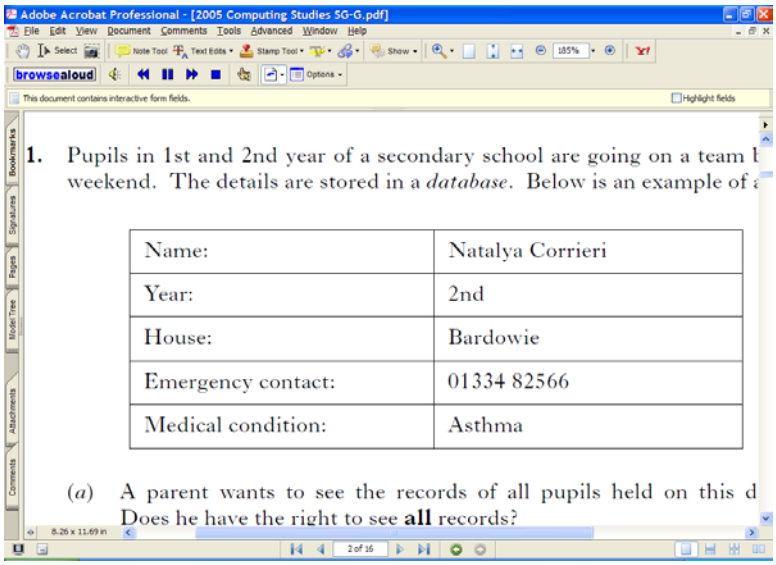

Figure 5 Digital paper at 185%, approximately N24 on 15" screen

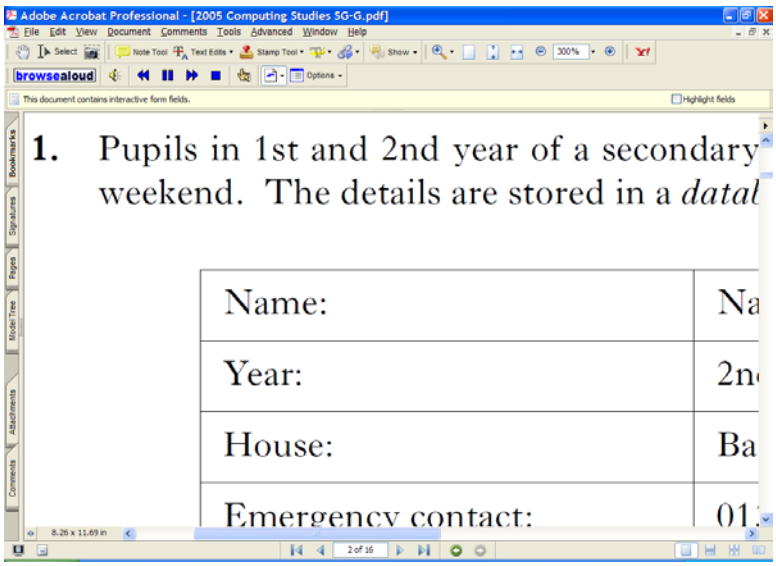

Figure 6 Digital paper at 300%, approximately N36 on 15" screen

The problem of the paper disappearing off the edge of the screen, thereby requiring inconvenient horizontal scrolling, can be addressed for question-only papers (which constitute just under half of the digital papers produced by SQA), by 'reflowing' the PDF. Reflowing (**View>Reflow**, or press **CTRL+4**) displays the paper such that all the text can be seen on screen without the need to scroll horizontally.

Question and answer papers cannot be reflowed because PDFs with form fields (answer boxes) are not able to be reflowed by Adobe Reader.

