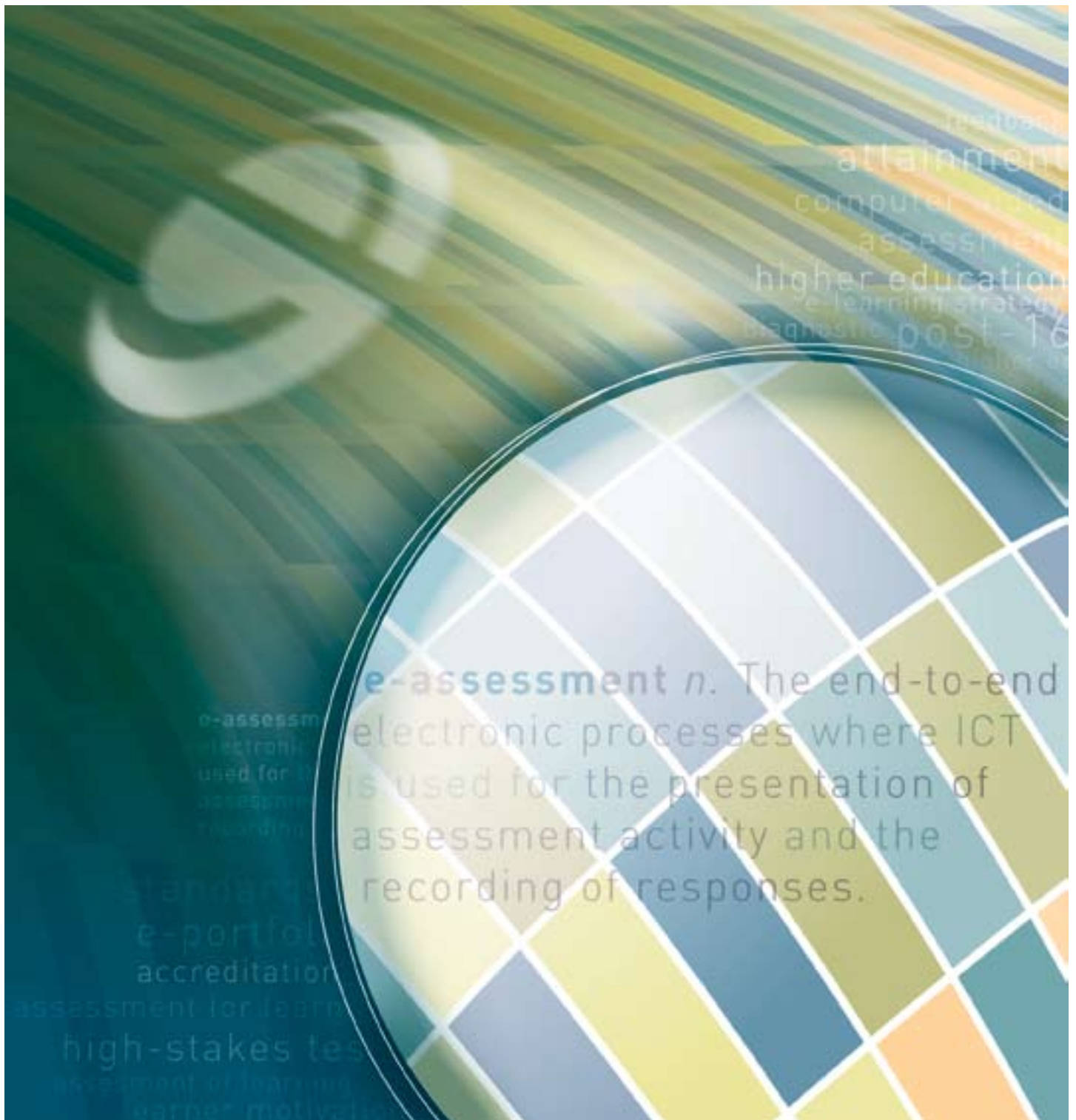


Effective Practice with e-Assessment

An overview of technologies, policies and practice
in further and higher education



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Effective Practice with e-Assessment

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'The variety of applications of e-assessment reported and their innovation and general effectiveness indicate the potential of e-assessment to significantly enhance the learning environment and the outcomes for students in a wide range of disciplines and applications.'

