# SQA Guidelines on e-assessment for Schools

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# Foreword

We live in an age of Information Technology (IT) — at home we are surrounded by, and constantly use, IT; at school, candidates use IT as part of the learning and teaching environment. The SCHOLAR programme[1], which was recently introduced into all Scottish schools, is a case in point. It is only natural, then, that IT be used in assessment.

SQA has been exploring issues of e-assessment and online assessment for several years. By 'e-assessment' we mean the use of electronic media in the assessment process — any application of computers to support assessment; by 'online assessment' we mean assessment that is delivered over a network or (now more often) the internet.

Work was started to address e-assessment and quality assurance issues in 2001. In the further education sector, SQA qualifications were already being adapted for online assessment. For this reason the Scottish Further Education Funding Council (SFEFC) agreed to support two projects in that sector. The *SQA Guidelines on Online Assessment for Further Education* (AA1641, March 2003) and *E-moderation: guidelines for FE staff and external moderators* (AA1675, November 2004) were produced as a result of these projects.

The Pass-IT project[2] (**www.pass-it.org.uk**) was another part of this work. This research project brought together key players in Scottish education to explore the applicability and suitability of different forms of technology to enhance assessment.

These *SQA Guidelines on e-assessment for Schools* have been developed from the results of these research projects — principally the Pass-IT project.

The guidelines offer advice on:

- why you might choose to use e-assessment — and when not to use it
- what you will need to do to use e-assessment — including staff development and technical support
- software and hardware issues
- security and authentication issues, including invigilated assessment sessions
- supporting candidates and giving feedback

[1] A programme of online teaching and learning resources at Higher and Advanced Higher levels in selected subjects.

[2] A Scottish Executive funded initiative that carried out research into the use of online assessment using web browsers and the internet. The partner organisations of the project were Learning and Teaching Scotland (LTS), SQA, Scottish Centre for Research into Online Learning and Assessment (SCROLLA, based at Heriot-Watt University), Scottish Further Education Unit (SFEU), and BBC Scotland. The project ran from August 2002 to December 2004.

These *Guidelines*, like the ones covering online assessment for FE colleges and e-moderation, should be viewed as work in progress — and as support documents which should be read in conjunction with our earlier publication *Assessment and Quality Assurance for Open and Distance Learning* (A1030, February 2001). All of these publications will continue to be updated as required in response to developments in e-assessment.

In issuing this publication, we are hoping to facilitate the use of e-assessment in schools. We would ask you to work with SQA to raise and address the assessment and quality assurance issues which will inform our next set of guidance on e-assessment. This can be done by providing feedback to your SQA Co-ordinator or the member of staff who has overall responsibility for e-assessment in the school.

# Introduction and overview

## Introduction

This document provides guidance for those in schools who are using computers and possibly internet technologies (or are considering using them) to assess candidates for SQA qualifications. It focuses on summative assessment in schools, though you will also find it useful when planning formative assessment.

The guidance is divided into three sections: '*Preparing for e-assessment*'; '*Holding assessment sessions*'; and '*After the assessment*'. Each covers a stage in e-assessment — for each stage there are several steps that must be taken to ensure the smooth and rigorous delivery of the e-assessment. The section on '*Holding assessment sessions*' covers practice as well as summative assessment sessions.

We won't be covering how to develop e-assessments in this document. This is covered in the Pass-IT project's *Good Practice Guide in Question and Test Design*.

One other major area of e-assessment that is not covered here is e-portfolios.

We have used the British Standards Institution Code of Practice in preparing these guidelines (*BS7988: Code of practice for the use of information technology [IT] in the delivery of assessments*). This code is currently being rewritten in 2005.

In these guidelines we focus on e-assessment. When we refer to *online assessment* we mean assessments that use a network and/or internet-based tools for:

- the real-time delivery of assessments to candidates
- the capture, marking, storage and analysis of candidates' responses
- the collation, analysis and return of results

## Scope of e-assessment and of these guidelines

E-assessment (like all other forms of assessment) has three main purposes:

- **Diagnostic** — carried out before or after learning activities take place to ascertain the level of a learner's (or a group's) knowledge.
- **Formative** — carried out as part of teaching — assessment for learning where the information gathered is used to adapt the teaching or the learning to meet the needs of the learner.
- **Summative** — carried out at the end of a learning programme or at a number of specific points during it to provide a mark which affects the level of qualification achieved or allows progression to the next stage of learning.

These guidelines apply to all three forms of assessment, though much of the information will be more relevant to summative assessment than to diagnostic or

formative assessment. It is, in any case, advisable to trial all systems extensively in a formative mode before carrying out summative assessments.

We will look specifically at delivering e-assessment using a local intranet and possibly a VLE (Virtual Learning Environment), though much of the document is relevant to other CAA (computer-assisted assessment) technologies such as online delivery through the internet, offline delivery, and the use of personal digital assistants (PDAs).

## Which parts should I read?

The guidelines in this document are aimed at all staff in schools. However, not all of the guidelines will be relevant to all users of the document.

- If you are a member of a senior management team and are involved in formulating your school's strategy for e-assessment, you will find the information in the section: *Preparing for e-assessment* relevant.
- If you are a teacher involved in the delivery, moderation or quality assurance of assessments, you will find all sections relevant, but in particular the sections: *Holding assessment sessions* and *After the assessment* will be of interest.
- For technical support staff, the first section: *Preparing for e-assessment* will be of most use, although it is essential that technical support staff are also involved in the delivery of the assessments. Other support staff, such as librarians, will also find some of the guidance contained in the document relevant.

# 1 Preparing for e-assessment

The first things to do are to analyse your reasons for introducing e-assessment, consider the SQA curricular areas to be targeted, and decide whether your school has the necessary organisational and technical infrastructure. You should explain your reasons to the staff who will be involved in e-assessment. Candidates, and (if you think it's necessary) their parents/guardians, should also be told why e-assessment is being introduced, and how it links with the other course activities.

## 1.1 Whole-school commitment

### a Senior Management Team

Because of the range of skills and technologies required to deliver e-assessment, it is essential that the Senior Management Team in the school be involved from the outset. Holding an e-assessment session in a department will involve more than the staff in that department, and unless the department has adequate computing facilities, the assessment sessions will need to be either in other departments or in a central facility (such as a library or an IT room). Experience has shown that this is much easier if the management of the school sanctions the temporary timetable changes that are necessary.

