Trial of External Papers

in Accessible PDF

for Candidates with Additional Support Needs

August 2004

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Project report to Scottish Qualifications Authority

August 2004

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Summary

1. The aim of the project was to trial electronic examinations on CD for candidates with additional support needs. The project was designed to investigate the ease of use of the electronic examinations, and candidates' opinions on reliability, confidence, familiarity and independence when using the exams. We also aimed to compare the use of human readers and scribes with the electronic examinations. The project was carried out as a ten-day consultancy between December 2004 and August 2005.

2. Adobe Acrobat PDF was chosen as the most suitable format for creating and distributing the examinations. SQA provided copies of the papers in PDF format; the CALL Centre added "form fields" in order that answers could be typed into the papers, and then "speech enabled" the papers using TextHelp Systems' *PDFAloud*. The process of creating Accessible PDF examinations is relatively straightforward and fast: adding 34 form fields to the English Reading Question Paper took less than ten minutes.

3. There are several options for creating and distributing examinations in Accessible PDF, should this be taken forward by SQA. The most cost-effective option for Scottish education as a whole would be for SQA to purchase the PDFAloud "Stamping Kit" which can be used to speech enable PDF's. The cost of this software is £1250, which includes 100 "credits", i.e. to speech enable 100 different papers. An additional 250 credits costs £349; 500 credits is £449; 1000 credits is £549. Once speech enabled, an examination paper can be copied and distributed electronically to as many schools as required.

4. Six schools in Scotland evaluated the SQA examinations in Accessible PDF. The schools were:

   Broughton High school, Edinburgh; Earlston High school, Borders; Kirkcaldy High School, Fife; Perth High school, Perth and Kinross, (mainstream secondaries);
   Ashcraig School, Glasgow, a secondary special school;
   Uddingston Grammar Visual Impairment Unit, South Lanarkshire.

   The papers were Standard Grade General examinations in: Biology, English Reading Text, English Reading Questions, English Writing, French Reading Questions, History, Maths 1 and Maths 2.

5. An evaluation questionnaire was designed to collect feedback from the students. 31 students in five schools returned evaluation questionnaires and/or completed electronic papers. The students who tested the papers had all experienced problems with traditional paper examinations, due to physical, visual, perceptual or reading difficulties. Schools would normally apply for permission for the students to use one or more special arrangements, such as extra time, a scribe or a reader, to sit the exams

6. The 31 students completed evaluation questionnaires with respect to 94 PDF examinations.

7. The electronic examinations were technically reliable. On managed network computers schools it was necessary to install the software in a particular order or when logged on as Administrator.

8. The most common suggestion for improvement to the PDF examinations was to improve the quality of the synthetic voice. There were also some suggestions about improving the layout of the answer boxes when typing into the maths papers.

9. Overall, students regarded a human reader as being easier to use than text-to-speech software with the electronic papers. However, students were less familiar with the text-to-speech software than with readers and so it is reasonable to assume that they would find it easier with more training and practice. Many of the students commented that the synthetic voice was of poor quality and was difficult to understand: if higher quality voices were provided this might improve ease of use. (The voices provided with the examinations were free: higher quality voices are available for extra cost.) In general, text-to-speech software was judged to be easier to use when reading examination papers in "communication" subjects such as English, French and History, than in Maths and Biology.

10. For the communication subjects (i.e. English, History, French) a majority of students scored typing as being easier to use than a scribe. Ease of use scores for the electronic communication subjects were considerably higher than scores for maths and biology. There was a difference between the ease of use of typing into PDF examination between students and different schools: students with literacy difficulties appeared to find typing into PDF's easier than students with physical or visual difficulties. Combining these two factors, we find that students with visual or physical difficulties rated the ease of use of the maths/biology papers lowest, while students with dyslexic-type difficulties rated communication papers highest.

11. Students were more familiar with using a reader and scribe than with using the electronic examination papers.

12. Students regarded learning to use a reader as easier than learning to use text-to-speech software. Conversely, learning to type into the PDF was seen as easier than learning to use a scribe.

13. Students regarded readers as being more reliable and providing them with more confidence than text-to-speech software. Typing into the PDF paper was seen as providing greater reliability and confidence than using a scribe.

14. Students considered that the electronic examinations gave them far greater independence (mean of 4.79 for the use of text-to-speech and 4.68 for typing into the PDF, out of 5) than scribes or readers (scribe - 2.06 and reader - 2.00 out of 5).

15. 27 out of 28 students (96%) felt that SQA should provide examinations in PDF for students requiring special arrangements.

16. SQA arranged for some of the completed electronic papers to be marked by subject markers. Feedback from the markers, together with comments from school staff, suggest that the use of the electronic examination papers provides an accurate assessment of attainment.

17. The results indicate that staff and students would welcome the introduction of examinations in PDF for students requiring special arrangements. The examinations should have form fields, for answers, and text-to-speech functionality. PDFAloud appears to be the most cost effective and suitable program for providing text-to-speech.

18. Staff in the schools were positive about the electronic exams and their potential to increase independence. Another significant factor identified by staff is the potential for electronic papers to reduce the numbers of readers, scribes, invigilators and separate accommodation required for candidates who require special arrangements.

If PDF examinations were to be provided by SQA as another type of special arrangement:

1. Schools would either have to purchase Adobe Acrobat Standard 6, or SQA would have to obtain the Adobe Document Server for Reader Extensions from Adobe, which would allow schools to use the free Acrobat Reader.

2. The PDFAloud text-to-speech facility may be added to the PDF examinations either through SQA purchasing the PDFAloud Stamping Kit from TextHelp Systems, which provides text to speech at zero cost to schools, or by schools buying their own licences for PDFAloud.

3. An investigation should be carried out into the effectiveness, supply and costing of higher quality voices to determine which, if any, voices, are most understandable for use in the examinations.

4. It will be necessary to develop training materials and deliver training for SQA and school staff.

Background

In 2002, 8,235 students applied to use special arrangements in Scottish Qualifications Authority examination. 5,614 students were described as having "specific learning difficulties", and this group sat 28,082 exams using special arrangements. The type of arrangement used in examinations varies according to the student's disability or difficulty and the subject and nature of the exam. A student with specific difficulties with reading and writing, for example, may use one or more of the following accommodations: extra time; transcription of the paper; word processor or other ICT; reader and/or scribe.

ICT (such as a word processor) is used by students requiring special arrangements, most commonly for papers that require generation of a large amount of text such as English Writing. ICT is not often used to help students read papers, although some schools have scanned papers into a computer using optical character recognition and used text-to-speech software to support students with reading or visual difficulties.

This project was designed to investigate whether examination papers in electronic format would provide an effective special arrangement for students with additional support needs. The format chosen for creation and distribution of the electronic examinations was Adobe PDF. Adobe PDF was chosen because: PDF's can be easily produced directly from the desktop publishing program used in SQA; the fidelity of the on-screen version to the printed copy is high; and PDF, as a format, has features which make it suitable for dissemination.

Consultation as a result of a previous project with staff and students in six schools revealed that a basic PDF version of the exam paper would not be particularly helpful –staff estimated that only around 10% of students who use special arrangements would benefit from examinations in this format. The addition of 'form fields' to the PDF, so that candidates could type their answers on screen was regarded as essential, and staff estimated that such adapted papers would be accessible for between 50 and 75% of students requiring special arrangements. Finally, staff suggested that up to 80% of students requiring special arrangements would be able to use electronic examinations if text-to-speech facilities were also integrated into the paper.

A sample of eight 2003 SQA Standard Grade examination papers were provided by SQA. Form fields were added to enable students to type answers to questions directly on screen, and text-to-speech was provided using *PDFAloud* from textHelp systems. Six schools were asked to trial the exams with students who had used, or were planning to use, special arrangements in SQA examinations. Schools were provided with copies of Adobe Acrobat Standard and PDFAloud, and a CD with the examination PDFs. Staff and students were asked to complete a questionnaire designed to investigate the ease of use of the electronic examinations, and compare them with readers and scribes.

The project was commissioned by Patricia MacDonald (Project Manager, Qualifications, Research and Development) and Sheila Rennie (Question Paper Manager) at SQA, and carried out by the CALL Centre, University of Edinburgh.

Format of the Report

This report contains two main sections. Section 1, *Creating Accessible PDF Examinations*, is written to advise SQA about the process of creating the electronic examinations. It contains details about the software used, and summarises key issues that were identified during the project. Section 2, *Trial in Schools*, presents results and analyses of the questionnaires returned by staff and students.

Creating Accessible PDF examinations

Eight Standard Grade General papers in PDF format were provided by SQA for the project: English Reading Text; English Reading Questions; English Writing; French Reading; Biology; History; Maths 1; Maths 2. The process of creating accessible PDF examinations involved three main steps: 1) saving the examination in PDF format, 2) adding form fields for answers, 3) speech enabling to provide text-to-speech functionality.

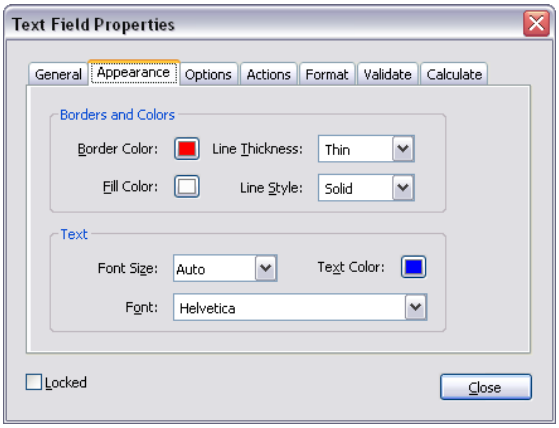
1. Creating the examination in PDF

SQA first produced "raw" PDFs. This was a straightforward process whereby Adobe Acrobat Professional was used to save a PDF version directly from the original desktop publishing program. Alterations to two of the original PDF papers supplied by SQA were required: some pages with illustrations in the English Writing Paper had to be rotated so they were displayed with the correct orientation; and SQA were asked to provide the English Reading Text paper as two A4 portrait pages, rather than a single A3 landscape page. The reason for this is that the PDFAloud text-to-speech did not read properly with the A3 landscape page.

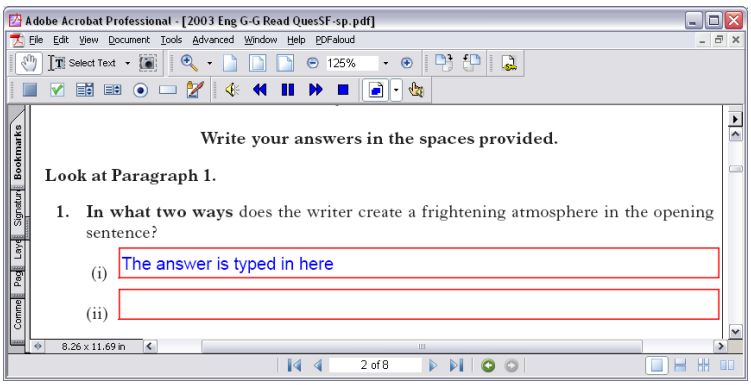
2. Adding Form Fields for answers

"Form fields" were then added to the question papers so that students could type their answers into the paper on screen. The process of adding form fields is relatively quick and involves using the Form Field tool in Acrobat Professional 6: it took less than 10 minutes to add 34 fields to the English Question paper. Note that neither Adobe Reader nor Acrobat Standard can be used to add form fields to PDFs. The process of adding fields to the exams uncovered several important issues:

- Selecting **View > Grid** and **View > Snap to Grid** made it easier to draw grids quickly and accurately. The grid should be turned off before saving the PDF exam.
- The standard grid size was too large, and so it was reduced to 1/10th of an inch: **Edit > Preferences > Units and Guides**.
- The **Text Field Properties** dialogue was used to adjust the appearance of the answer boxes. Once the properties are set for the first field, right-click on it and select **Use current properties as new defaults** so they apply to the rest of the fields.