Roadmap for e-Assessment Report for JISC (Open University, 2006)



Introduction

***Effective Practice with e-Assessment* is the third in a series of JISC publications on the skillful use of e-learning in 21st century practice in a technology-rich context. In contrast to the preceding guides in the series – *Effective Practice with e-Learning* and *Innovative Practice with e-Learning* – the focus of this publication is on practice in a broader institutional sense, including the potential impact of e-assessment on learning and teaching.**

Through a sequence of case studies, *Effective Practice with e-Assessment* provides an overview of current e-assessment activity in further and higher education in the UK. In doing so, it does not cover in any depth the technical developments that underpin e-assessment. Its aim is to illustrate how the work of researchers, tools and technical standards developers has combined with initiatives from individual colleges and university departments to advance our understanding of what is effective practice in relation to e-assessment.

Its audience is those who manage, deliver or support educational practice in a technology-rich context – departmental heads, educational developers and learning technologists, e-learning managers, examinations officers and administrators, as well as classroom practitioners seeking to know more about how e-assessment can add value to teaching and learning.

Effective Practice with e-Assessment draws on a range of JISC projects and studies, notably the *e-Assessment Glossary, First edition* (JISC/QCA, 2006), *the Roadmap for e-Assessment Report for JISC* (Open University, 2006) and case studies researched for JISC by The Open University and the University of Derby. Links to further information about these resources can be found in the final section of this publication.

How to use this publication

The case studies provide illustrations of practice to accompany an ongoing discussion of the issues and benefits relating to e-assessment. These may be read in sequence or be approached individually through three broadly based thematic groupings: institutional, academic and learner-focused practice.

The full sequence of case studies provides a benchmark against which to assess the progress and barriers in any one institution, offering an opportunity to explore how others have tackled issues, the lessons they have learnt, and the models of effective practice that have been developed. For those who set strategic targets or are involved in research and development projects, these examples can also help to identify the challenges still to be met.

A tool for implementing effective practice with e-assessment is included to assist institutions in reviewing their current practice and procedures or preparing for wider use of e-assessment. The tool can also be downloaded from the JISC website [www.jisc.ac.uk/assessment.html] for further development and adaption in individual contexts.

As the terminology used may not be familiar to all readers, terms defined in the glossary section have been highlighted on first occurrence.

Introducing key terms

e-Assessment is used in this publication as a generic term covering all uses of computers in assessment. This and some closely related terms are explored here. Other key terms are defined in the glossary section, using definitions given in the *JISC/QCA e-Assessment Glossary*.

The term e-assessment is a broadly-based one, covering a range of activities in which digital technologies are used in assessment. Such activities include the designing and delivery of assessments, marking – by computers, or humans assisted by scanners and online tools – and all processes of reporting, storing and transferring of data associated with public and internal assessments.

JISC/QCA definition of e-assessment

e-Assessment is the end-to-end electronic assessment processes where ICT is used for the presentation of assessment activity, and the recording of responses. This includes the end-to-end assessment process from the perspective of learners, tutors, learning establishments, awarding bodies and regulators, and the general public.

To differentiate between different types of activity, **computer-based assessment (CBA)** is used in this publication to refer to assessments delivered and marked by computer, and **computer-assisted assessment (CAA)** to refer to practice that relies in part on computers – for example, use of online discussion forums for peer-assessment, **audience response systems** in group work, completion and submission of work electronically, or storage of work in an **e-portfolio**. However, it should be noted that these terms are often viewed as interchangeable.

Some form of e-assessment may be used at each of the three stages at which a learner's attainment and progress come under review:

Diagnostic – assessment of a learner's knowledge and skills at the outset of a course.

Formative – assessment that provides developmental feedback to a learner on his or her current understanding and skills. Formative assessment can also be described as 'assessment for learning' since an assessment that is entered into voluntarily, and on which no final qualification depends, can prompt learners to adjust their own performance.

Summative – the final assessment of a learner's achievement, usually leading to a formal qualification or certification of a skill. Summative assessment is also referred to as assessment of learning.

Assessment of any kind can be referred to as **low, medium** or **high stakes**. A low-stakes assessment is usually formative, with results recorded locally. A medium-stakes assessment is one in which results may be recorded locally and nationally, but is not life changing. A high-stakes assessment, however, is one in which the outcomes are of high importance to both centre and candidates, affecting progression to subsequent roles and activities.