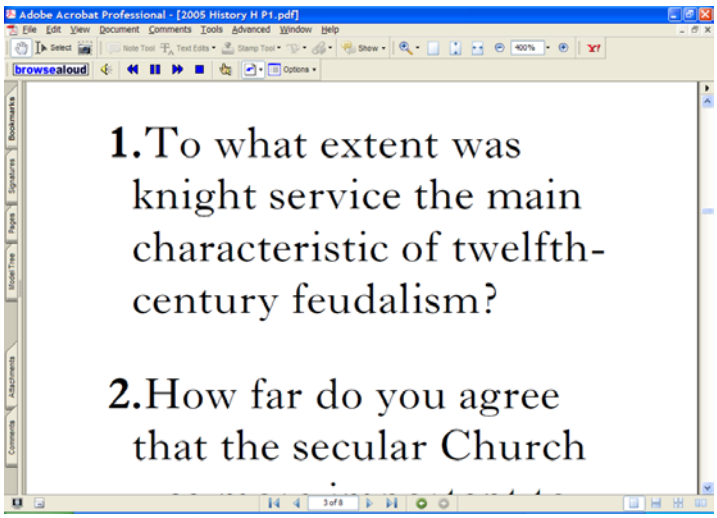

Figure 7 History Higher paper magnified to 400% (approximately N48) and reflowed

For question-and-answer papers which cannot be reflowed, higher levels of magnification (e.g. beyond 150%; approximately N18) may therefore be problematic.

There are some techniques that can be used with such papers:

1. The candidate could scroll backwards and forwards horizontally to read the paper. Excessive vertical scrolling may also be required for papers with diagrams. Such scrolling and navigation around the paper is time-consuming and confusing and would not be acceptable in an examination.
2. When text is read out by the PDFaloud text reader, the text is highlighted as it is spoken and the page scrolled horizontally automatically by the software. This could assist some candidates but at very high levels of magnification the text is scrolled and highlighted rather quickly (as the same speed as it is read) and so may not be readable.

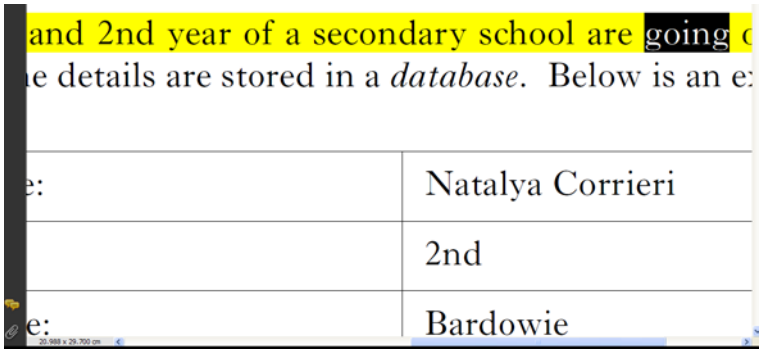

Figure 8 Text scrolling horizontally while read by PDFaloud

3. Another option is to use a larger screen so that the candidate is able to see more of the paper without scrolling. For example, with a 17” LCD screen (at higher resolution than 1024x768) the whole of the paper width should be visible on screen when viewed at the equivalent of 24 point (instead of only 91% on a 15” screen). With a 22” wide screen LCD, 70% of the question text displayed at Arial N36 equivalent would be visible instead of just 43% (although 70% is still not satisfactory).
4. Alternatively, two screens could be used with the question paper (perhaps reflowed) displayed on one and a word processor with answer booklet on the second. Additional displays are usually relatively easy to find in schools and can be plugged straight into a laptop, or graphics cards that can drive two displays can be fitted to a desktop computer.

In conclusion, candidates who require font sizes of about N18 or smaller should be able to access most digital papers in PDF using the standard Adobe Reader software, although this requires confirmation through practical trials. Candidates who require font sizes greater than N18 may be able to access digital question-only papers but question and answer papers are likely to be less accessible at higher levels of magnification on standard 15” screens.

Accessing PDF papers with Screen Magnification software

Purpose-designed screen magnification programs such as ZoomText, Lunar and Bigshot are faster and more efficient to use than the magnification built in to Adobe Reader itself. Most screen magnification programs can magnify digital papers in PDF[10]. Bigshot has been specifically mentioned as working well with Adobe Reader partly because it uses ALT keyboard shortcuts which are not used by Adobe Reader.

The specialist screen magnification programs give faster and more efficient access than the basic built-in magnification in Adobe Reader; in addition most pupils who require significant levels of magnification will have expertise in using a particular screen magnification program and will be able to use it to full advantage. Therefore, the best option for pupils who require significant levels of magnification is to use their own screen magnification programs with the digital PDF papers.

Trials with screen magnification software

Interviews and trials of digital papers were conducted with four visually impaired young people. All attend a special secondary school catering for pupils with sight loss.