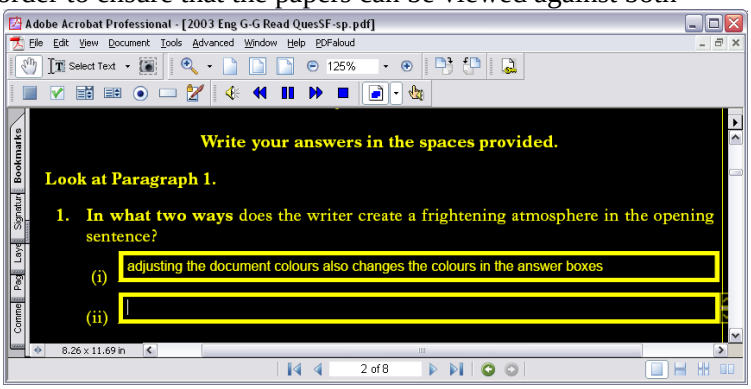


- Each field was given a name to correspond to the question number, e.g. 2ii.
- The field **Fill** colour was set to **white**. If there was no fill colour, the horizontal guidelines marking the areas for students to write in their answers would show through the text box.



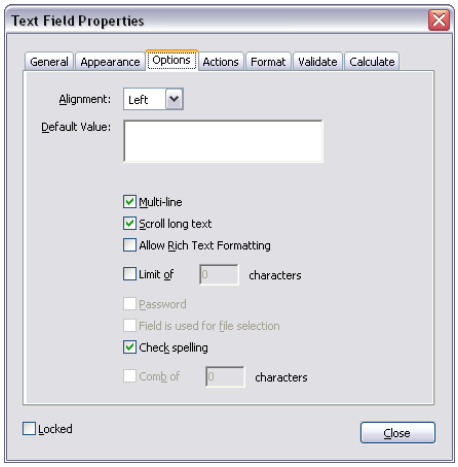
- In the first set of exams produced, the **Border Colour** was set to blue, to mark out the answer box against the white page. However, one pupil at Uddingston VI Unit used a high contrast yellow on blue colour scheme, which rendered the answer boxes invisible on his Windows 98 computer. Using the Windows XP

operating system, however, did not give the same problem: the high-contrast settings were successfully inherited by the PDF so that the text and form field borders were shown yellow against a blue background. In order to ensure that the papers can be viewed against both standard white background and also the more common high contrast blue or black backgrounds, on Windows 98, we recommend that the answer fields should have a **red** border.



- The **text colour** for the answer field was set to **navy blue** to provide a contrast with the black text of the paper itself. Note that this colour is automatically changed if the user selects a different colour combination. In the case of the Uddingston pupil, for example, Adobe Acrobat was set to inherit the colours set in the Accessibility Options in the Windows Control Panel, and changed to yellow, as shown.

- The Font Size was set to **Auto**, and **Font** to Helvetica. Helvetica was chosen as being easiest to read, while the Auto size ensures that the font size adapts to the size of the field.

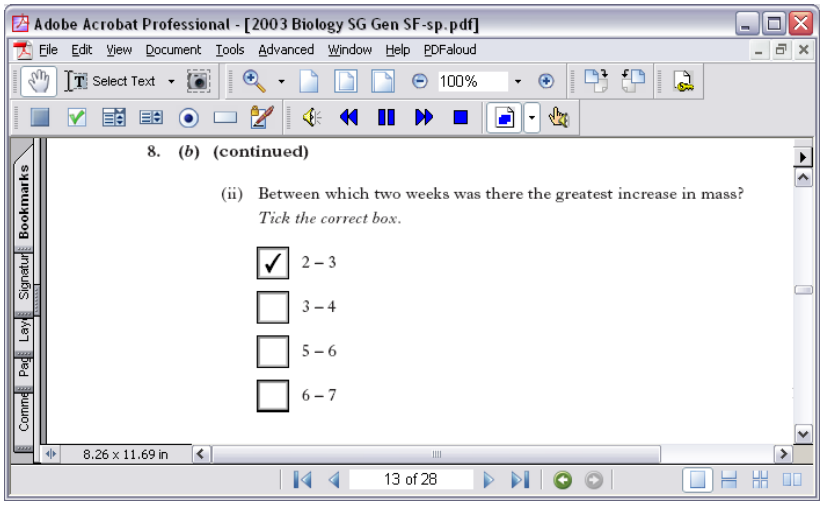


- In the **Options** tab, the field was set to be **Multi-line**, with **Scrolling** text. This allows longer answers to be typed in and displayed in the answer box.

- The **Check Spelling button** was selected so that text typed into the answer box would be spell checked.

- In the example shown above, the question paper had a single guideline to indicate to the candidate that their answer should contain one line of text. The form field was therefore sized to allow one line of text to be typed. The properties chosen ensure that if a very long answer is typed in, the size of the font is automatically reduced to fit the form field. Although this may not be ideal, the alternative, where the text size is maintained, would result in the text scrolling and disappearing, so the first part of the answer would not be visible when the paper was printed out.

- **Text Form Fields** were used for most fields, and **Radio Button** fields were used for questions were a 'tick' was required.



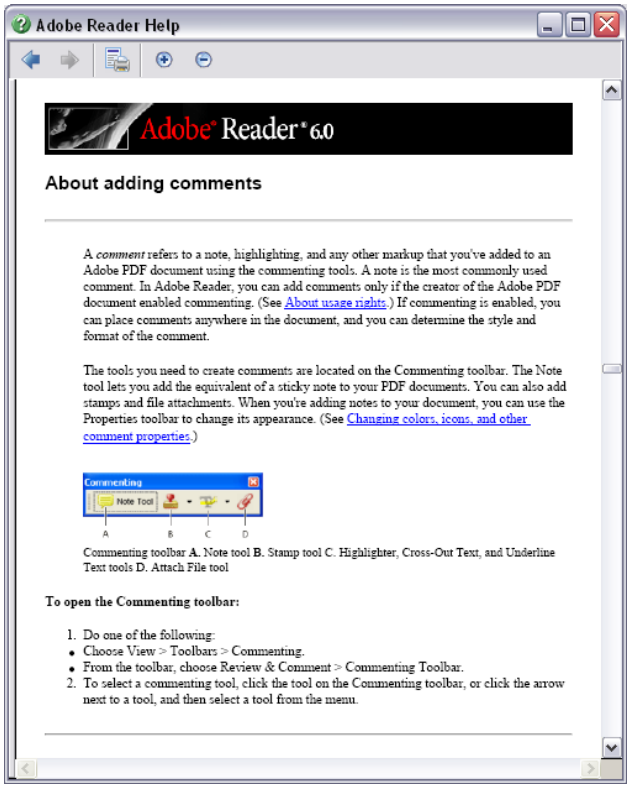
- The process of adding form fields to the PDFs must be undertaken with some care, and the completed paper should be tested before distribution to schools. For example, in Maths 1, we had cut and pasted one form field to create another, but had omitted to change the name of the field. The result of this was that answers inserted into the first field also appeared in the second.

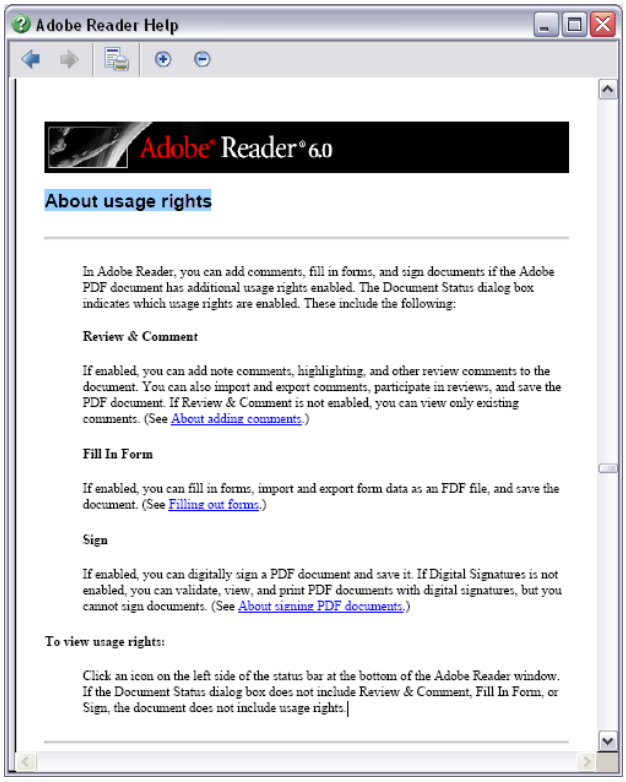
- Another comment made about the maths papers was that fields which contain mathematical working should be right justified rather than left justified.

Problems with printing form fields with Adobe Acrobat Reader

When the project was originally conceived, we had intended to provide schools with the latest version 6 of the free Adobe Acrobat Reader program for the students to use to complete the exams. However, when the exams with form fields were first tested, prior to distribution to schools, we found that the answers typed into the form fields were not saved with the document and were also not printed.

The Adobe Reader 6 Help guide states that comments can be added, and form field text can be saved and printed provided the appropriate usage rights are enabled in the document:





However, even after setting the document security properties using Acrobat Professional to 'none', and allowing comments and form fields to be added, text typed into the fields was *not* saved or printed when the document is viewed in Acrobat Reader.

Discussion with Adobe revealed that the facility to save and print text in form fields in Reader can only be added using an 'Enterprise' version of Acrobat. The Acrobat 6 Professional Help Guide contains the following statement:

"Some PDF documents include usage rights that allow users to fill in forms, add comments, and sign a document using Adobe Reader. You cannot add these usage rights using Acrobat Professional. Instead, Adobe offers a server extension that allows Adobe Reader users to perform tasks that normally require Acrobat Standard or Professional. This service, Adobe Document Server for Reader Extensions, is used primarily by government agencies to add forms-processing tools to the Adobe Reader software at no extra cost to their constituents. In turn, their constituents can download, save, fill in, digitally sign, and submit PDF forms at their convenience. For more information, see the Web site, http://www.adobe.com/products/server/readerextensions/main.html (English only)."

It was beyond the scope of this project to investigate the technical and cost issues involved in this "server extension", but if SQA are intending to make examinations available in PDF format it would be important to address the issue so that schools could use the free Acrobat Reader program.