A closely related concept is the e-portfolio, which can be used to document in digital form the outcomes of each stage in a learner's journey. The distinction between an e-portfolio as a record of achievement and an e-portfolio as a tool for assessment becomes blurred when the outcomes of assessments, including self- or peer-assessments in the form of diaries, **blogs** or **wikis**, are included. An e-portfolio may also be the means by which some qualifications are assessed.



Summary of key findings

Assessment is central to learning and teaching. What is assessed defines what is taught and how it is learnt. The process of assessment, in turn, shapes institutional practice and affects a learner's view of the value of engaging in learning. Getting assessment 'right' is essential to the well-being of learners and institutions, and instrumental to the achievement of national strategies for widening participation and e-learning.

Given the potential importance of e-assessment, developing a clearer understanding of what constitutes effective practice in relation to its use is now of key importance.

The potential of e-assessment

This review of current practice suggests technology can add value to assessment practice in a variety of ways. If used with skill and imagination, e-assessment – defined in its broadest sense to refer to both computer-assisted and computer-based assessments – can increase the range of what is tested. It can provide evidence of both cognitive and skills-based achievements in ways that are durable and transferable. It can enhance the validity of assessment systems and encourage deeper learning.

e-Assessment in fact is much more than just an alternative way of doing what we already do. A growing body of evidence,¹ some illustrated in this publication, indicates that well-designed and well-deployed diagnostic and formative assessments can foster more effective learning for a wider diversity of learners. Assessment is perhaps the best way of identifying the support needs of learners and can instil a desire to progress further if linked to appropriate resources,

good quality, timely feedback, and to challenging but stimulating ways of demonstrating understanding and skills. Effective use of technology can make significant contributions here.

e-Assessment can support **personalisation**. Any time, anywhere assessments benefit learners for whom a traditional assessment regime presents difficulties due to distance, disability, illness, or work commitments. On-demand summative assessments, when available, increase participation in learning by enabling learners to progress at a pace and in a way appropriate to them.

Looking to the future, e-assessment can offer a broader palette of tools for awarding bodies, developers and academic staff to work with. Some significant projects in 14-19 and higher education indicate that more valid and imaginative assessment and learning experiences could ensue. Which technologies are selected and how they are deployed form part of the challenges and skills inherent in 'designing for learning', a concept explored further in a companion guide, *Effective Practice with e-Learning* (JISC, 2004).²

¹ Nicol, D J (2006) Increasing success in first year courses: assessment re-design, self-regulation and learning technologies, paper presented at ASCILITE Conference, Sydney, 3-6 December, 2006, www.ascilite.org.au/conferences/sydney06/proceeding/onlineIndex.html
Also Sharpe, R, Benfield, G, Roberts, G and Francis, R (2006) The undergraduate experience of blended e-learning: a review of UK literature and practice undertaken for the Higher Education Academy, www.heacademy.ac.uk/4884.htm

² *Effective Practice with e-Learning* (JISC, 2004), www.jisc.ac.uk/elp_practice.html

Enhancing assessment practice

The case studies in this publication have highlighted the following as important considerations when rethinking assessment practice:

- **Appropriateness**
- **Timeliness**
- **Relevance**
- **Accessibility**
- **Validity**
- **Quality of supporting systems**

These criteria do not apply solely to e-assessment, but are significant here because the application of technology has either proved beneficial, or has prompted a reassessment of institutional, organisational or academic processes in the following respects:

One way in which the introduction of e-assessment may enhance the quality of the learner's experience is through the closer alignment of assessment with the pedagogic approach used – as options for modes of delivery broaden to include blended and online models, assessment in a similar form becomes increasingly appropriate and relevant.

However, e-assessment should not be viewed in isolation from the practice surrounding its use – for example, the timeliness of assessments and the quality of the feedback provided are key to learners' progress. Technology can assist by supporting on-demand delivery of tests to large numbers of learners, but the real advantage may lie in the immediacy of feedback and opportunities for further learning – for example, the any time, anywhere availability of resources.

Increasingly, a range of methods, both computer-based and computer-assisted, is occurring in higher education. Online tasks involving peer- and self-assessment and increasing use of e-portfolios and assessment tools within **virtual learning environments (VLEs)** indicate the diversity of approaches that has been established in this sector. Equally important is the relevance and **accessibility** of the assessment for the learner: evidence suggests e-assessments can provide assessment experiences that are more authentic – through the use of e-portfolios, reflective diaries, blogs or **virtual world scenarios**, for example. When **objective tests** are the most appropriate method, interactive elements and multimedia, or **confidence-based marking**, can make assessments more valid, accessible and engaging.