- R does not use a specialist screen magnifier and instead normally relies on the built-in zoom tools in Microsoft Word and Adobe Reader.
- M uses Supernova set to magnify to around 270-300%
- J uses Supernova.
- L uses Jaws (see below for discussion about screen reading software).

R was content with the magnification tools built into Adobe Reader, although he commented that he would prefer bigger line spacing (which cannot be adjusted using Adobe Reader – this would have to be done by SQA when the paper was originally set out prior conversion to PDF). R liked the interactive question and answer format and the comment and markup tools available in Adobe Reader; particularly the highlighter for marking key passages, which he felt would aid navigation, and the Sticky Note tool, so that he could copy a question and paste it into a note beside the text as an aide-memoire when reading the text.

M and J were satisfied with the way in which Supernova magnified the PDF. It was important to set the Adobe Reader zoom to 100% (or wide enough to fit the width of the screen): if the Adobe Reader zoom was set to be 25%, for example, then Supernova would magnify that screen display and the result was low resolution, poor quality text. By setting the Adobe Reader zoom to be higher, Supernova was magnifying a higher resolution original image and the result was much cleaner.

Supernova smoothes the magnified text. M compared one paper set out using the standard SQA Imprint font with a second typeset in Arial, and preferred the Arial paper. Another pupil in another school compared Arial and Imprint papers magnified with Supernova and preferred Arial. There seemed to be little visible difference between the two fonts by the time that Supernova had smoothed them, but the two

[10] Questions and Answers about reading PDF documents in ZoomText 9.0 and 8.1, http://www.aisquared.com/Support/KBdetail.cfm?ID=120
Lunar Manual, http://www.yourdolphin.com/productdetail.asp?act=findmanual&z=10&id=3

pupils both preferred Arial. SQA currently offer Adapted and Enlarged print papers in Arial font and so it should be feasible for pupils to request digital papers in the font.

The users did not make any comments about the layout or design of the papers themselves, but it is likely that improvements could be made to the papers to aid navigation for candidates who use screen magnification programs. For example, in some Biology and science papers questions make reference to a diagram and it may be helpful to lay out the paper differently with the question closer to the diagram so that the pupil can locate both more easily. SQA desktop publishers already create Large Print papers in hard copy and so one option may be to provide digital versions of these large print papers. More tests with users are required to investigate this further.

Accessing PDF Digital Papers with Screen Reading software

Screen reading applications such as Jaws or HAL can read PDF documents but there can be problems if the PDFs have not been designed for this purpose. RNIB provide helpful information on using Jaws and other screen readers to access PDF documents[11] in general and many of the issues identified apply to the digital paper PDFs.

The digital papers in PDF are not tagged and do not have specified 'reading order'. This means that some text in the paper is not read out in the correct order: for example, the marks in the margins are unlikely to be read out in a way that the candidate could understand – the mark would just get read out as a number, and it would not be clear as to which question it applied. The screen reader would also have difficulty with text mixed with images and with mathematical expressions: e.g. $a^2+b^2=c^2$ is likely to be read out as 'a two plus b two equals c two'; and some maths expressions are not recognised as text at all and so are not read out. Tables may or may not be read out correctly, and images and diagrams do not have text descriptions.

One approach to dealing with these difficulties is to adapt the PDF paper to be fully accessible for candidates who use screen readers, but this is unlikely to be successful and is also time-consuming and inefficient (see Nisbet 2003[12]). The main issue here is that the original paper was designed using Quark Xpress and as a result has no inherent structure. It is extremely difficult to add the tags and other information that is required in order to make it accessible for screen reader programs using Adobe Acrobat after the PDF has been created.

Given that candidates, schools and SQA collectively know well in advance which candidates need digital papers to be accessed using screen reading software, digital papers can be prepared in a suitable format. Note also that the number of candidates who use screen readers is very small in comparison with the number of candidates who can access the PDF question papers. There is no point in wasting resources attempting to make every PDF paper accessible for a very small number of candidates when far more efficient and effective alternatives exist. There is also no point in re-creating every PDF paper in another digital format which may be more accessible with a screen reader when the PDF papers are accessible to the majority of candidates.