In order to carry out the project, licences for Adobe Acrobat Standard were purchased and the software was installed on computers in the schools taking part in the project. Adobe Acrobat Standard does allow comments to be added to the document, and text typed into form fields to be saved and printed. At the time of writing, the education price for a single user license for Acrobat Standard is around £20.

3. 'Speech Enabling' using PDFAloud

The final part of the process was to 'speech enable' the PDF so that it could be read using the PDFAloud text-to-speech plug-in for Adobe Acrobat. There are several software tools that could be used to read text from a PDF document, and the most suitable is PDFAloud, from TextHelp Systems. It is well integrated into Adobe Acrobat, has a straightforward user interface, works smoothly, and gives highlighting of the text as it speaks. It is available for both Macintosh and Windows computers, and the Windows version can use either Microsoft or other SAPI-compatible speech engines. TextHelp Systems, the publishers, offer two costing schemes for PDFAloud: the 'per desktop' price is a licence to install a full version PDFAloud that can read any PDF document; and the 'per document' method is aimed at organisations such as SQA. With the per-document pricing, the author pays to speech-enable the exams, and users then download a free version of PDFAloud, to read these 'speech enabled' documents. TextHelp provided us with a free copy of this PDFAloud Stamping Kit and sufficient stamping 'credits' to speech-enable the exams for the project. Speech enabling is a very quick process: the author simply selects **PDFAloud > Stamp Document** from the PDFAloud menu in Acrobat.

For the project, we provided each school with the free copy of PDFAloud to read the speech-enabled exams, together with additional higher quality TTS3000 Lernaut and Hauspie British English and French voices. These voices are free and can be downloaded from the PDFAloud web site at http://www.pdfaloud.com/.

Ian Stuart, Business Development manager at TextHelp, provided the following costings for supplying PDFAloud, to create speech enabled exams:

"Option 1. SQA purchase a PDF stamping kit to produce speech-enabled exams. The schools can download the free PDFAloud plug-in to work with the pdf exams.

Typical cost : Stamping Kit (includes 100 credits) £1,250

Additional Credits

250 credits	£349
500 credits	£449
1000 credits	£549

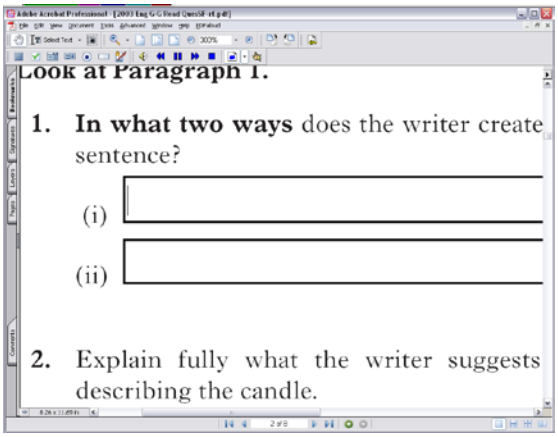
Option 2. The schools buy individual copies of PDF Aloud @ £59 per license. This solution comes with **RealSpeak** high quality voices. SQA would then distribute the exam in PDF format, but would not need to stamp each document.

Option 3. Any student who uses **Read & Write Gold 7** software has PDF Aloud included already in that software. A secondary school license is £1,795. This solution would mean that every pupil would have the option of a range of assistance."

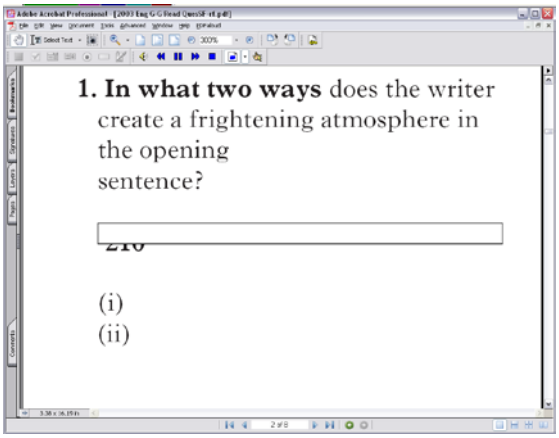
While it is not within the remit of this report to make recommendations about implementation and costing regarding the creation and solution of electronic exams, we suggest that option 1 provides the most cost-effective solution for Scottish education as a whole.

PDFAloud and Re-flowed exams

Adobe Acrobat has an accessibility feature that enables the PDFs to be enlarged to a high magnification, and then "re-flowed" so that the text fills the screen properly. However, when we re-flowed the examination papers we found that the PDFAloud speech would not read paragraphs contiguously, and the form fields and other aspects of the layout were adversely affected. We did provide schools with both the speech enabled exams, and a second set that could be reflowed but did not have speech and suggested that students who required magnification of 200% or more, but not speech, should use the reflowed exams. However, because of the problems of layout with the reflowed examinations we suggest that they should not be used, should SQA make examinations in PDF available.

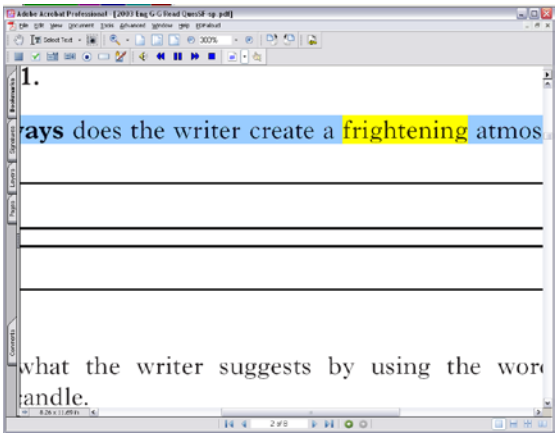


Standard paper magnified to 300%



Re-flowed paper – answer boxes are misplaced

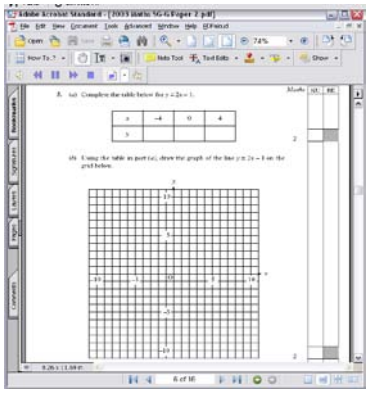
Also, we found that PDFAloud would actually scroll the page across as it was reading and highlighting the text, so to some extent there is little need to reflow the document, provided PDFAloud is being used.



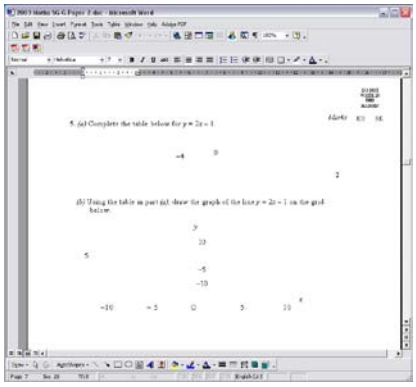
4. Electronic examinations in Microsoft Word Format

While it is undoubtedly easier for SQA to produce electronic examinations in PDF, many schools would prefer to receive them in Microsoft Word format, because Word is the most common word processor used in secondary schools. Therefore, at the end of the project a brief investigation into tools for converting PDF to Word format was undertaken. PDF Converter from Scansoft, and ABBYY FineReader Pro 7 were both used to convert "raw" PDFs from SQA, into Word. Both

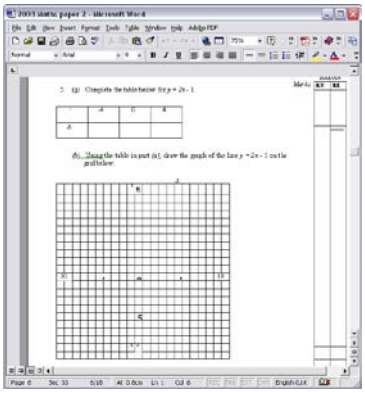
programs converted the papers with simple layouts (e.g. English Reading Text) reasonably accurately, but the form fields for answer boxes were unreliable and the fidelity of the more complex papers was poor. Papers created in this way would not be satisfactory for distribution to schools without significant editing.



The original Maths 2 PDF..



..converted with PDF Converter..



..and FineReader Pro 7

Trial in schools

Six schools were approached to take part in the project. The schools were identified through discussion with SQA and were chosen to try and give a good spread of candidates with different needs. The schools were:

- Ashcraig School, Glasgow, a special school for students with predominantly physical difficulties;
- Broughton High school, Edinburgh, a secondary school with a large number of children with specific learning difficulties;
- Earlston High school, Borders, a secondary school supporting a range of students;
- Kirkcaldy High school, Fife, secondary school with a Support for Learning Department supporting children with mainly specific learning difficulties;
- Perth High school, Perth, a secondary school with a Support for Learning department specialising in dyslexia, which pioneered the use of speech recognition for children with writing difficulties;
- Uddingston Grammar Visual Impairment Unit, South Lanarkshire, an integrated unit for students with visual impairment.

A visit was made to each school to install the Adobe Acrobat Standard and PDFAloud software and train the staff involved in the project.

In schools where the computers were on a managed network, it was usually necessary to install the Adobe Acrobat and PDFAloud software when logged on as an administrator. However, in some of the schools, although PDFAloud would appear within Acrobat, either it would not speak, or the additional high-quality and French voices were not available. The solution in these cases was to install the voices again when logged on as a pupil. It is likely that installation procedures will vary depending on the design of the managed network and so schools and local authorities would need to test the software thoroughly before using it in a real exam situation.

Schools and were provided with the backup copies of the software and examinations on CD, and a loose leaf folder containing the following documents:

- *Evaluation of SQA Examinations in Accessible PDF for Students requiring Special Arrangements* - a description of the project (appendix A);
- *Using Accessible PDF Exams* - instructions for staff and students on how to use the examinations in PDF (appendix B);
- *Using Accessible PDF Exams Summary* - a single page guide on how to use the examinations (appendix C);
- *SQA questionnaire* - a questionnaire to be completed by and with each student testing the papers (appendix D);
- Adobe Standard 6 installation instructions;
- Extracts from Adobe Standard 6 Help Guide (*Looking at the work area*, and *Using commenting tools*);
- a printed copy of the PDFAloud Help guide.

Decisions about the number and skills of the students to invite to evaluate the examinations were left to the school staff. We suggested that it would be most useful to involve students who had either just completed Standard Grade prelims in December 2003 or January 2004, or the Standard Grade examinations in 2003. We asked for the schools to conduct the trials in "exam-like" conditions. While timetabling restrictions might prevent students from completing an examination in a single sitting, we asked schools to avoid a situation where a student would complete the exam over a number of sessions.

Evaluation Questionnaire

An evaluation questionnaire was designed, to answer a number of questions:

- How easy are PDF exams to use, compared with human scribe and/or reader?
- How easy was it to learn to use the PDF exams?
- Do students feel the PDF exams are reliable?
- Do PDF exams offer more independence than scribes or readers?
- Would students be confident using PDF exams?
- Should SQA provide exams in PDF?