Quality assurance procedures and staff training in the design and delivery of e-assessments need to respond to these new developments. For example, in preparation for increasing use of e-assessment in further education, the regulatory authorities in England, Wales and Northern Ireland are producing regulatory principles and guidance for e-assessment.³ These will be supported by the development of accredited qualifications for staff in conjunction with Lifelong Learning UK (LLUK).

Implementation of computer-based assessment on a wide scale, however, presents a range of organisational challenges, including management of the IT infrastructure and accommodation in response to fluctuating periods of demand, and provision of dedicated technical support staff. As a result, the use of such assessments is still uneven, although highly effective in some areas. Examination regulations need to be reassessed to encompass new practices and procedures,

³ www.qca.org.uk/downloads/qca-06-3006_e-assessmentweb.pdf

to address issues of authentication and accessibility, for example, and institutions or departments involved in the delivery of medium- to high-stakes tests will require contingency plans against computer failure and loss of data.

As e-assessment becomes more widely adopted, institutions may prefer to place in the hands of specialists many of the issues associated with computer-based assessment, such as accessibility and **intellectual property rights (IPR)** in item bank development, or the maintenance of a suitable IT infrastructure for assessment delivery. Test design and item bank development may be outsourced and scanning bureaux, optical mark reading units or commercial e-assessment centres used. Some universities have set up specialist units for e-assessment, taking responsibility for assessment

development away from individual departments and changing the scope of the practitioner's role.

The use of any form of e-assessment has increased concerns over plagiarism and malpractice, but some case studies in this review have revealed how technology can enhance the validity and security of assessments. Currently, e-assessment is more frequently found in low- to medium-stakes than in high-profile, high-stakes contexts. But this is changing, as the major awarding and regulatory bodies and institutional departments prepare for wider use of e-assessment in the second decade of the 21st century, and as a more sophisticated understanding develops of how learning and assessment can be effectively integrated into a flexible and supportive learning environment, enabled by technology.

Figure 1 shows how the integration of assessments, feedback, learning resources and e-portfolio records into one technology-supported learning environment can provide the basis for effective learner progression.

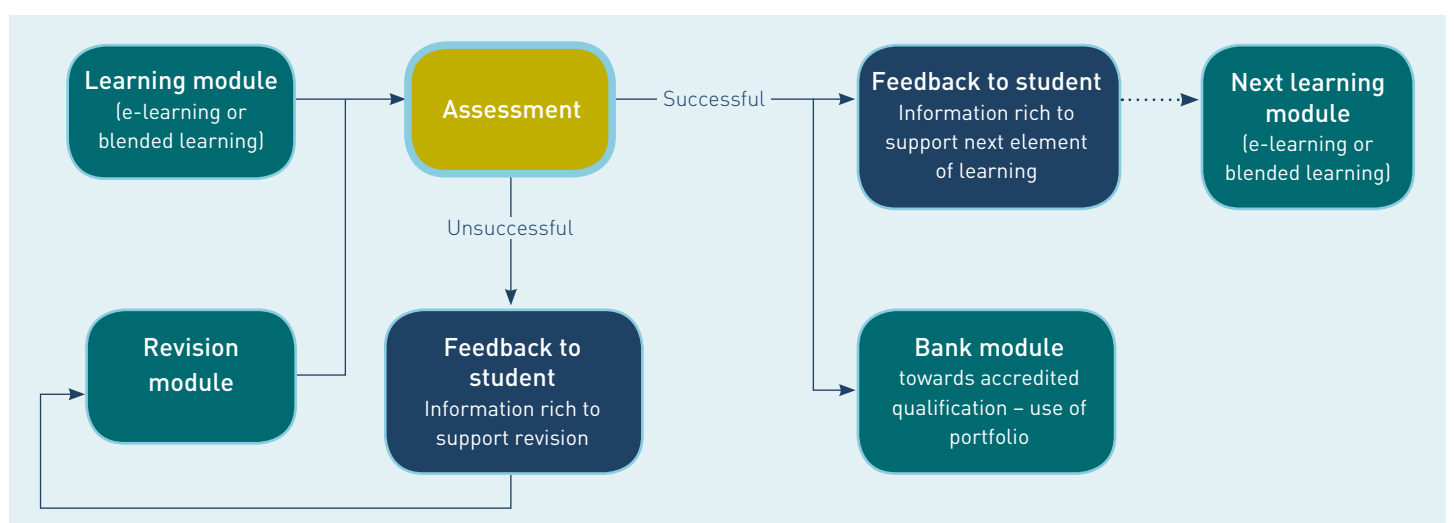


Figure 1 The relationship between assessment and effective learning, adapted from a model by Roads, M (2006)