It may also be necessary to arrange for class cover during practice or the final e-assessment sessions. This is normally arranged by a member of senior management.

You may have a policy of keeping parents/guardians informed about developments affecting the teaching or assessment of candidates. If this is the case, a member of the Senior Management Team might want to send a letter to the parents/guardians of the candidates involved in summative e-assessment.

Your school should identify a member of staff to have overall responsibility for e-assessment activity within the school. Since introducing CAA within a school is likely to involve whole-school policy decisions, we suggest that this is a member of the Senior Management Team — it could be the headteacher, SQA Co-ordinator, your Flexible Learning Co-ordinator or some other member of staff. This person will be the point of contact between the SQA and the school on issues relating to e-assessment.

### b Costs

SQA will provide schools with e-assessments to support its qualifications and the assessment engine required to deliver the assessments. Online assessment capabilities are likely to be built into the Scottish Schools Digital Network[3] (SSDN) Intranet (**www.ltscotland.org.uk/ssdn/index.asp**). Key considerations in providing

[3]A Scottish Executive initiative which aims to deliver a range of services, applications and content to teachers, pupils and education managers using a secure national intranet for education.

this e-assessment system to schools, either directly from SQA or through SSDN, will be to reduce the costs associated with its use and administration, and to provide training for staff who will be involved in supporting the system.

Costs which do need to be considered, though, are:

- **staff development** to assist staff in using the systems, supporting candidates and invigilating
- **technical support** for staff and candidates, particularly when using the system for the first time and during summative e-assessments

In the longer term, your school might be able to offset these costs against reductions in marking time and administration. Economies of scale are increasingly likely as the uptake of e-assessment increases across the school.

### c Staff development

While members of a Senior Management Team may find a briefing on e-assessment adequate, teaching staff who will be using the technologies are likely to need training and support. Support staff in libraries, and in administration and technical areas, may need specialised training in how to support those using the systems. SQA will increasingly use e-assessment in future to support its qualifications, and our intention is to work with schools and education authorities to ensure appropriate training is available for using these assessments.

### d Technical and other support staff

Technical assistance is needed both before and during e-assessment sessions at a number of levels. Maintenance of computer labs, networks and servers becomes much more critical when they are being used for an invigilated assessment. Also when running e-assessment sessions and when using practice e-assessments, it may be necessary to involve the librarian or other support staff. It is advisable that:

- technical staff are given advance notice and made aware that such assessments should be given priority
- dedicated technical support is available both before and during assessments

## 1.2 Considerations about using e-assessment

### a Improving learning

Research suggests that e-assessment can have a positive impact on learning. E-assessments can be incorporated into the delivery of a Unit and can give instant feedback to candidates. Assessments that incorporate randomisation and selection from a substantial bank of questions can be used repeatedly by candidates for formative assessment without losing the confidentiality of the questions for use in summative assessment.

Increasing the frequency of assessment and improving feedback are recognised motivators for learners, and they can also help staff to identify candidates who need remedial assistance. Some candidates prefer to do coursework which is assessed (because, for instance, they find it motivating), so frequent e-assessments can ensure that they learn more without increasing marking loads. E-assessment can also be used to increase motivation — some candidates, in particular some males, are more motivated by an e-assessment than by a pencil and paper assessment.

Formative e-assessments can reinforce learning while preparing candidates for the summative assessment at the end of the Unit. At the same time, the candidates become familiar with the assessment engine.

E-assessments can also incorporate media-rich elements that include video, sound, animations, simulations and interactive graphics. These elements are designed to be user-friendly and encourage candidate participation.

## b Objective marking

In conventional assessment, marking can vary between markers as a result of different interpretations of marking schemes and learners' responses. Computers, however, will mark the same responses in the same way every time. All assessment engines can handle multiple-choice questions, but some can go further than this.

The assessments developed as part of the Pass-IT project contain a spread of question types. Those that involve objective marking, such as multiple choice, multiple selection and hot-spot questions as well as judged mathematical expression (JME) and word match (WM) questions, can be automatically marked, reducing marking load for teachers. This is one of the most commonly stated reasons for introducing e-assessment.

More advanced assessment engines, such as the one developed for the Pass-IT project, can award partial marks for students by the use of optional steps in questions.

## c Non-objective questions

The downside of computer marking is that sometimes the assessment engine can be less accommodating than human markers. An example of this is when a candidate enters text; a computer might mark an answer wrong where a human marker would consider the answer to be correct or partially correct.

One question type available with some assessment engines that is not usually marked automatically is the free-text/extended response or essay question. The responses entered by candidates to these questions need to be scrutinised by a human. Candidates type their answers in a text box and submit them in the normal way. The assessment engine stores the answers. These answers may then be recalled by the teacher and printed out if necessary for marking.

In the Pass-IT project some progress was made with automatic marking of short free-text responses, although the technology required to mark free-text responses is not yet robust enough to be made widely available. The system used was developed by Intelligent Assessment Technologies (**www.IntelligentAssessment.com**).

## d Automated results collation, analysis and return

A major benefit of e-assessment is the ability to collate results and instantly analyse the responses to questions. A good assessment system includes analysis tools and reporting systems that make it possible to analyse the performance of a single candidate, a class, or a number of classes. It is also possible to analyse the responses made to individual questions by a group of candidates, and use this to inform teaching and learning — for example, if the responses to a particular question all show the same misunderstanding, it should be possible to reinforce teaching.

One of the most significant administrative benefits of e-assessment is the ability to transfer results into management information systems automatically. This saves time and reduces clerical errors. Results can also be collated easily either by Unit or on a Learning Outcome basis and provided to candidates either online or by e-mail.

There is a significant reduction in printing of paper assessments and the associated administration involved in storing the papers securely, as well as distributing papers and collecting responses. With robust e-assessment systems, the chances of a candidate's responses going missing should be reduced.

## e Improving access

Some candidates with additional support needs find e-assessment preferable to traditional pencil and paper assessments. It should be possible for candidates to modify the screen display to suit their particular needs.

## f Reducing opportunities for plagiarism

Although the use of technology increases the opportunities for plagiarism, it also increases the availability of tools to detect it. Essays submitted electronically can be analysed using various technologies, and inconsistencies between the styles of different sections, suggesting incorporation of others' work, can be detected automatically. Software is also available to locate similar materials on the internet and to compare the work of a cohort of candidates.