The evaluation questionnaire was to be completed by each student who participated in the project. It consisted of two sections: the first section was designed to investigate the ease-of-use of the PDF exams for different exam subjects; and the second part of the questionnaire asked more general questions applicable to all PDF exams. Both sections were designed to explore comparisons between the use of text-to-speech provided by PDFAloud and a human reader, and between the use of a human scribe and typing answers directly on screen. The questionnaire is given in Appendix D.

Marking of papers

Christine Wood at SQA offered to try and arrange for completed papers to be marked by SQA examiners, and so copies of papers returned to CALL were forwarded to SQA for marking. Eight English Reading papers, three biology, and five Maths papers were marked. We were not able in the course of the short project to compare the marks given using the electronic papers with the equivalent scores obtained in prelims or 2003 examinations, but comments from the markers suggest that the format of the examination did not adversely effect attainment. There is further discussion on the accuracy of measurement of attainment in the next section.

Results

1. Schools and pupils

All the schools who took part in the project trialled the examinations with a number of different pupils. Two schools (Kirkcaldy and Earlston) did not return any evaluation questionnaires, although staff did provide very useful feedback on the examinations (see appendix E). Table 1 gives a breakdown of the schools, students and the PDF exams completed.

School	No of pupils
Ashcraig	9
Broughton	9
Perth	7
Uddingston	5
Earlston	1
Totals	**31**

Subject	No of PDF exams tested
Biology	5
English Reading Text	13
English Reading Questions	23
English Writing	12
French Reading Questions	4
History G	11
Maths 1	14
Maths 2	12
Total	**94**

Table 1: Schools, pupils and PDF examinations evaluated

2. How easy were PDF examinations to use compared with scribe and reader?

One of the potential advantages of electronic examinations for students who require special arrangements in examinations is that it may provide a more independent method than using human readers or scribes. As far schools are concerned, electronic examinations may reduce the number of scribes, readers, invigilators and separate accommodation required to administer examinations, Therefore, it was important to obtain feedback from students about the usability of the electronic examinations in comparison with human support. We asked students to give ease-of-use ratings (on a scale from 1 to 10) for exams or prelims where they had previously used scribes and/or readers, and also for text-to-speech and typing answers into the PDF exam. The table and graph below give the mean ratings for ease-of-use for all students and examinations.

Type of support	No. of exams	Mean ease of use
Reader	77	9.19
TTS	68	7.45
Scribe	15	8.60
Typing	63	7.79

Table 2: Mean Ease of use ratings

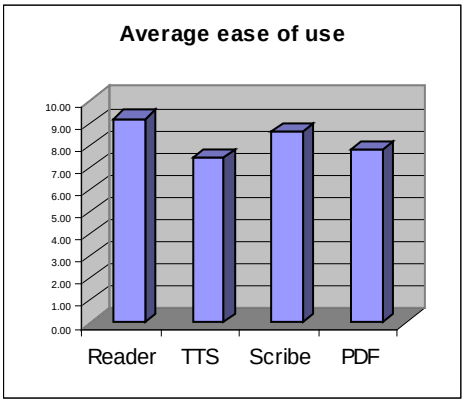


Figure 1: Mean Ease of use ratings

Overall, students rate the ease-of-use of the electronic exams to be slightly lower than human support. This is not unexpected -- for most people, it is easier to ask another person to perform the task than interact with a computer. In addition, most of the students already had considerable experience using scribes and readers, whereas they were less familiar with the electronic method (familiarity ratings are given later).

3. How easy was text-to-speech to use, compared with a reader, for different examination subjects?

Subject	No. of exams where reader was used	Average ease of use of reader	No. of exams where text to speech was used	Average ease of use of Text to speech
Biology	3	8.33	1	5.00
English Reading Text	13	9.46	13	7.77
English Reading Questions	13	9.38	13	8.04
English Writing	10	9.80	10	8.20
French	3	9.67	2	9.00
History G	11	9.18	10	7.80
Maths 1	12	8.75	10	6.89
Maths 2	12	8.75	9	7.00
TOTALS	**77 exams**		**68 exams**	

Table 3: Ease of use comparison for Reader and TTS across subjects

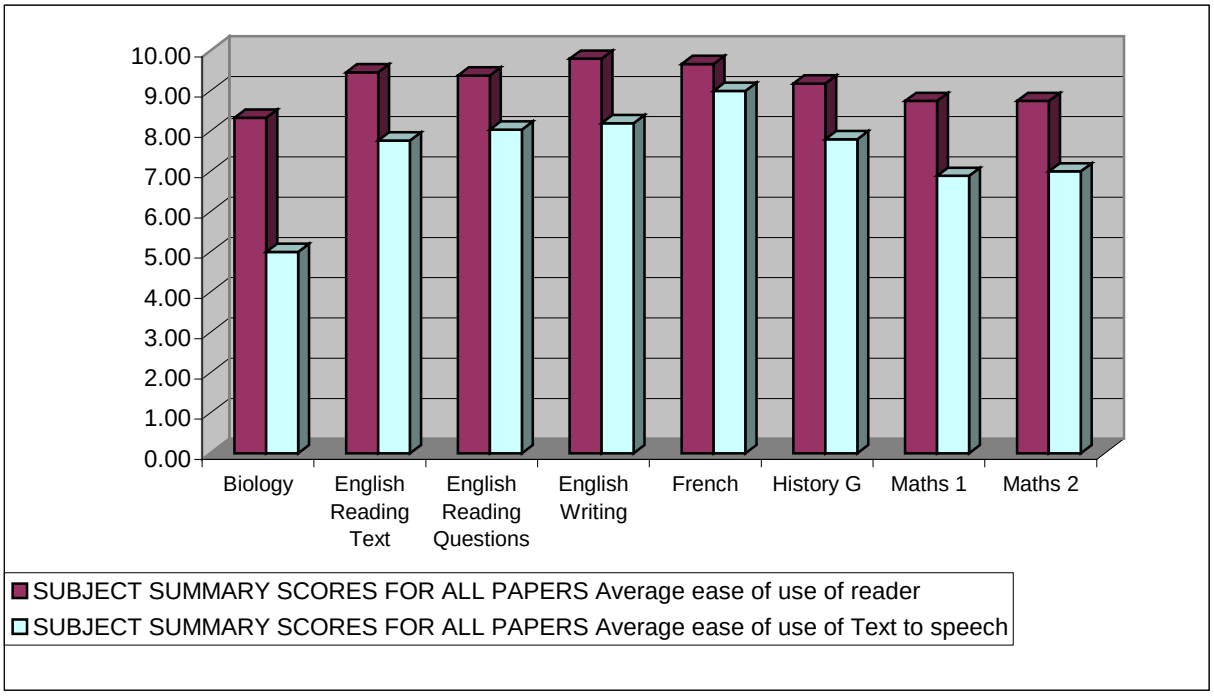


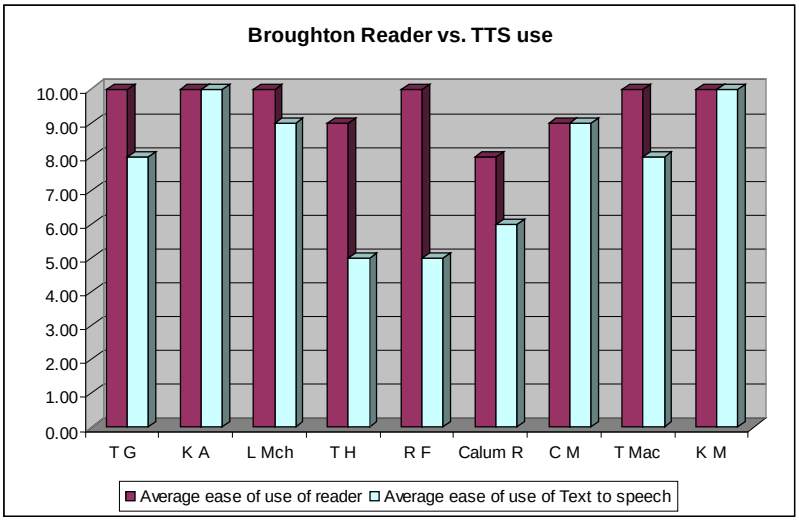
Figure 2: Ease of use comparison for Reader and TTS across subjects

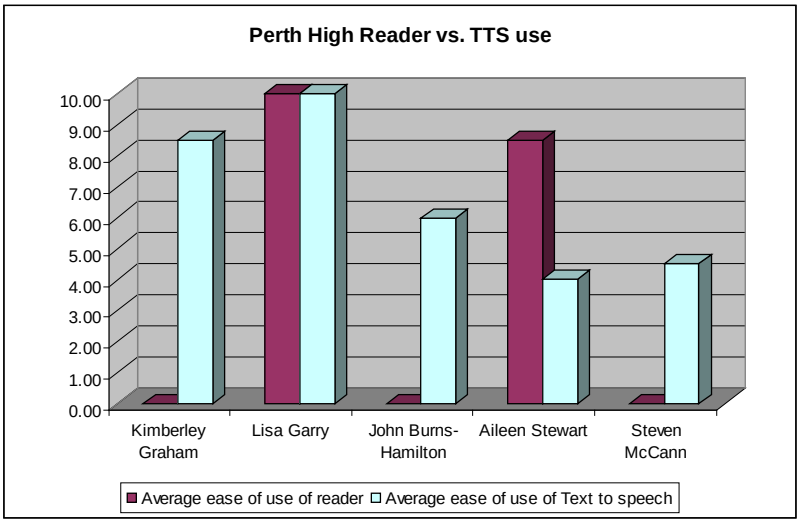
The text-to-speech scores are consistently lower than a reader for all the papers. The smallest differential is in the subjects that involved the most reading and writing -- English, French, and History. French has the smallest differential, but was taken by only three students. Two of the students used the TTS however, and one of these scored the reader and TTS equally with 9 out of 10 for each. Both these students were at Broughton.

Biology seems to have fared worst, although only 3 students used the reader, and just one the TTS. The single user who used the TTS said that in regard to the reader; *"Good -- but you sometimes feel embarrassed about asking them to read the same bit over and over again."* This student, when asked about the TTS, remarked that *"I liked having the computer read to me but I couldn't understand the voices very well."* (these comments applied to all of the 7 papers this pupil completed, not just biology).

4. Was there any difference in ease of use of TTS and reader between different schools and groups of pupils?

Students with different needs will have different demands when using the electronic examinations. A candidate with a visual impairment will experience different challenges compared to a sighted student with a writing difficulty. The graphs below break down ease-of-use scores across the different schools.