Where we are now

e-Assessment can play a significant part in a more flexible and personalised environment for learning as illustrated in this review, but the extent to which awarding bodies and institutions across the UK are prepared for its wider adoption still varies. There are a number of reasons for this quiet prelude to what could be the next technology-based revolution in the classroom.

Further education: summative assessment

All four **regulatory authorities** in the UK are committed to a future in which e-assessment plays a more significant role. The Qualifications and Curriculum Authority (QCA)'s vision for awarding bodies and learning providers is that existing GCSE, AS and A2 examinations will be available on screen, all new qualifications will include an on-screen option, and the first on-demand assessments will be introduced by 2009.

However, the fastest uptake has been in those areas of the curriculum that have a strong rationale for on-demand objective testing – use of online City & Guilds tests has increased sharply since 2002 (see Figure 2). Elsewhere, the financial risk inherent in systems development and concerns over public acceptance of computer-based assessment (CBA) in high-stakes examinations have acted as a brake on the introduction of summative e-assessment in England.

Nonetheless, the foundations are being laid. Edexcel and the Assessment and Qualifications Alliance (AQA) now offer online components in GCSE general science. Modern foreign languages and design and technology could soon follow suit. In 2006, Scottish students used computers to sit a multiple-choice examination in biotechnology for the first time. A pilot for on-screen Key Stage 3 ICT tests is to be completed in 2007, although this test will not be statutory.

These examples have provided test beds for high-volume application of CBA. New qualifications, especially those

associated with ICT – for example, the online GCE Moving Image Arts from the Council for Curriculum Examinations and Assessment (CCEA) in Northern Ireland and Edexcel's Diploma in Digital Applications (DiDA) – have offered further opportunities to test the robustness and security of systems and procedures and the appropriateness of online assessment for learners, staff and institutions.

Further education: an integrated approach

Integration of e-learning and e-assessment into the fabric of the curriculum is vital to wider-scale implementation of computer-based and computer-assisted assessments in schools and further education.

Scotland has made significant inroads into establishing an integrated e-learning environment through initiatives such as Glow, a national schools **learning platform** funded by the Scottish Executive, through the development of online question banks for Scottish Qualifications Authority (SQA) unit assessments and through the SCHOLAR virtual college resources and assessments. In Northern Ireland, the Department for Education and Learning (DEL) has proposed that colleges include e-assessment in their **ILT** strategies – another major step towards the integration of e-assessment into an ICT-rich vision for learning.

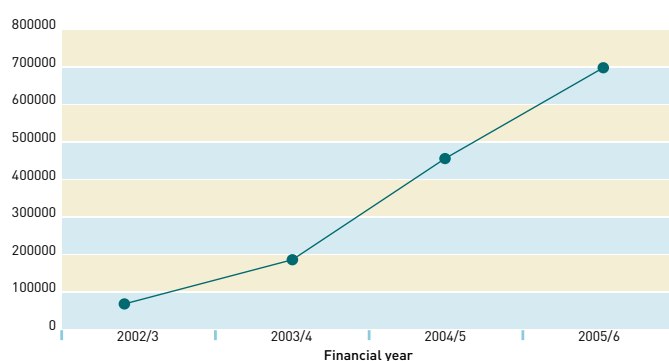


Figure 2 City & Guilds Global Online Assessment (GOLA) system growth in test numbers since 2002

‘The assessment industry is undergoing a fundamental transformation. A decade ago, the phrase ‘e-assessment’ was not even in use.’

Martin Ripley (2004) Educational Consultant and former Head of e-Strategy Unit, QCA

Higher education: formative e-assessment

Increased student numbers and reduced student-to-staff ratios have focused attention in higher education on ways in which e-assessment can support learners starting out with varying levels of knowledge and ability.

New pedagogic approaches are opening up, challenging perceptions that e-assessment is only suited to testing surface knowledge.