## g Time factors

E-assessment increases the time available for teaching. This is mainly because most questions are automatically marked by the system and the results are returned immediately to candidates. The time spent in marking and returning candidates' work is greatly reduced. Re-sits can often be organised on an individual basis, freeing the teacher to concentrate on teaching the rest of the class.

*BS7988: Code of practice for the use of information technology (IT) in the delivery of assessments* recommends that no one should spend longer than 1½ hours working continuously at a computer. This should not pose any real problem where NAB assessments are involved, although it is as well to be aware that the time any candidate spends on the computer may include:

- logging on to the local authority and/or the school intranet
- logging on to the assessment site
- taking the assessment
- any additional time granted because of special assessment arrangements

Research has found that candidates taking assessments on computer require on average ten percent more time to complete the assessment compared to traditional methods. You should allow for this when you are planning the assessment.

## h Are all subjects and areas suitable for e-assessment?

The short answer to this question is no. Objective questions, such as multiple-choice questions (MCQs), may not always be appropriate. They are effective in assessing factual recall, but it is harder to use them to assess higher-order learning skills such as creativity, communication skills or synthesis. They cannot elicit qualitative or reflective responses. It is also clear that candidates' understanding and problem-solving skills are assessed better when they have to recall and enter information than when they are presented with a selection of possible responses.

However it is not only the more numerate subjects that can be made available as e-assessments. For obvious reasons it may not be possible or advisable to assess practical skills (such as the ability to carry out an experiment in Chemistry) entirely using e-assessment. However, as part of the Pass-IT project, JelSIM produced a series of simulations to support practical experimentation in Higher and Advanced Higher Chemistry (**www.jelsim.org/chemistry/practicals/**). You should use your experience and professional judgement to determine the most appropriate assessment tool.

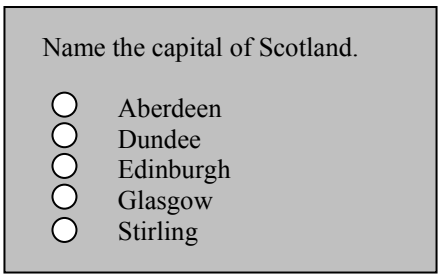
One thing that will be available in the foreseeable future is 'blended assessment'. In some subjects and areas, e-assessments and traditional assessments will be available side-by-side; for other assessments, only paper tests will be available; for a very small number of assessments, e-assessment may be the only option available. The appropriateness of the assessment tool — rather than trying to reduce the administrative burden — should be the primary driver for introducing e-assessment.

## i Different question types

Although this guide is not intended to cover the process of creating e-assessments, it may be useful to outline the main question types you are likely to find in an e-assessment package, and some of the considerations that arise when these are being created.

### Multiple choice

With multiple choice questions (MCQs) candidates are required to choose one out of several responses to a question.



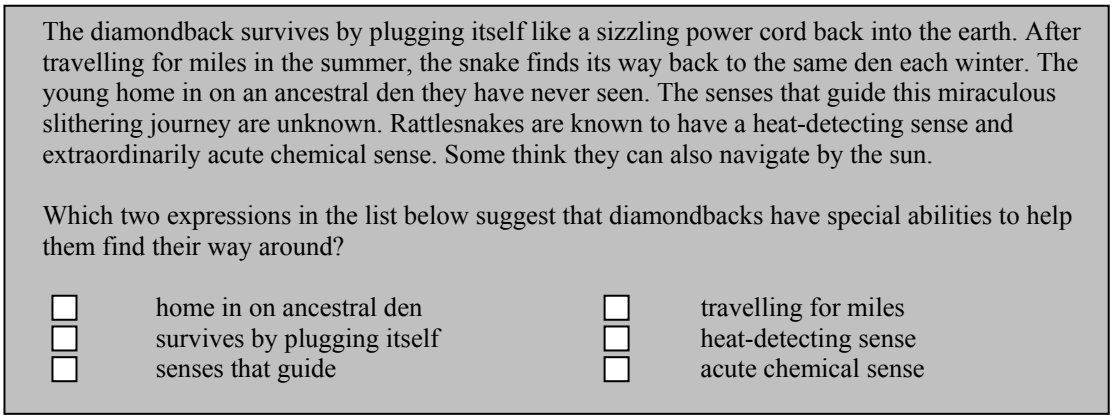

Multiple choice questions can also be authored as drop-down (sometimes called pull-down) list questions.

### True/false and yes/no

True/false and yes/no questions are simply multiple choice questions with two possible responses. Such questions allow the rapid assessment of large amounts of material. There is very little educational benefit in using these questions since a score of 50% is statistically likely in an assessment containing only true/false or yes/no questions if the candidate knows nothing about the subject. Also, it can be difficult to write stems which have two such absolute responses.

### Multiple selection or multiple response

Multiple selection or multiple response questions are similar to MCQs but more difficult to answer correctly because the candidate can choose one or more correct responses.




The convention is to use a square *checkbox* rather than a round *radio button* where more than one response can be selected. This is a function of the software, and is not something you can normally alter.

## Matching

This question type can be used when candidates are required to match two related items or concepts.

Documents are produced by the software development team at each stage in the Software Development Process.

Choose a document which is produced at each of the three stages mentioned.

| *Stage* | *Document* |
|---|---|
| Analysis | User Guide |
| Implementation | Program Specification |
| Documentation | Structured Listing |

Matching questions are variations of MCQs. In the example above, for the first stage there is the choice of one of three documents and for the second stage one of the two that are left. This means that if the candidate does not know which document is produced at the last stage, they can still get the question right by a process of elimination. It is therefore a good idea in this type of question to incorporate an extra type (*ie* an extra category on the right: in the example above, an extra *Document* which is not produced at any of the stages mentioned) — both to provide a more taxing question, and to ensure that the candidate is not forced into a second error if they have already selected one incorrect option.

## Sequencing/ordering

Sometimes candidates are required to know a sequence or order. They will normally be required to drag the responses into the correct order.