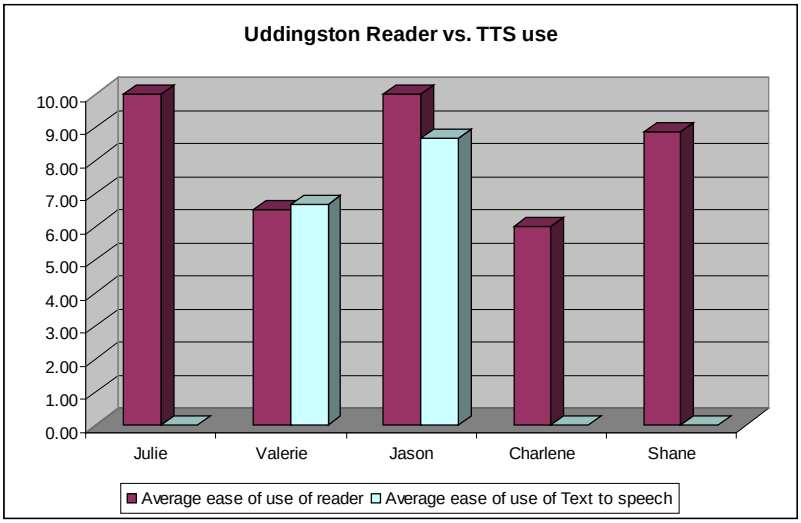


Figure 3: Ease of use comparison for Reader and TTS across schools

Students with literacy difficulties (dyslexia): Broughton and Perth

There seemed to generally be quite high scoring here. The student at Perth who gave the TTS the lowest score did not leave us any comments on why they rated it so poorly. The two pupils at Broughton who gave TTS the next lowest scores both wrote about the quality of the voices and the difficulty in understanding them. Both students also mentioned however that they liked the PDF exams because they gave greater independence.

At Perth, three pupils who didn't use a reader for the exam or prelim tried the TTS and gave it very mixed scores. Kimberly, who scored the TTS highest said that *"Quality of synthetic voice could be improved, but much better than not having a paper read to me. Size of box provided 'good indication' of how much to write"*. The comment on the voices was echoed by John and Steven, though John felt that using the electronic exams was 'more private'.

Although the dyslexic students commented that it could be embarrassing having to ask readers to repeat things over and over, and they felt the electronic exams gave greater independence, 7 out of 11 (64%) rated the reader to be easier to use than text-to-speech. It is nevertheless encouraging to see that four of the pupils (36%) rated Reader and TTS equally, and three gave top marks of 10 out of 10 for ease of use.

Students with a Visual Impairment: Uddingston

Only two students at Uddingston used the TTS. Valerie did 6 papers (3 English, 1 History, 2 Maths) and scored the TTS a point higher than

the reader in the English Reading and History examinations. She felt that the maths exams were one point easier with a reader. She said that *"I like being able to use the voice [TTS] when I want, but not all the time."* She also liked to have someone with her in exams for health reasons. Jason is a regular JAWS user, and felt this experience helped him to use PDFAloud. He liked to have the option of reader in class as he sometimes found the JAWS voices hard to understand. Jason completed the same papers as Valerie, and scored them all equally with full marks for both reader and TTS except the 2 maths papers, where the reader scored 10 and TTS 6.

The other three pupils used the PDF examinations without text-to-speech, Julie liked the PDFs but she also commented that she liked to have a reader or helper available. She found a problem viewing diagrams and questions in the examination papers (maths and biology) because she needed to magnify the paper and so she had to scroll up and down. She suggested that this could be addressed by providing the examination in two papers (as in the case of the English Reading Text and Questions) so that she could swap between the diagrams and the question document. Charlene doesn't always need a reader, and enjoyed being able to type in her answers, and Shane said *"I liked this - it was easy and I could read some of the bits out loud [with the TTS] but not everything"*.

As well as the schools and students discussed above, a single student at Ashcraig used a reader, who was scored at 10 out of 10 for ease of use. This student did not try the TTS.

The results show that students were generally positive about the PDF papers with text-to-speech, but that some candidates found in easier to use than other. The communication papers were regarded as being easier to use than biology and maths. This correlates with results of studies investigating the use of text-to-speech to assist reading (see the References), where significant gains in reading speed, comprehension and endurance have been reported for certain groups of subjects. Elkind (1998) suggests that students who benefit from the use of text-to-speech have:

- Poor unaided reading rate, comprehension or endurance
- Good oral language capabilities
- Good ability to integrate auditory and visual information.

5. How easy was typing into the PDF, compared with using a scribe, for different examination subjects?

Subject	No. of exams where scribe was used	Mean ease of use of scribe	No. of PDF exams used	Mean ease of use of typing
Biology	1	9.00	5	6.60
English Reading Text	0	-	0	-
English Reading Questions	6	8.50	22	8.73
English Writing	3	8.67	11	9.18
French	1	9.00	3	9.33
History G	4	8.50	10	9.00
Maths 1	0	-	7	4.29
Maths 2	0	-	5	3.40
TOTAL	**15**		**63**	

Table 4: Ease of use comparison for scribe and PDF exams across subjects

In general, the pattern here is different from the comparison of text-to-speech and the human reader: in most cases, the ease-of-use of electronic exams was rated higher than the use of the human scribe. However, since the number of students who used a scribe was less than a quarter of the number who used PDF exams (15 versus 63), drawing definitive conclusions from the comparison may have less validity.

The English, French and History papers were judged easier to use in the electronic format than using a scribe, on average. Examination of the data reveals what looks like a significant difference in the scoring for the maths and biology PDF papers, compared to the "communication" PDF papers.

	Scribe		Typing into PDF	
	No of papers	Mean ease of use	No of papers	Mean ease of use
All papers	15	8.60	63	7.79
Maths and Biology	1	9.00	17	4.71
Communication subjects	14	8.00	46	8.93

Table 5 shows that the mean ease of use score for the PDF communication papers (8.93) was higher than for scribes (8.00), although the differences in sample size must be taken into account.

Table 5: Ease of use comparison for communication and maths/science subjects

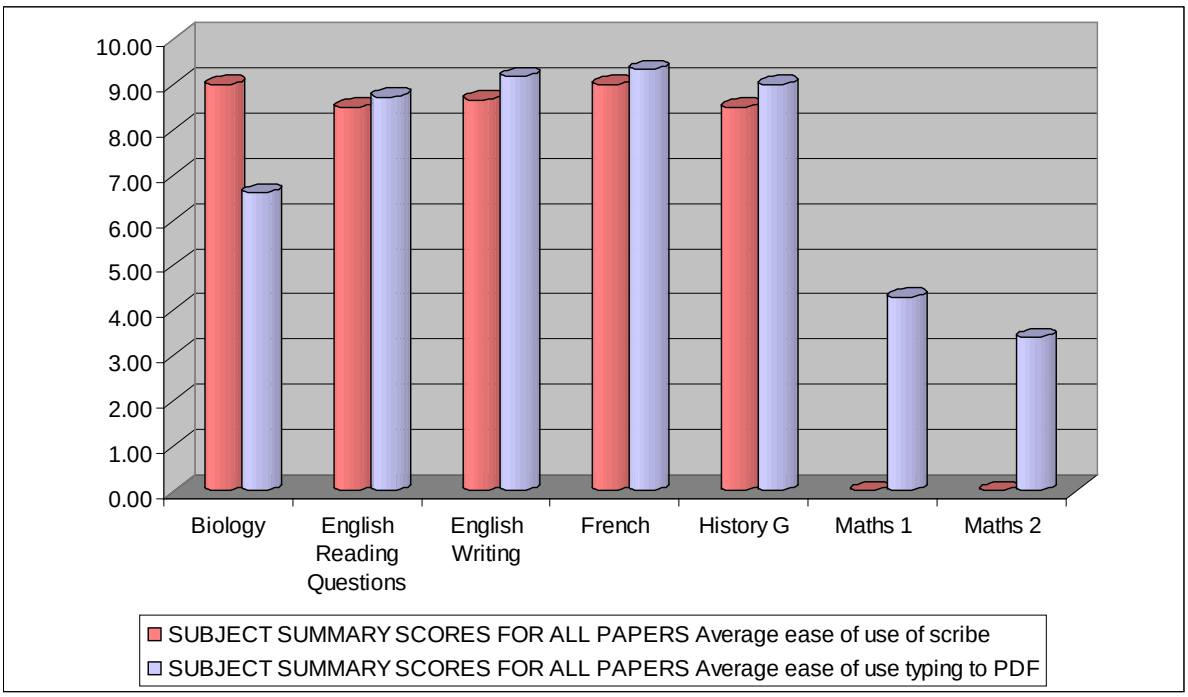


Figure 4: Ease of use comparison for scribe and keyboarding

In addition, the school, and by implication, the type of student, also appears to be relevant. Across all the schools, the ease-of-use ratings for maths and biology (4.71) are significantly lower than the scores for the communications subjects (8.93). But if we look at the scores from Broughton and Perth, where the majority of the students have predominantly literacy difficulties, we find there is little difference between maths and biology. However, this may not be significant given that only 3 science papers were scored compared to 27 communication papers.

	No of papers	Mean scores for PDF exams
Broughton and Perth		
All papers	30	9
Maths and Biology	3	9
Communication subjects	27	9.48
Ashcraig		
All papers	12	5
Maths and Biology	4	3.5
Communication subjects	8	8.38
Uddingston		
All papers	20	5
Maths and Biology	9	3.78
Communication subjects	11	8

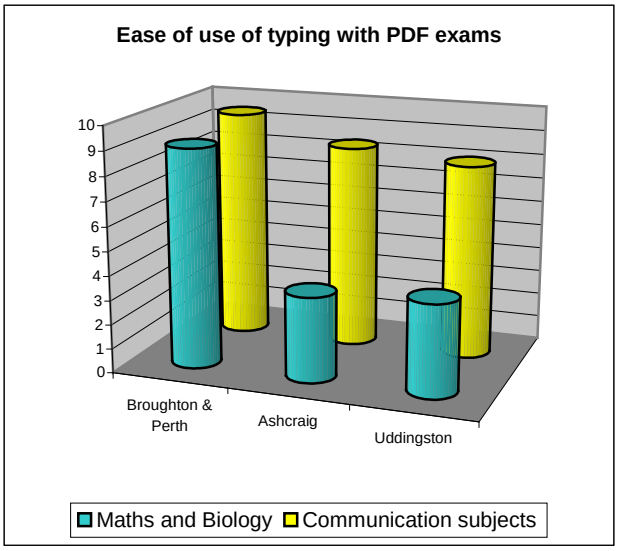


Table 6 and Figure 5: Comparison of PDF ease of use across subject and school

Turning to Ashcraig and Uddingston, where the students generally either have physical and/or visual difficulties, there appears to be a far more significant difference in the scores between science and communications subjects. The students in both schools judged the science papers to be significantly more difficult to use than the communication papers. Comments from the schools and pupils suggest that this is because these papers, which involve diagrams and charts, are more difficult to navigate around electronically than when dealing with the paper versions, particularly in the case of candidates who have a visual impairment. The other factor is of course that the communications subjects involve more typing and so the use of word processing and spellchecker will give greater advantage in these subjects, compared to handwriting.

Biology was taken by five students, only one of whom scored the use of a scribe, and so any comparison between scribe and PDF is probably unreliable. This student also did not complete any other exams, so we cannot tell if he generally scores scribes more highly than PDF. The three students who scored the biology PDF poorly (5 out of 10) were all described as having a visual impairment, while the two dyslexic pupils scored it more highly, at 8 and 10 respectively. Two out of three of the pupils with visual impairment commented that it was difficult to scroll around the electronic paper to navigate between diagrams and questions.