Some innovative examples of assessment for learning include virtual world scenarios for professional training, and web-based tools, such as e-portfolios, blogs and wikis, to develop skills in reflection and self-assessment. Online tasks involving peer- and self-assessment, which can capture evidence of achievement in collaborative activities, and increasing use of the assessment tools within VLEs, indicate the diversity of approaches that has been established in this sector.

Higher education: summative assessment

Longer experience of e-assessment in higher education has demonstrated the challenges and benefits in low- to medium-stakes contexts. Objective tests – either computer based or on **optical mark reader** sheets – are well-established in subject disciplines that depend on accurate recall of knowledge. With effective integration of interactivity and multimedia, these have established a valid role and purpose, but are still not used in all disciplines.

Issues of plagiarism and authentication of candidates’ work present considerable challenges. Nonetheless, applications of computer-based assessment in high-stakes contexts are being piloted and innovative developments from these trials can be transferable to other subject areas.

Key steps towards e-assessment

- Over 80,000 e-assessments were taken at Loughborough University during 2006.
- The City & Guilds Institute has delivered 1.3 million tests since 2003, 650,000 of which were in the academic year 2005-06.
- The CCEA GCE Moving Image Arts completes its pilot phase in 2007-08 to become the first AS/A2 qualification to be assessed entirely online.
- Awarding bodies in England offer an online GCSE science in 2006.
- In 2006, awarding bodies and TechDis collaborate on the production of guidelines for accessibility in e-assessment.
- A pilot online multiple-choice examination in biotechnology at Intermediate 2 and Higher Level was offered by SQA for the first time in 2006.
- In 2007, the Phase 2 report became available from Project e-Scape on e-portfolio-based assessment of GCSE design and technology coursework.
- SQA now provides online National Qualification Unit assessments in computing and Higher mathematics. Pupils with additional assessment requirements at Standard Grade are able to word process their responses.
- Following initial trials in 2001, on-demand basic and key skills tests in England, Wales and Northern Ireland can be taken online at levels 1 and 2.
- Availability of VLEs and their use by UK educational providers grows year on year.

The learner's view

Learners are increasingly more likely to experience technology-based assessment directly, or to be assessed within a system that is supported by online resources. Figure 3 gives an insight into how this could occur and suggests the experiences and needs learners could acquire at the different stages of their learning journey.

As today's school pupils progress on to post compulsory and higher education, their experience of gaming in the social and personal dimensions of their lives, and of interactive formative assessments in the educational dimension of their lives, means that they are increasingly confident about taking computer-based assessments.

| 5 – 11 | 11 – 14 | 14 – 16 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> Online internet safety and proficiency training Web-based interactive multimedia learning resources and games Drill and skill quizzes direct to mobile phones Statutory teacher assessment based on online assessment materials (National Assessments – Scotland) Statutory teacher assessment based on online exemplars (National Curriculum – England) e-Profiling of early years development (Optional –England) <p>Learners need:</p> | <ul style="list-style-type: none"> BBC Mobile Bitesize quizzes for learning on the move Online interactive resources for personal, social and health education Gaming Online banks of National Assessment materials (Scotland) Key Stage 3 ICT non-statutory on-screen assessments (England) Curriculum Online multimedia resources for learning (England) | <ul style="list-style-type: none"> DiDA – a paperless qualification in digital media Interactive web-based BBC Bitesize resources for revision Online learning and assessment materials for gifted and talented children Virtual world simulations testing skills in context (ICT and science) Online Standard Grade practice resources (Scotland) Computer-based components in GCSE science examinations (England) |
| <ul style="list-style-type: none"> Access to computers and learning resources out of school High-quality web-based assessments for learning | <ul style="list-style-type: none"> Innovative games-based assessments for learning A unique learner number | <ul style="list-style-type: none"> Opportunities to personalise their learning, by taking some assessments online when ready |

Figure 3 An overview of e-assessment opportunities at different ages and stages

'I feel that assessment on a computer is better than writing because usually you forget what you are going to write...before you write it. The brain works faster than your handwriting.'