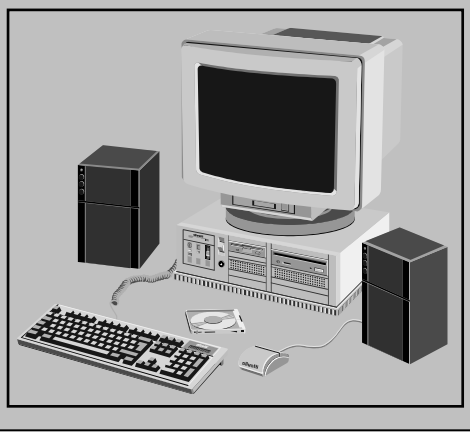
Put the following colours of the spectrum into the correct order, starting with the colour that has the shortest wavelength.

Blue
Green
Indigo
Orange
Red
Violet
Yellow

## Hotspot

Hotspot questions are useful when a candidate should to be able to identify or interpret parts of a picture or diagram.

Select the keyboard of the computer.



## Judged mathematical expression

Most assessment engines can handle questions requiring a number or a mathematical expression as a response.

A lorry travels 52 miles in one hour on a motorway.

How many miles will it travel in 4 hours at the same rate?

☐ miles

Some assessment engines treat this type of question as a form of short answer question where only one response is acceptable (*eg* 208 may be accepted, but 208·0 not).

Some assessment engines have taken JME questions to a higher level of development. This type of engine can handle all mathematically-equivalent expressions and evaluate them to see if the response is correct. Responses of 208, 208·0, 52 × 4 and (52 + 52 + 52 + 52) would, if required, all be given credit as mathematically equivalent. In addition, a question can be set up to 'lock-out' certain responses. So, for example, if an answer has to be evaluated, then responses containing the symbols '×' and '+' could be excluded.

For numerical questions where a number and a unit are required, care has to be taken with the unit part of the response. If a unit is entered in the response and none is expected, then the candidate would be marked wrong. Careful question authoring can remove this problem.

### Short answer

There are many types of automatically-marked question that require one of a small number of textual responses — one word, or at the most a short phrase. Fill in the blank, gap fill and word match are all varieties of this type of question.

Il est presque dix heures quand Héléna rentre chez elle. Le mercredi soir, c'est toujours la course. Après le cours de maths au lycée, elle doit filer jusqu'au supermarché où elle travaille. Elle laisse son cartable au vestiaire et enfile son "cher uniforme", comme elle appelle sa blouse orange et blanche. En quelques minutes, elle devient la "demoiselle du comptoir charcuterie". Héléna mène une double vie: élève de première la journée, vendeuse dans un supermarché le soir et le week-end.

What is Héléna's part-time job?

### Free text response or essay

While software for automated marking of full essays is in its infancy, you may still encounter questions in which candidates have to enter short essay style answers that can be marked by a teacher later.

The boiling points of the hydrogen halides increase from hydrogen chloride to hydrogen iodide because the strength of the van der Waals' forces between the molecules increases.

Why does the strength of the van der Waals' forces increase?

## 1.3 Software considerations

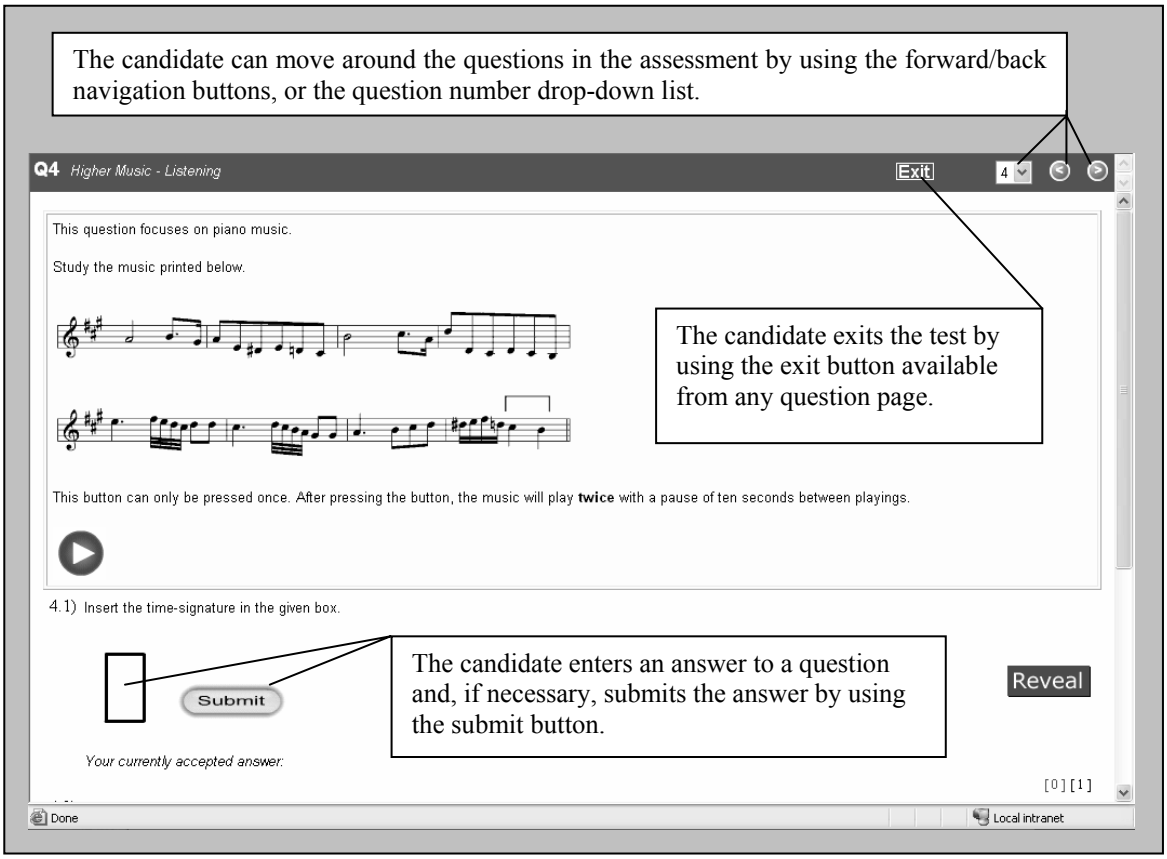
As noted earlier, SQA will provide schools with e-assessments to support delivery of its qualifications and also the system to deliver these assessments. Schools are however free to use assessment software from other sources to deliver e-assessment to support teaching and learning. It is useful, therefore, to discuss software here — this will help you to get the best out of the software that is available, and will help in the choice of additional software, should this be needed.