For the maths papers, no one claimed to have used a scribe, and so the scores given are for pupils who would normally write their answers themselves. The sample size for the two maths papers were 7 and 5 pupils respectively. Four of these pupils were at Uddingston, two at Ashcraig and one at Perth. The single pupil at Perth scored Maths-1 at 9 out of 10, while the other six students all the scored the maths PDF papers at less than 5 out of 10.

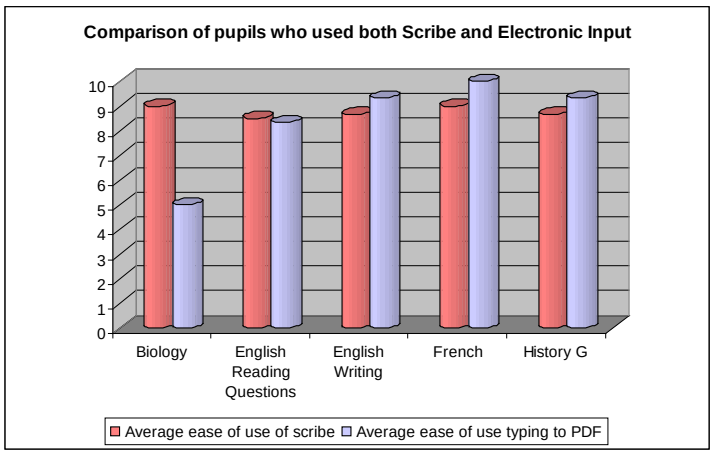


Figure 6: Ease of use comparison for students who used both scribe and keyboarding

The graph to the left compares the scores for those 15 students who used both scribe and PDF exam.

As we can see, it is only in the English reading questions that non-scribe users have made a noticeable change in the results, where scribes are now rated slightly higher than using the electronic examination.

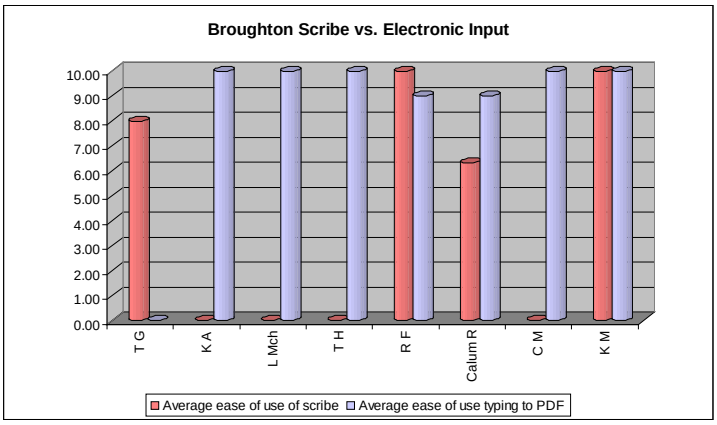
Where students have used both a scribe and PDFs, we find that 5 students scored scribes higher than the PDF, in 4 cases they scored equally, and in 4 cases PDF's were scored higher than scribes. In over 60% of cases, electronic input scored as well or better than scribe use for users who tried both input methods.

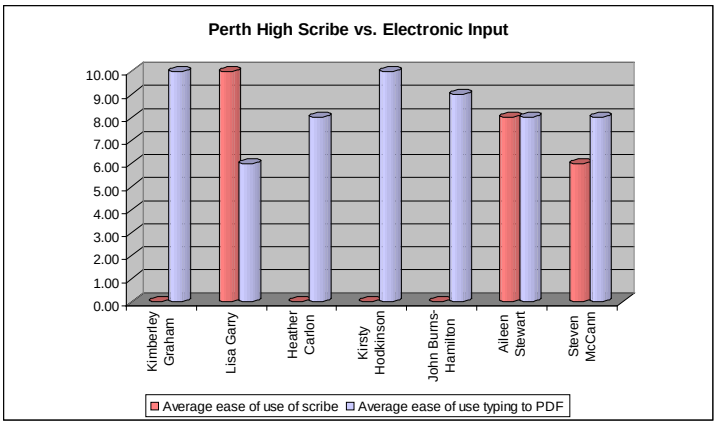
6. Was there any difference in ease of use of PDF and scribe between different schools and groups of pupils?

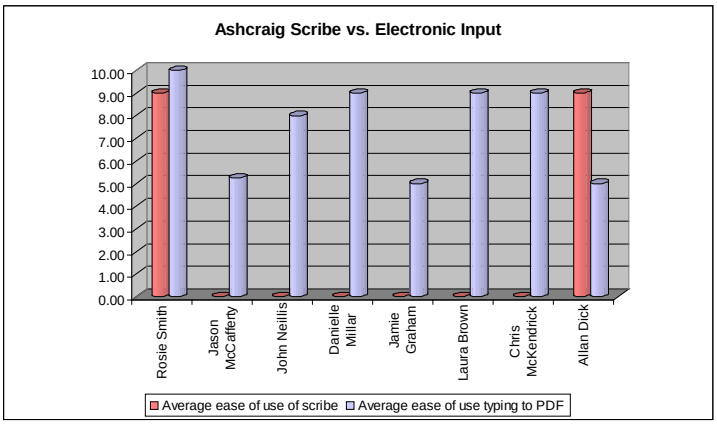
As we said previously, there were only 15 pupils who gave scores for using a scribe compared with 63 who used the PDF and so direct comparisons may not be particularly reliable.

In general, the students (at Broughton and Perth) who primarily have difficulties with literacy scored electronic input highly. Those with visual impairment and physical difficulties at Uddingston and Ashcraig, generally gave lower scores. However, as we saw above, this is probably as much to do with the subjects as with the students or the schools. Comments on scribes were both positive and negative: *"Good because I've always used a scribe."*; *"Can be difficult when I don't know what to say. Can be quite embarrassing when you think something might be wrong"*. Several comments on the electronic exams were about the freedom (and independence) it affords the student.

Students with literacy difficulties (dyslexia): Broughton and Perth







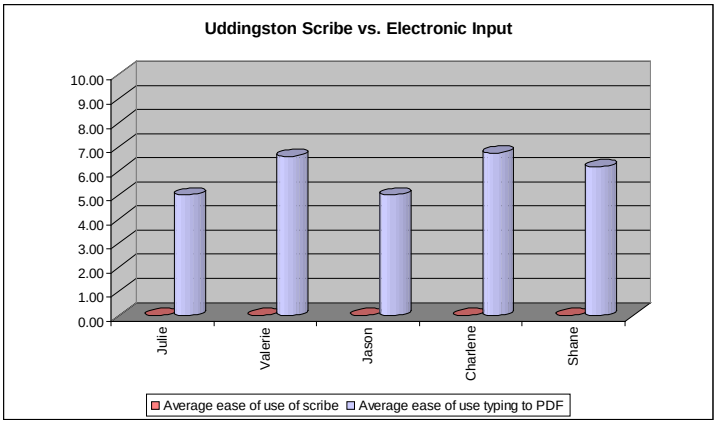


Figure 7: Ease of use comparisons for scribe and PDF across different schools

Broughton pupils scored the electronic input highly across the board. Perth had a bigger distribution of scores. One scribe user scored electronic input higher and one scored it lower, on the whole still broadly positive with scores from 6 to 10. Pupils mentioned the quality of the voices a lot, one saying that mispronunciations were distracting, another pointed out that more practice would make it easier to understand. Generally, pupils with dyslexia have scored the electronic input higher than the other students with visual and physical difficulties.

Students with Physical Difficulties: Ashcraig

As in Perth there is quite a wide spread of broadly positive scores here. Comments included: *"It [the PDF paper] was easier because the questions don't have to be numbered [unlike using a straight word processor]. Less paper to cope with. It was quicker to use for me."* and *"Need time to become familiar with PDF exams especially graphs and diagrams, changing size of print and scrolling up and down"*. The students who gave lower ratings are all those who used the maths or science papers.

Students with Visual Impairment: Uddingston

On the whole scores for typing into PDF exams from pupils at Uddingston were lower than the other schools. Some of the comments indicate familiarity with JAWS, which could mean that there was some confusion through using a different input method, although other comments indicate it was simply a question of visual formatting – i.e. needed more flexibility with colours, sizes and arrangement of elements on the screen. For example, *"I couldn't see the diagrams properly when they were big enough. I like being able to see the question and the diagram together"* and *"The colours would have to be worked out because I had trouble at first but it got fixed"*. There were positive comments as well though *"I liked this - it was easy and I could read some of the bits out loud but not everything"* and *"I like typing my answers in and I didn't need the speech"*. We have to assume that at least a few students use scribes from their comments, though having no comparison scores for their opinions of the ease of use of scribers is unfortunate.

7. Familiarity, ease of learning, reliability, confidence and independence

The second part of the questionnaire asked students to score readers, scribes and the use of the PDF examinations. These questions were intended to apply to all the examinations:

- How familiar was the student with this method before the exam? (1 = not familiar; 5 = very familiar)
- How easy was it to learn to use this method? (1 = very hard; 5 = very easy)
- How much would you rely on the method of assistance? (1 = definitely not rely on; 5 = definitely rely on)
- How much independence does each method give? (1 = no independence; 5 = totally independent)
- How confident would you be in an exam with each method? (1 = not confident; 5 = very confident)
- Finally please give an overall rating to compare each? (1 = poor; 5 = excellent)
- Should SQA provide exams for students requiring special arrangements in this kind of electronic format? (yes / no)

The table below gives the number of students and the mean scores for each question, for each type of assistance.

	Reader		TTS		Scribe		Typing into PDF	
	No of students	Mean score	No of students	Mean score	No of students	Mean score	No of students	Mean score
Familiarity	18	4.50	19	2.53	17	3.65	28	3.43
Ease of learning	18	4.39	19	3.79	17	3.35	27	4.48
Reliance	17	4.65	18	3.44	16	3.94	27	4.19
Independence	18	2.00	19	4.79	17	2.06	28	4.68
Confidence	18	4.72	19	3.53	17	4.00	28	4.21
Overall	18	4.61	19	3.58	17	3.82	27	4.33

Table 7: Mean scores for Familiarity, ease of learning, reliance, independence, confidence and overall

Familiarity

As one might expect, pupils felt least familiar with the text-to-speech. Typing into a PDF document was only marginally more unfamiliar than using a scribe.

Ease of learning

Learning to use a reader was regarded as easier than learning to use text-to-speech software. Conversely, typing into the PDF is seen as easier than learning to use a scribe. The fact that text-to-speech was easier to learn to use than a scribe, and that typing into the PDF is easier to learn to use than a reader is encouraging.

Reliance and confidence

The reliance scores are interesting as they mirror almost exactly the Confidence and Overall rating scores for each method. However, this perhaps provides a clear indication of the confidence we can have in the value and veracity of the Overall scores. Reading the questionnaire again, we wondered whether the confidence and reliance questions could have been taken to be two formulations of the question *"Would you trust this method for sitting an exam?"* The fact that the scores for all methods for both these questions differ by less than 0.1 points when averaged makes us believe this may have been the case.

Students regarded readers as being more reliable and providing them with more confidence than text-to-speech software, while typing into the PDF was seen as providing greater reliability and confidence than the use of a scribe.