A better solution is to convert or save the text of the paper in another format that can be read successfully using a screen reader, such as DOC, RTF, plain text or HTML and then edit the text in order to produce a suitable file. This is more efficient than trying to make the PDF itself accessible (particularly if the exam paper originated as a DOC or text file before it was composed with Quark Xpress for publishing). This technique is already used by SQA to produce Braille papers. Once the paper is saved as DOC, RTF, Text or HTML:

- the effective reading order can be easily seen and altered;

[11] RNIB Web Access Centre; Jaws access of PDF - a users guide, http://www.rnib.org.uk/xpedio/groups/public/documents/PublicWebsite/public_accessingpdf.hcsp

[12] Nisbet, P.D. (2003) *An investigation into the Accessibility of SQA assessments in Portable Document Format.* Report to SQA, January 2003. CALL Centre.

- suitable indications of navigation features (e.g. 'page 1 of 8'), marks and other information can be added (e.g. 'Question 1 (a), worth 1 mark');
- mathematical and scientific expressions can be typed out (or created with an MathML[13] editor)so that they are spoken correctly;
- text descriptions for diagrams and images can be added.

A file format which can be opened using a word processor or web browser is preferable (rather than an eBook format such as Daisy), because this allows a candidate to type answers in and to use the type of markup, study and commeting tools that were identified by R as being helpful. Most eBook formats have limited facilities for interaction and candidates cannot answer questions by typing into the digital paper. Daisy in particular could be used to prepare question-only papers but it should not be the only format offered because some blind candidates may not use Daisy software or may prefer to use other software with which they are more familiar, such as Microsoft Word plus their screen reader program. Suitable digital formats should therefore be made available (within reason) to suit the needs of candidates.

However, one disadvantage of a word processor format is that it may be possible for the candidate to accidentally alter or delete the text or questions in the paper when they are answering the questions. In discussion with staff who support visually impaired candidates, it was felt that this was a significant issue, and so options for protecting the text were investigated. Both K and L also felt that the potential for deleting text accidentally in the assessment was too great.

Microsoft Word forms

It is possible to create Microsoft Word 'forms' with protected text and fields for answers. One issue with Word forms is that the locked text in a form is not read out satisfactorily by most text reader programs (e.g. WordTalk, Read and Write Gold, etc). However a review of information and resources from publishers of screen reader programs (e.g. Jaws, HAL) suggests that screen readers can access locked text and forms[14]. Tests with users are required to establish whether papers created as Word forms would be accessible for screen reader users.

Adobe LiveCycle Tagged PDFs

While re-ordering reading layout and editing tags in an untagged paper in PDF is not practical, an alternative is to re-create the paper in PDF using Adobe LiveCycle Designer (LCD). LCD is essentially a simple desktop publishing package which gives much better control over page elements, reading order, and form field behaviour. PDF forms are more flexible and offer greater functionality than Microsoft Word forms. A small number of question and answer papers were created using LCD and evaluated by L.

L tested the PDF papers produced using LCD and noted that:

- the reading order of the text was correct;

[13] W3C MathML Home, http://www.w3.org/Math/
[14] Creating Accessible Forms in Word. Freedom Scientific, http://www.freedomscientific.com/Training/accessible-forms-in-word.asp

- Jaws read text one line at a time (rather than a whole sentence or paragraph) which means it stops in the middle of the sentence. L said this was a feature of Jaws.
- Jaws retained focus when swapping between for example a question and the reading text papers.
- To answer questions, L had to listen to the question, go into the Jaws Form Mode, find the correct field, type the answer, come out of Forms Mode, read the next question, and so on, which was time consuming. A better design may be to lay out the paper simply as a linear set of fields and add the whole question as screen reader text along with the number of marks that the question is worth. The candidate would then complete the whole paper in forms mode, and would be able to tab quickly between fields. This method would only work for shorter questions that did not refer to a passage of text, for example.

Conclusion for screen reader users

The simplest procedure for creating digital papers for candidates who use screen readers is to extract the text of the assessment and edit it using the same process that is already used to produce Braille papers.

Question and answer papers are problematic because of the need to protect the question text and also provide the candidate with good navigational signs. There are several options that have been investigated to date but more work is required to create and trial papers in more formats before firm recommendations can be given.

Paul D. Nisbet

15th September 2009