### a Navigation and prompts

Navigation between questions should be straightforward and consistent. It should be possible to ignore questions and return to them later, and to alter the response to a previously-answered question. A facility to allow candidates to go to any question by number, or to the first or last question, is also helpful.

If candidates are allowed to leave the assessment early, they should be prompted for confirmation that they have completed the assessment. It should be possible for candidates to ignore questions which they cannot answer. Some systems also enable candidates to flag a question that they would later like to return to.

The navigation features of the Pass-IT system are shown in the following screenshot of a question. This system includes almost all of the features mentioned.




## b Help facilities

Candidates should have had sufficient practice in using the system before taking a summative assessment to ensure that the technology does not interfere with the assessment being carried out. Help facilities should be available throughout both practice and summative assessment sessions, and the help should explain how to respond to questions, navigate through them, and exit from the assessment. The help could either be on-screen or on paper.

In addition, some systems display information about the numbers of questions which have been answered or are unanswered, together with the time remaining for the assessment. Some also have a warning message sent automatically to the candidate a set period before the end of the assessment. However, since most school e-assessment sessions are invigilated, time controls for the assessment can normally be left in the hands of the teacher or invigilator.

## c Security features

There are many measures that can be taken to improve security during e-assessments. Some possible security breaches that can be prevented with the help of the software are:

- **Loss of candidates' responses**: The responses to each question should be stored on a remote server as soon as they are submitted. In the event of system failure or network outage, responses should be saved so that candidates can restart from where they left off when the system has been restored. Timing should be reset accordingly. There should be measures to prevent accidental quitting, such as a dialogue box requesting confirmation.
- **Opportunities for copying**: There are several measures that can be built in to the assessment system to minimise opportunities for copying, involving using different versions of essentially the same assessments. For some assessments, it may be possible for the system to deliver a different one of a number of pre-structured and moderated assessments to each candidate. Decisions on which candidate is assessed by which assessment would be made at the login generating stage.

  The order in which options for objective questions are presented, such as all of the possible answers to a multiple choice question, can sometimes be randomised. Different parameters in judged mathematical expression (JME) questions can be delivered to different candidates. The Pass-IT research has shown that these randomisations have no effect on the performance of individual candidates.
- **Communication with others and access to other information sources**: Some assessment systems do not permit printing or give access to the internet. If the system being used does not do so automatically, disabling or removing other communication software, such as chat or e-mail, should also be considered.

## d Candidates' responses

The assessment system should ensure that questions and responses are not cached on the candidate's machine.

With the assessment system it should be possible to view details of when a candidate took an assessment, how long it took, and from which IP address it was taken. It should also be possible to re-create the assessment exactly as it was taken by the candidate, with any randomly generated parameters and ordering. Records of all responses to each question should be kept on the server, including the full text of free-text responses and any feedback or result given to the candidate.

A good assessment system will have a Teacher Reporting System included. This would allow remediation to take place if an e-assessment is used for practice. It would also help to identify which parts of an e-assessment have to be retaken, in the case of a candidate who has not been completely successful.

## e Interoperability

E-assessment systems can be used in isolation from other systems, but the administrative benefits of this would be minimal. Ideally, you need to be able to import and export questions and whole assessments between different systems.

More importantly from a school point of view, you must be able to export responses and results to spreadsheets, statistical analysis packages and candidate record databases. This facility will allow the electronic transfer to SQA of assessment results.

## f Accessibility

By law, schools offering assessment for qualifications should take all reasonable steps not to discriminate against candidates with additional support needs. If an e-assessment is not felt to be appropriate, an alternative or equivalent assessment, such as a paper version, should be provided.

The assessment system should be compatible with different assistive technologies — screen readers, speech recognition software and touch screens, for example. More time should be allocated for candidates using such technologies, if it is needed.

For assessments where sound input or output is needed, candidates will have to be provided with headphones or be located in a separate room. Dyslexic candidates should have their text response submissions reviewed manually, unless correct word order and spelling are learning requirements.

Images used in e-assessments should be provided with a textual equivalent. Candidates with visual impairment should be able to adjust the text size. Most systems allow the use of style sheets, enabling candidates to customise the appearance of the pages on the screen. People who cannot use a mouse should be able to use shortcut (access) keys.

Good design for candidates with additional support needs is good design for all candidates. The World Wide Web Consortium (w3c) has drawn up guidelines on how to make web content accessible. Following these guidelines when assessments are created makes the assessments more accessible to all candidates, whatever input device they are using (desktop browser, voice browser, mobile phone, etc) and whatever constraint they are under (noisy surroundings, under- or over-illuminated room, hands-free environment, etc).

The Joint Information Systems Committee (JISC), an organisation that advises the UK further education and higher education sectors on issues relating to the use of information and communication technologies, operates the TechDis Web Accessibility and Usability Resource — a website that provides further information on the practical and technical aspects of accessibility (**www.techdis.ac.uk**).

### g Other software considerations

Some e-assessments require the use of plug-ins, such as Macromedia Flash™. Although this is widely available, it will still need to be installed on every computer that will be used to run the e-assessment. A lot of the assessments developed for the Pass-IT project make use of Flash.

Other e-assessments require the use of Java applets, which means JavaScript will have to be enabled on all computers. You may have to ensure that specific fonts are installed for foreign language assessments.

It is, of course, essential that the assessment system runs on the operating system of the server being used. In addition, the database system used by the assessment software for storing and handling results should be compatible with the MI system that is already being used in the school.

Before using the system with candidates, the assessment software should be checked to ensure that it is fully functional. This check should include:

- the registration and authentication facilities
- the ability of the system to provide appropriate assessments
- the ability of the system to randomise questions (if required) and to deliver questions, parameters and response options correctly
- the ability of the system to deliver correct feedback to candidates' responses
- the navigation through the questions
- the recording of responses

## 1.4 Hardware considerations

### a Servers

It is advisable if possible to mirror the server in a separate location so that e-assessments can still go ahead if the primary server breaks down.

Servers should be backed-up daily, and it is particularly important to back up candidates' responses immediately after the assessment has taken place.

### b Network infrastructure

By specifying the likely frequency and size of traffic between browser and server during one assessment, and the number of candidates, it should be possible to predict the load on the network. Don't forget to consider other uses of the network which may be taking place at the same time as the assessment.