Independence

The scores given for Independence are striking and significant. Pupils rated Readers and Scribes at only 2 and 2.06 out of 5 for independence, whilst the scores given to the TTS and keyboarding were 4.79 and 4.68 respectively.

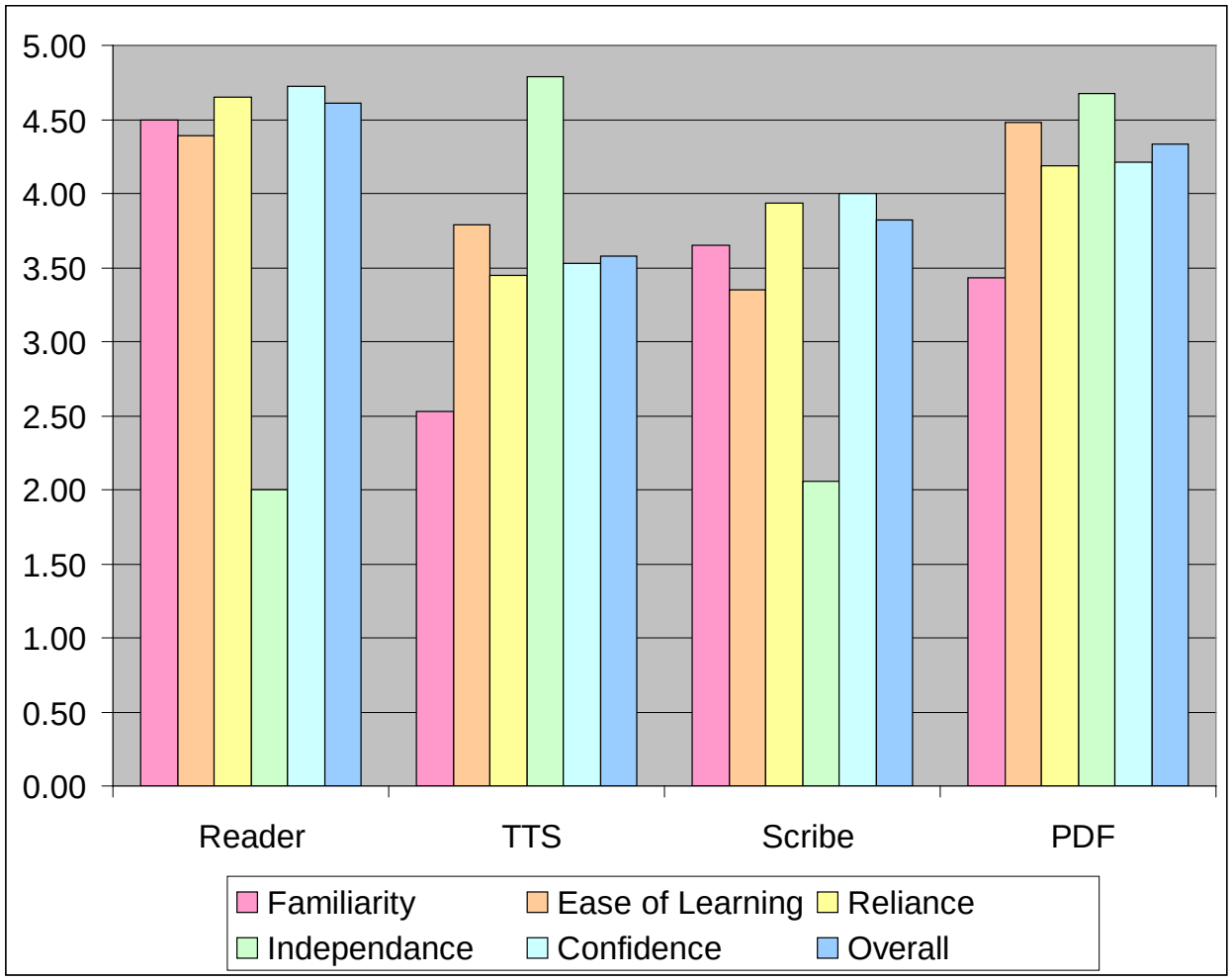


Figure 8: Mean scores for Familiarity, ease of learning, reliance, independence, confidence and overall

Overall

Looking at the overall scores, we see that students are happier with a reader than using TTS. The reasons for this appear to be because readers are more familiar to the students, easier to learn and therefore offer greater reliability and confidence. It is therefore possible, that had students received more training and were more familiar with the use of text-to-speech, they may have felt greater confidence and would be able to rely on them in the exam to a greater extent. However, there is no doubt that the human reader has two main advantages over text-to-speech software: firstly, it is undoubtedly much easier to ask another person to read a particular section of text from a paper than it is to highlight and click with a mouse; and secondly, the quality of human speech is obviously much better than synthetic speech. There were many comments from students and staff relating to the quality of the electronic voices and so this is one area that could profitably be addressed if examinations were to be made available in electronic format. The examinations were provided with the standard Microsoft voices, and higher quality English and French voices TTS3000 from Learnaut and Hauspie. However, the quality of these voices is still relatively poor compared with some of the more recent speech engines available, such as Learnaut and Hauspie's *RealSpeak*, AT&T's *Natural Voices*, or Rhetorical Systems' *rVoice*, which is a very high-quality Scottish speech engine. A member of staff in Ashcraig School compared the French Learnaut and Hauspie voice with the French voice from *Digalo* that was installed on the Ashcraig computers and observed that the TTS3000 voice was of poorer quality and intelligibility.

Across all the students polled, scribes were not as well regarded as the electronic exams. Despite being less familiar, they were easier to learn, more reliable, students felt more confident using them and they provide a much higher level of independence than scribes.

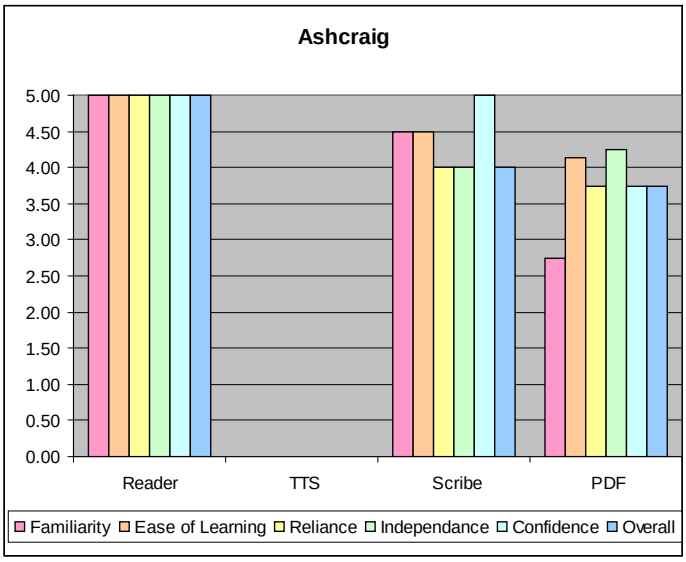
8. Should SQA provide exams for students requiring special arrangements in this kind of electronic format?

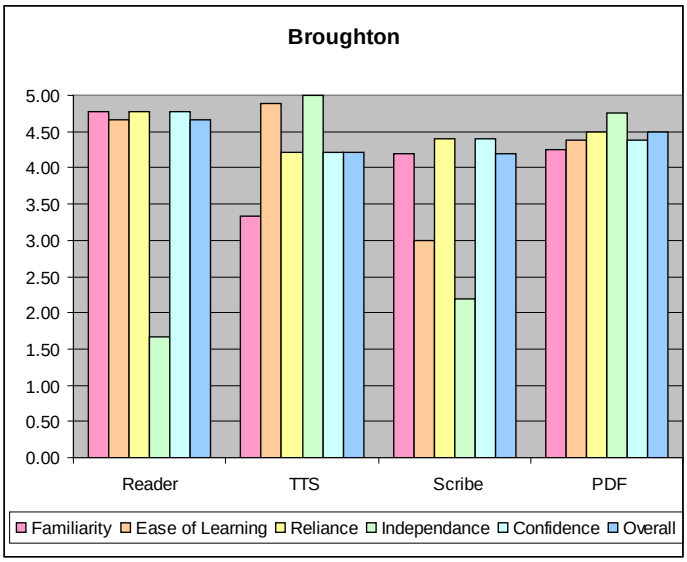
In answer to this question, 27 out of 28 students said "yes" (96%).

The one student who did not think that SQA should provide electronic exams scored a single English Reading Questions PDF exam (i.e. he did not give any scores for reader, text-to-speech or scribe), and gave the exam 8 out of 10 for ease of use and 4 out of 5 overall. He was not very familiar with typing direct into the PDF, found it very easy to use, was not confident with it, and gave it to 3 out of 5 for independence. It is therefore not clear why he does not think that the exams should be provided in electronic format.

9. School and nature of student difficulty

Figure 9: General scores across different schools





Students with Physical Difficulties: Ashcraig
No one at Ashcraig gave scores for TTS. We might expect this in a school where the main challenge facing the students is physical rather than to do with reading the paper. Ashcraig only had a single pupil that required a Reader, and that the pupil really liked everything about having the reader! Although PDF's were thought to provide more independence at this school than having a scribe, the difference was nowhere near as marked as the opinion in the other schools. On every other measure, electronic exams were marked lower than scribing at Ashcraig.

Students with literacy difficulties: Perth & Broughton
On first glance, these schools look like they may have given similar results, but there are some differences between them.

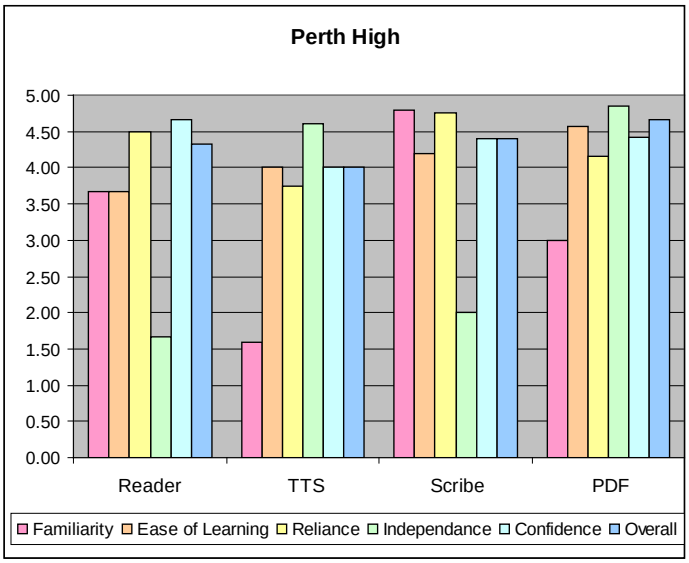
Familiarity with TTS and PDF's is lower at Perth than at Broughton. This unfamiliarity with technology does not have much impact on the ease of learning scores - at Broughton and Perth the Reader and Scribe both score lower than their electronic equivalents.