Student, University of Derby

Many older learners are also finding benefit in e-assessment due to the respite this provides from traditional written examinations, the convenience of on-demand testing and the greater likelihood that results will be based on objective and accurate marking. However, the full value from the learner's perspective can only be obtained where access to computers

is widely available and adequately supported with guidance. Learners also need rich and timely feedback on formative assessments and a personal online space for recording and evidencing attainment in an e-portfolio.

| 16 – 19 | 19 – 25 | 25+ |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> Online on-demand City & Guilds assessments Online diagnostic assessment of basic and key skills Driving theory test Online National Unit assessments in Higher mathematics (Scotland) Multiple-choice online component in Intermediate 2 and Higher biotechnology (Scotland) Online basic and key skills at levels 1 and 2 (England, Wales and Northern Ireland) | <ul style="list-style-type: none"> Formative and summative e-assessments in some degree and diploma courses Online on-demand City & Guilds assessments Online diagnostic assessment of basic and key skills Driving theory test Online basic and key skills at levels 1 and 2 (England, Wales and Northern Ireland) | <ul style="list-style-type: none"> Continuing professional development online Work submitted online for Open University courses Formative and summative e-assessments in some degree and diploma courses Online learndirect courses Online on-demand vocational qualifications (eg City & Guilds) |
| <ul style="list-style-type: none"> e-Portfolios that are transferable between institutions Personal online space for e-portfolio development | <ul style="list-style-type: none"> Online peer and tutor support High-quality feedback on online formative assessments | <ul style="list-style-type: none"> Personal online space for e-portfolio development High-quality feedback on online formative assessments |



Barriers and enablers in computer-based assessment

Much of the innovative work in computer-based assessment (CBA) in higher education has been in institutions where systems and tools development has been seeded by project funding. Even then, use is often limited to a few departments. Scaling up the use of e-assessment requires financial commitment and senior management support. Where these exist, many of the case studies show that there is a greater confidence in the capability of e-assessments to deliver a return on investment, and a wider acceptance of the benefits of change amongst staff.

Effective e-assessment for formative purposes can be set up relatively simply by using the assessment tool within the institution's VLE, but a sustainable programme of technical and pedagogic support for academic staff is still needed. In most cases, wider-scale use has only been achieved when a central support unit has been set up. Medium- to high-stakes e-assessments demand a dedicated team whose role is to ensure the reliability of systems, provide technical support to academic staff and facilitate **interoperability** with other systems in the institution. The next stage of development is to create **item banks** that can be shared between departments, or even between institutions. However, mutually compatible interfaces adhering to universal **technical standards** have to be in place to make systems fully interoperable. These complex and costly issues have been barriers to vigorous growth in computer-based assessment.

In the schools and further education sectors in England, the cost of development of secure systems for use across a range of qualifications is currently borne by awarding bodies, and that investment is only made when there is a sound business case. As a result, despite valuable and successful pilot schemes, it may be some time still before online public examinations are available across the curriculum. A prevailing public mood of conservatism over changes to the formal examination system is a further curb to innovation.

A different picture emerges, however, when a close-knit community of institutions, supported by funding from central government, and a single awarding/regulatory body collaborate on an integrated e-learning and e-assessment environment, as has happened in Scotland. Two initiatives – SCHOLAR and Pass-IT – show how a partnership approach between a university (Heriot-Watt), subject specialists, key national agencies, colleges and schools has opened up opportunities to empower research and development in e-assessment.

The COLA project, however, illustrates some of the technical barriers that had to be addressed to facilitate partnership approaches to item bank creation and highlights the importance of JISC work on systems design based on web services and a **service-oriented approach** to facilitate the exchange of data.

Around 500 online formative tests have been written and shared since 2005.

Collaborating for change

The COLA project

Background

The COLEG Online Assessment project (COLA) is run by Scotland's Colleges Open Learning Exchange Group (COLEG) – an association of further education colleges in Scotland formed to develop and share learning resources, including e-learning content.

With funding from the Scottish Further Education Funding Council and subsequently the Scottish Funding Council, the aim of COLA has been to create a bank of online formative assessments across a wide range of courses and levels in support of SQA qualifications. COLA assessments are objective tests containing up to 20 questions available in 17 subject areas from Access to HND level, or Scottish Credit and Qualifications Framework (SCQF) levels 1-8.

Technologies, systems and policies

The project generated online assessments for use in the four VLEs used in Scottish colleges – Blackboard®, Moodle™, Serco (Teknical) Virtual Campus™ and WebCT® – with the assistance of subject specialists from the colleges. To ensure that question writers had a good understanding of objective testing and online delivery, they attended workshops to develop best practice techniques.

This ambitious project has not been without problems, however. The final databank was delivered in **IMS Question and Test Interoperability (QTI)** standard compliant form,

but none of the VLEs complied with the IMS QTI standard satisfactorily. The solution was that the databank should hold only the QTI version of each question but that certain conversion tools for different platforms (for example, Respondus®) should be provided alongside.