If network capacity could be a potential problem, you may be able to eliminate any unnecessary multimedia elements in the assessments. You could allow for the duration of assessments to be extended in the event of any network delays, but it is much better to ensure that network capacity is adequate in the first place.

## c Candidate workstations

The supplier of the assessment engine will specify the minimum requirements for the memory and speed of computers being used by candidates for e-assessments, as well as the operating system needed. You should check the screen resolution and colour depth, as well as the keyboard and mouse for functionality, of all computers that will be used by candidates. No candidate should be put at any disadvantage, or given an unfair advantage, by the specification or the set-up of the equipment that they are using.

Sufficient workstations are required to allow one networked computer per candidate, with some spare capacity. We suggest that one additional workstation for every ten candidates sitting the assessment would be sufficient to cater for most unforeseen difficulties.

A typical workstation needed for e-assessment would include:

- a web browser
- a mouse
- a keyboard
- a soundcard with jack-point for headphones
- Macromedia Flash™ plug-in installed
- JavaScript enabled
- space next to it to do rough working

# 2 Holding assessment sessions

This section is mainly about the invigilated assessment sessions required for the delivery of summative assessment — end-of-Unit NABs for example. However, much of what is contained here is also applicable to practice (formative) sessions.

When conditions for assessment require assessments to be supervised, you should take steps to ensure that the assessments are delivered in an environment that both supports candidates and upholds the conditions for assessment.

## 2.1 Delivery method

In schools, most e-assessment will take place in invigilated sessions. However e-assessment lends itself to distance or remote assessment, and in this situation, additional factors need to be considered. The three other SQA publications in this series (*Assessment and Quality Assurance for Open and Distance Learning*; *Guidelines in Online Assessment for Further Education*, and *E-moderation: guidelines for FE staff and external moderators*) cover the issues you will need to consider if assessing remotely. These issues include:

- **Authentication** — introducing and maintaining appropriate systems to establish and authenticate the candidate's identity
- **Impersonation** — with or without the candidate's permission
- **Accessing other resources** — either books, another computer with internet access or personal help from someone

## 2.2 Giving candidates practice

It is essential that the technology used does not affect the outcome of any assessment. Candidates sitting an e-assessment must therefore be familiar with the system being used, and must be comfortable with it.

Candidates must practise using the system before any summative assessment. These practice assessments allow candidates to try out the navigational aspects of the software and most of the question types — questions with a similar style, level of difficulty and method of feedback to those to be used in the actual assessment.

Candidates should be given user names as required to carry out the practice assessments. Practice assessments can be conducted in the school either in timetabled subject time, during personal development time (PDT) or outwith timetabled time, for example in a library during a break. Alternatively, it may be possible for candidates to carry out practice assessments at home, if you feel this is appropriate, and the software supports it.

Some assessment engines, for example the one used in the Pass-IT project, can deliver assessments which give different degrees of feedback to candidates. In the case of Pass-IT, these are:

- **Help mode**: In this mode, ticks and crosses are instantly fed back to the candidate in response to correct and incorrect answers respectively. The total marks available for each question part are shown, and the mark awarded for a submitted answer is shown. In addition, a 'reveal' button is available for the candidate to use so that the correct response can be seen.
- **Practice mode**: In this mode, ticks and crosses are available but there is no reveal facility. The allocated mark and the mark awarded for a submitted answer are also shown.
- **Exam mode**: In this mode, there is no feedback to candidates about whether a submitted answer is correct or not. There is no reveal facility. Only the mark allocated to each question part is shown.

Before candidates sit an assessment in exam mode where the results will count as a summative assessment, they should be encouraged to use the assessments in practice and help modes. There are two benefits in doing this:

- candidates are given additional revision material to reinforce their learning
- candidates and teachers become familiar with the assessment engine and do not have to worry about navigation issues when the summative assessment is carried out

Candidates should, where possible, also be encouraged to sit a practice assessment in exam mode so that they are given feedback and results in the same way as they can expect from the summative assessment.

## 2.3 Registering candidates for e-assessment

At the start of the assessment, candidates should be given their individual user names for the summative assessment. They should already have practised registering and using the system with the user names issued for practice assessments.

In reality, some candidates may have forgotten the login procedure, and others may try to access the summative assessment using their practice user name.

## 2.4 Briefing candidates

Candidates should be briefed, in advance of the assessment. Briefings should include information on:

- the date and duration of the assessment
- authentication procedures and any ID required
- the work that will be included in the assessment

- the nature of the assessments (number and types of questions in the assessments)
- any permitted, non-permitted or provided data or aids, such as data sheets or calculators (physical or software)
- arrangements for carrying out practice assessments
- any provision made for candidates with special needs
- what to do in the event of technical problems

Instructions for candidates should be provided before the assessment. The assessment should not begin until the candidates have been given the initial instructions and information about the number of questions, the question types being used, the scoring mechanism and the duration of the assessment.

In some circumstances, for example if the time available for carrying out the assessment is at a premium, this information may be passed on to candidates before the assessment.

## 2.5 Preparing rooms and equipment

### a Physical environment and equipment

It can be difficult to meet some of the following requirements but, ideally, for an e-assessment:

- The room used should have suitable temperature, ventilation and lighting for working both on and off screen.
- *BS7988* recommends that the screens of computers delivering the same assessments should be at least 1·25 metres apart, unless there are partitions between workstations. The key issue is that one candidate should not be able to see the screen of another candidate who is taking the same assessment, whether the candidates are seated alongside each other or one behind the other. Where more than one version of an assessment is available, candidates taking the same version should not be at adjacent computers.
- Each workplace should have space for printed materials and other equipment, and space for making rough notes.
- Candidates in wheelchairs or those requiring assistive technologies should have additional space, if required.
- If there is any sound output with the assessment, headphones and computers with sound cards capable of playing the sound must be available.
- An invigilator's desk should be available and in a good position to observe that communication between candidates does not take place and that unauthorised reference material and resources are not used. It should be possible for the invigilator to walk around the room viewing every workstation.
- Virus protection should be in place and up-to-date on candidates' computers.
- A suitable number of spare computers, including keyboards and mice, should be available. We suggest that one additional workstation for every ten candidates would be sufficient to cater for most unforeseen difficulties.

### b Checking equipment

Before the assessment begins, hardware and connectivity for delivering the assessment should be checked.