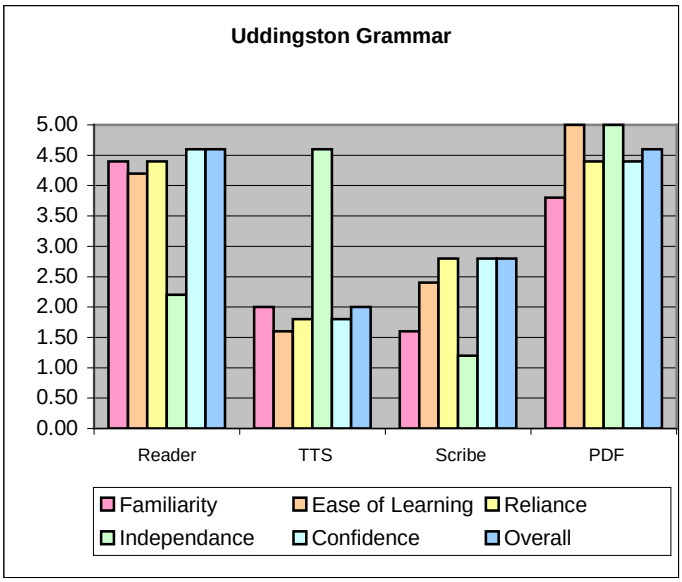
At both schools the independence given by the electronic versions was recognised but the focus was different, as Broughton felt that TTS provided slightly more independence than electronic PDF's and Perth students said the opposite.

Whereas confidence in Readers is higher then that in Scribes at Broughton, the opposite is true at Perth.

Students at both schools have more confidence and would rely more in a reader than in text-to-speech. Scores for scribe and PDF exams are roughly similar.

The general overall conclusion is that readers are more highly rated than text-to-speech, while typing into PDF exams is more popular than using a scribe. There are small differences between the schools - Broughton students give the highest rating to a Reader, and Perth to the PDF exams





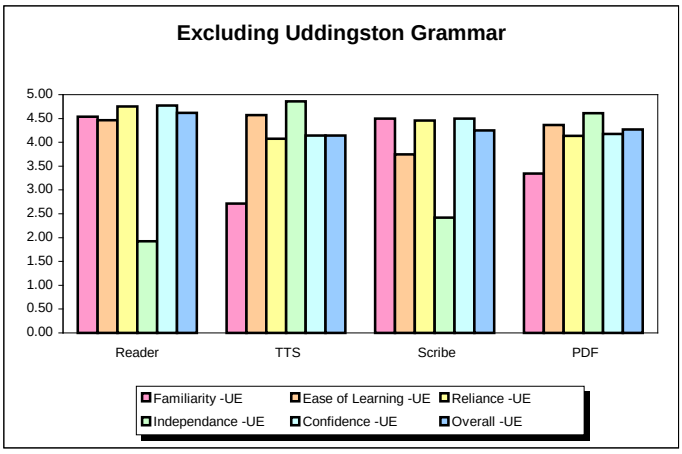


Figure 10: General scores, excluding those from Uddingston

Visual Impairment: Uddingston

At Uddingston we see a different picture. Familiarity here with scribes is the lowest of any school, because none of the pupils who participated said that they had used a scribe for any paper.

The low scores given to TTS are perhaps a surprise. From the comments it appears that some pupils were familiar with TTS through having used JAWS. Although both JAWS and PDFAloud are both screen readers, they are aimed at quite different groups of users. Jaws is designed for visually impaired and blind people, whereas PDFAloud is a tool for users with reading difficulties. PDFAloud is probably most efficient if the user can see the screen well enough to click on the text to be read using a mouse, which is obviously impossible for a blind user. While PDFAloud does have keyboard shortcuts available, it does not provide the same level of navigation or speech feedback as JAWS. In addition, comments from the pupils at Uddingston indicated that they actually wanted a Reader present in the exam for reasons other than just reading (i.e. health reasons etc.) The ease of learning and independence scores for the PDFs was higher than at any other school. Perhaps the experience of JAWS and other types of technology had prepared pupils for typing into documents, or the sheer willingness to embrace the electronic exams had meant that pupils started with a more open-minded attitude? Again the pattern of similarity between confidence, reliance and overall scores was repeated at the school, and in fact reflects the overall picture closest, with the reader and PDFs scoring highly and scribes outperforming TTS by a small margin.

Removing Uddingston Grange from the results entirely, we get the graph in Figure 10. The pattern is similar to the original that includes all results, but there is a much more even distribution of scores across the various methods, with TTS and Scribing showing the most overall change. The scores for the overall rating still average out to the same pattern of Reader, PDF, Scribe then TTS in order of popularity.

10. Validity of the PDF papers for measuring attainment

We asked schools to work with students who had sat prelims in December 2003 or January 2004, or the Standard Grade examinations in spring 2003, partly so that schools could compare the completed PDF papers with the results obtained using the more typical special arrangements.

- Moira Thomson, Principal Teacher, Support for Learning at Broughton high school, noted: "*No one did worse than they had at the prelim in December. Those who did the Maths all did much better than in the prelim. I suspect that this is partly because they had spent more time revising the Maths in school. All but one agreed that they preferred the independence the computer gave them and several admitted that they often did not ask their human reader to read things over again because it embarrassed them to ask too often and it made them feel stupid."*
- Helen Gill, Principal Teacher Pupil Support (Learning), Kirkcaldy High School, commented that typing answers on screen could be a fairer means of assessment for some candidates: "*Having the paper on screen and the ability to type in the answers proved to be a much better way than having to type in answers on a blank page. This allowed pupils with ASN to have the one paper in front of them, as is the case for their peers and took away the disadvantage of having two pieces of paper in front of them – a situation some candidates find confusing and awkward. The method put forward by the project is therefore to be highly commended."*
- Several staff and students noted that they felt embarrassed asking a human reader to read sections of the papers several times, or if they were unsure about dictating the correct answer, whereas the text-to-speech software enabled them to review the text as many times as necessary, and typing answers was obviously private. "*Using the system also removed the element of embarrassment. This was commented upon by several pupils who find dictating wrong answers or those which they are not sure about, very embarrassing."* Elaine Donald, Perth High School.
- On the other hand, the relatively poor quality of the synthetic voices, compared with a human reader, was felt to be a disadvantage by some staff and students. "*The maths paper likewise was not tried as the reader could not cope with mathematical terms. It could not speak numbers as we would. It was just too confusing. Again a human voice would have done this efficiently and in a manner expected by the student."* R.J. Fullerton, Earlston High School.
- Several staff commented that the PDF papers took longer to complete than the standard time allowed for the exam. It is recognised that reading a document on screen takes longer than reading it on paper, so this is not surprising, but it is clear that candidates using electronic examinations would also require extra time. "*All of them took longer to complete the PDF exam than they did the prelim - this is partly due to the difficulty some of them had understanding the voices and partly due to the fact that they were able to have bits read over and over again."* Moira Thomson; "*Time factor was not a problem as most found the time taken was similar to that for the exam so use of the system would not impinge on time allocation any more than the present 'extra time' provided for special arrangements."* Elaine Donald.

Christine Wood at SQA arranged for some completed PDF papers to be marked by SQA markers. Eight English Reading papers, three biology, and five Maths papers were marked.

- The English marker commented that *"The range of answers proved the same as for the main cohort and there was nothing unusual or unexpected in these papers."*.
- The biology marker reported: *"My first impression was that the candidates were able to make a good attempt at tackling the paper using the system. I think the standard of grammar is better than equivalent handwritten scripts and that the candidates make a greater effort to answer in sentences, rather than simple words or phrases."*
- There were no general comments made by the maths marker.

Given that schools and candidates regarded the use of PDF papers as providing significantly greater independence than the use of readers or scribes, it seems likely that the electronic method would provide a more accurate method of measuring attainment, provided the student is competent and confident about using the computer. However, given the comments made by staff and students above and in Appendix E, it is clear that decisions about the nature of special arrangements to be used must continue to be made on an individual basis, for each candidate, taking into account the difficulties faced and the nature of the examination.

11. Administration of examinations using PDF papers

In addition to providing greater independence for the candidates, staff in schools were enthusiastic about the potential advantages of electronic examinations to improve management, administration and reduce the cost of providing special arrangements for examinations:

- *"My personal view is that, for many of the pupils concerned, using the PDF exams would be a much better option than using a human reader/scribe. Much of this is due to the organisational difficulties of arranging rooms, staff and invigilators for many pupils - this year we have 19 needing readers/scribes for S grade History and 10 using computers - that means 19 extra rooms, 19 members of staff and 19 extra invigilators while the computer users just need one room and one invigilator - and technical support standing by in case of computer problems."*

  Moira Thomson, Broughton High School.

- *"Our investigations concluded that the project/the arrangement…*
  - *was a huge step forward and should be pursued;*
  - *that it allows for independence for a number of candidates*
  - *would reduce the number of readers and scribes, the reading/scribing arrangement having considerable training implications and one that is not always enjoyed by candidates."*

  Helen S. Gill, Kirkcaldy High School.

The relatively low scores given by students with respect to familiarity with the electronic examinations, together with comments from staff, show that it would be important for candidates to receive training in the use of the PDF examinations prior to sitting the exams. In addition, school management would have to liaise with the appropriate technical support teams in order to ensure that the Adobe Acrobat and PDFAloud software was installed correctly, and that satisfactory technical backup facilities were available. It is likely that SQA would need to offer staff development for schools and invigilators in the use of the electronic examinations.

References

Disseldorp, B. and Chambers, D. (2002). Independent access: Which students might benefit from a talking computer? In S. McNamara and E. Stacey (Eds), *Untangling the Web: Establishing Learning Links*. Proceedings ASET Conference 2002. Melbourne, 7-10 July.
http://www.aset.org.au/confs/2002/disseldorp.html

Elkind, J., Cohen, K., & Murray, C (1993). Using computer-based readers to improve reading comprehension of students with dyslexia. *Annals of Dyslexia*, 42, 238-259.

Higgins, E., & Raskind, M. (1997). The compensatory effectiveness of optical character recognition/speech synthesis on reading comprehension of post-secondary students learning disabilities. *Learning Disabilities: A Multidisciplinary Journal*, 8, 75-87.

Nisbet, P.D. (2002) Special Arrangements For Using ICT In SQA Assessments. Project report to Scottish Qualifications Authority. CALL Centre, University of Edinburgh.

Nisbet, P.D. (2003a) Accessibility of SQA assessments in Portable Document Format. Project report to Scottish Qualifications Authority. CALL Centre, University of Edinburgh.

Nisbet, P.D. (2003b) An investigation into the Accessibility of SQA Assessments in Electronic Format. Project report to Scottish Qualifications Authority. CALL Centre, University of Edinburgh.

Olson, R. K., & Wise, B. W. (1992). Reading on the computer with orthographic and speech feedback. *Reading and Writing: An Interdisciplinary Journal*, 4, 107-144.

Shany, M. & Biemiller, A. (1995). Assisted reading practice: Effects on performance for poor readers in grades 3 and 4. *Reading Research Quarterly* 30, 382-395.

SQA (2003) Annual Statistical Report 2002. The Scottish Qualifications Authority. ISBN 1 85969 467 5

SQA (2004) Guidance on Special ('Alternative') Assessment Arrangements (Draft) The Scottish Qualifications Authority.

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