Immediately before the assessment takes place, you should make the following checks on the equipment:

- switch all computers and monitors on to ensure that they are working
- test keyboards and mice to ensure they are functioning
- test the browser to ensure it is present, correctly configured, and able to access the assessment system
- disable access to any software other than the assessment software

### c Other material

As with all assessments, it may be necessary to have other resources available to candidates. These might include:

- navigation guide for the assessment engine
- subject-specific material such as formulae sheets, data sheets or mathematical input sheets
- rough working booklets — these booklets should have the candidates' names and login details entered on them, and should be collected in at the end of the assessment, since the working may be used to modify the mark assigned by the computer (see the next section — *After the assessment*)

The candidates' user names should also be available for issuing immediately before the start of the assessment.

Sufficient paper copies of the relevant assessment should also be available, in case there is any form of technical failure.

## 2.6 Ensuring adequate staffing

Supervised e-assessment requires more staff than supervised paper-based assessment. This is due to the necessity of having technical support available at immediate notice. Network administrators and technical support staff should be advised of the time for the assessment in advance, and the assessment should be treated as priority.

Those carrying out supervisory or invigilation functions would generally have to be familiar with the assessment system: how to log in; navigate; respond to all question types; and exit. It should not be necessary to assist candidates with these functions if there have been opportunities to practise. At the end of the assessment, invigilators should ensure that candidates have completed and exited correctly from the

assessment, to ensure that the computer has recorded candidates' total marks. Invigilators should also assist candidates in exiting from the system, if necessary.

Invigilators should not be distracted from their duties by the need to provide technical assistance, so there may be a need for more than one invigilator. Invigilators should also be careful to assist only in the use of the system and not in understanding the content of any questions.

## 2.7 Ensuring security

The issues surrounding whether to allow candidates to bring materials of their choice to invigilated e-assessments are similar to those in invigilated paper-based assessments. Information on this is available in the relevant SQA subject documents.

The following procedures are also recommended:

- **Avoiding unauthorised access to the system**: For a summative assessment this can largely be achieved by only issuing the user names once all the candidates are seated at their computers.
- **Removing access to unauthorised materials**: Candidates should not have access to e-mail, Windows Messenger, any other Messenger services or any e-learning materials during the assessment. Aids such as on-screen calculators and spell checkers, and access to unauthorised sources of information (such as search engines), should have been disabled as necessary in advance. This can be achieved by hiding navigation toolbars, disabling shortcut keys, and preventing return to the assessment if any other software has been accessed.
- **Preventing unauthorised disclosure of content**: Facilities to print, copy materials into another application or send files to the hard disk, removable media or other computers should be removed.

## 2.8 Specifying technical failure and avoiding loss of candidate responses

It is advisable to have spare workstations in case equipment fails (approximately one spare workstation per ten candidates). Candidates must be able to restart the assessment on another computer without loss of working time, and if possible to access any responses they have already made. In the event of system failure or network outage, responses should be saved so that candidates can restart from where they left off when the system has been restored. Timing should be reset accordingly.

You should log all technical failures and delays. No candidate should be disadvantaged by technical problems. Alternative assessment materials should be available for use in the event of a failure of any e-assessment.

## 2.9 Specifying emergency procedures

In the event of fire alarms or other emergencies, it should be possible to vacate the room with browsers still open. When they return to the assessment, candidates should be given the full time for completion. Details of all emergencies and the implications for the assessment should be logged.

# 3 After the assessment

## 3.1 Finalising marking of assessments

Most types of question used in e-assessments are marked automatically. These include all the objective types of questions — multiple-choice; multiple-selection; drop-down list; drag and drop; hot spot and judged mathematical expression (JME).

The automatic marking of non-objective word match questions, where candidates respond by typing a short answer into an answer box, may need checking.

There are some types of question that are not marked immediately by the system. These are the essay questions where a candidate's response is entered into a free text box.

For all of these reasons, human intervention in the marking of assessments may be required. This is one reason why candidates may need to use rough working booklets when sitting a summative e-assessment. The rough working can help in deciding whether or not to modify the mark automatically assigned by the system.

### a Reviewing automatic marking

When an e-assessment has been developed from a prior-moderated item bank, the acceptable responses will have been included in the coding. This will be the case with most e-assessments used in schools — e-NABs, for example. In these assessments, where a candidate's response to a question has been marked as correct by the system, no intervention is necessary.

Where some of the candidates' responses have been marked as incorrect by the system, it may be necessary to review the marking. The candidates' responses, and any working from the rough working booklets, should be available for this review.

In some cases, you will find that candidates should have been credited with more marks than they have been awarded automatically by the system. There are two reasons for this.

The first reason is that the candidate has obtained the correct answer for a question but has not typed in the correct answer, or has forgotten to type an answer in at all. The evidence available from the candidate's rough working should show up this type of input error. Candidates should not be penalised for input errors. Examples of this type of input error include:

- Incorrect mathematical expression typed in — perhaps a missing or a misplaced bracket.
- Spelling error — such as 'Sterling' for 'Stirling'.
- Wrong case used in a chemical symbol — LiCL for LiCl.

Such errors may only be considered as input errors where there is evidence to indicate this on the candidate's rough working. It is unlikely that spelling or case errors will have such additional evidence available. In this situation the same marking that would be used for a paper-based assessment applies. For NAB assessments this marking is detailed in the marking instructions published by SQA as part of the NAB specification.

The second reason why candidates could be awarded more marks than are automatically assigned can arise even although the candidate has obtained the wrong answer. Even wrong answers in Mathematics or other mathematical based subjects may have some correct working, as seen on the rough working. 'Partial credit marks' should be awarded for this correct working, according to the published marking instructions for the particular assessment.

If any automatically assigned marks are amended, the reasons for the amendments should be recorded and kept, along with the candidate's rough working.

### b Free text response questions (essay questions)

Candidates' answers to essay questions are normally typed in free text boxes. Most assessment systems store these answers but do not automatically mark them. The candidates' answers for these questions should be retrieved and marked. The marks awarded to candidates for all essay questions should be added to the marks awarded by the computer for the automatically marked questions.

## 3.2 Returning results to candidates

Most assessment systems provide immediate or automatic feedback to candidates. It is important that candidates are made aware, at an early stage in the use of e-assessments, that this only includes the mark automatically assigned by the computer. You should make sure they know that this mark could be changed for the reasons already mentioned:

- input errors that can be picked up from their rough working
- partial credit that may be available after examining their rough working
- marks awarded for any questions that are not automatically marked

When the automatic marking has been modified as necessary, the results can be returned to the candidates. You should tell the candidates that, as happens with paper-based assessments, the results are only provisional at this stage, since they are subject to verification by internal and external moderation.

## 3.3 Re-sits

It is almost inevitable that some candidates will not reach the required threshold of attainment for a Unit or a Learning Outcome. This situation is the same whether a candidate is assessed by traditional means or by e-assessment.

If some candidates need to take a second e-assessment, it is important that the second one is different from the first one, although of an equal standard. This may be achieved by giving the candidates different user names — allowing access to a different e-assessment.

## 3.4 Moderation of e-assessments

Moderation is the process by which SQA ensures that national standards are applied in internal assessment carried out by schools. Where a school is assessing candidate performance using electronic media, such as an e-assessment, the moderation process that is used is called 'e-moderation'.

E-moderation, like all other moderation, requires that evidence produced during an assessment is retained and made available for external moderation. The documentary evidence for e-moderation may be paper documentation or it may be made available electronically.

***E-moderation is subject to the same SQA conditions that are applied to traditional internal and external moderation procedures.***

E-moderation of an e-assessment involves the inspection of various paper and electronic documents including:

- **The instrument of assessment (IA)**: Since an e-assessment may include randomisation, it is important that your system is able to tag each unique version of the IA to an individual candidate's name together with the number of attempts by each candidate.
- **The candidates' evidence**: This evidence will include the electronic evidence as input by the candidates. Candidates' evidence also includes any rough working done on paper by the candidates and submitted as part of their evidence.
- **Evaluation of candidates' evidence/evidence of internal moderation**: For any candidates where the mark automatically awarded has been amended, evidence of both the raw mark and the amended mark should be available, along with a note of the reasons for any changes. This would amount to evidence of internal moderation.
- **Re-sits**: If a candidate has taken a second e-assessment, the same information about the re-sit assessment should be available for moderation.

A moderator carrying out an external e-moderation may need access to other documentation covering: the assessment event(s) — information relating to the location and conduct of the assessment; the authentication of candidates and the candidates' evidence; results and reporting.

For these documents to be valid as evidence for external moderation, they will need to be date and time stamped. You will have to identify the location(s) used for assessment events. You will also have to identify the conditions and arrangements that were used for assessment.

There are various ways in which an External Moderator can gain access to your electronic systems to carry out e-moderation. These are:

- at your school
- from the moderator's home normally through internet access
- from another mutually agreed location, normally through internet access
- from SQA premises

You should ensure that you have well-documented procedures detailing access arrangements for External Moderators. In the event that access by these methods is not possible, traditional arrangements for external moderation will be used.

Detailed information relating to e-moderation can be found in the SQA publication *E-moderation: guidelines for FE staff and external moderators*.

# Checklist of action required

Good practice for holding an e-assessment event is similar to good practice for holding a traditional assessment event. This checklist should serve as a guide. If you follow these steps and retain the appropriate evidence you should satisfy the assessment requirements.

## Preparing for e-assessment

- ☐ Staff responsibilities clearly identified
- ☐ Staff training/development delivered
- ☐ Suitable technical infrastructure (including backup facilities) available
- ☐ School policies on management of e-assessment issues in place

## Holding assessment sessions

- ☐ Suitable e-assessments available for use
- ☐ Candidates registered
- ☐ Candidates given necessary information about the e-assessment
- ☐ Practice sessions using e-assessment organised and run with candidates
- ☐ Rooms and equipment prepared and checked
- ☐ Issues relating to holding assessment sessions resolved:
  staffing; authentication; security; technical failure; emergency procedures

## After the assessment

- ☐ Marking of assessments finalised
- ☐ Results returned to candidates
- ☐ Arrangements made for re-sits, as necessary
- ☐ Material retained and made available for e-moderation

# Glossary

| | |
|---|---|
| assessment engine | The hardware and software that collectively deliver an electronic test |
| blended assessment | A combination of traditional (paper-based) assessment and electronic (digital) assessment |
| CAA | Computer-Assisted Assessment or Computer-Aided Assessment |
| e-assessment | The use of electronic media in assessment — any application of computers to support assessment |
| e-moderation | The moderation process applied when a school is assessing candidate performance using electronic media such as an e-assessment |
| e-NABs | Electronic National Assessment Bank (NAB) assessments for Units in a number of National Qualification (NQ) subjects and levels |
| Flash™ | Graphic animation technology owned by Macromedia Inc. |
| internet | A global network that connects computers to one another |
| interoperability | The ability to transfer items or questions from one item bank to another |
| IP address | A number that identifies a computer or other device on a network |
| JavaScript | A language that allows web authors to design interactive web sites |
| JISC | The Joint Information Systems Committee, an organisation that advises UK further and higher education sectors on issues about the use of information and communication technologies |
| online assessment | Assessment that is delivered over a network or, more often, the internet |
| replicability | The ability of an assessment system to reproduce an instrument of assessment |
| w3c | An organisation set up to develop open standards for the World Wide Web |
| web browser | Software application used to locate and display web pages |

# References


British Standards Institution (2002) *BS7988: Code of practice for the use of information technology (IT) in the delivery of assessments*

Costigan, F, Khaled, O, Woodger, S (2004) *Good Practice Guide in Question and Test Design*, Pass-IT, **www.pass-it.org.uk**

Intelligent Assessment Technologies website **www.IntelligentAssessment.com**

JelSIM Chemistry practicals website **www.jelsim.org/chemistry/practicals/**

Pass-IT project website **www.pass-it.org.uk**

SCHOLAR website **scholar.hw.ac.uk**

SQA *Assessment and Quality Assurance for Open and Distance Learning,* (A1030, February 2001)

SQA *Guidelines on Online Assessment for Further Education*, (AA1641, March 2003)

SQA *E-moderation: guidelines for FE staff and external moderators*, (AA1675, November 2004)

SSDN website **www.ltscotland.org.uk/ssdn/index.asp**

TechDis website **www.techdis.ac.uk**

w3c Accessibility Guidelines **www.w3.org/TR/WAI-WEBCONTENT/**