At the outset it was decided to restrict the question types to multiple choice, multiple response, true or false, and match and fill-the-blank questions, but because of difficulties in rendering the fill-the-blank questions, these were excluded from the item bank. There were also problems with user tracking in certain VLEs and with the way in which some VLEs handled the scoring. The accessibility of the questions could also be affected by the way in which the individual VLE rendered them.

Rethinking assessment practice

Solutions to many of the initial problems have been found, although the way that VLEs handle scoring is still an issue. The experience of COLA has also influenced some colleges to upgrade or change their VLE.

In time, the value of the online formative tests will outweigh the cost of resolving these issues. Already, around 500 online formative tests have been written and shared since 2005 and practitioners and learners have found use of the assessments beneficial. Notably, the project has raised the profile of e-learning in Scotland. It has also highlighted the value of a nationally funded drive for innovation and focused attention on the urgent need for interoperability between systems.



Challenges and benefits from e-assessment tools and systems

Adopting e-assessment has more radical implications than just changing the mode of assessment – it can challenge assumptions about the way the education system is structured and change patterns of work for staff and students.

If examinations can be taken on demand or when a tutor feels the learner is ready – as is the case with many professional and vocational qualifications – individuals can be fast tracked when they excel in certain aspects of the curriculum. This represents a considerable challenge to the formal education system, but may increase the motivation of more young people to stay within it. When interactive online tests are available for formative assessment, there is evidence that learners retake tests voluntarily and that availability of these any time, anywhere, can help to establish more regular patterns of study.

Interactive tests are a valuable means of engaging learners, as has been shown by innovative work with formative assessments on mobile devices designed for disaffected learners⁴ or those studying in workplace environments. Assessments built around virtual worlds can remove the tedium associated with traditional examinations for all types and age groups of learners. For many, including those with cognitive and some physical disabilities, e-assessment can offer a richer, more engaging, and a potentially more valid assessment experience than paper-based testing. The challenge is to make more use of this motivational potential in high-stakes examinations.

To ensure a fully inclusive experience, objective tests must provide built-in accessibility features that are customisable for each candidate in advance – a challenge that will increase in importance as e-assessment is more commonly used. This is especially the case when teaching staff are responsible for question authoring. Questions in item banks also need to be assessed and indexed so that each candidate experiences a test of equal measure to their ability, regardless of the combination of questions presented to them in a randomly generated test. While computer-based assessment may offer a reduction in the time spent marking, it will for these reasons shift the focus of effort for staff to before, rather than after, the examination period. However, a greater variety of methods used in assessment will undoubtedly benefit those disadvantaged by pen and paper tests.

What is clear is that understanding of the potential of e-assessment tools and systems needs to be matched by awareness of their pedagogic benefits and pitfalls. Perhaps the greatest challenge to be faced over the next decade is choosing the best and most appropriate ways of using these tools.

⁴ Attewell, J (2005) *Mobile technologies and learning*, www.lsda.org.uk/files/PDF/041923RS.pdf

‘Something I always try to point out is that it is intellectually a lot more stimulating to design an online or e-assessment than it is to sit there marking 300 scripts.’

Professor Don Mackenzie, Senior e-Assessment Manager, Innovation 4 Learning, University of Derby

Designing for high-stakes computer-based assessment

University of Derby

Background

A multimedia interactive e-assessment system – the Tripartite Interactive Assessment Delivery System (TRIADS) – was developed in house at the University of Derby in 1992 and developed further in partnership with the University of Liverpool and The Open University. Unusually, most tests delivered by TRIADS are medium or high stakes with a smaller but increasing proportion of purely formative assessments. In 2005-2006, TRIADS delivered medium- to high-stakes assessments to 10,000 students at Derby, measured on a single student access per assessment basis.

Technologies, systems and policies

With a Macromedia® Authorware® base, TRIADS provides a flexible design structure with the option to build in **simulations** and multimedia. The wide variety of question designs required by different subjects has been resolved by producing code templates for generic question styles that may be used singly or in combination. The templates contain full error-trapping routines and can facilitate the award of partial credit, ie the awarding of marks for method or for stages in an answer, as well as for final answers. The screen layout has been developed over many years for clarity and ease of use and in accordance with current guidelines on accessibility.

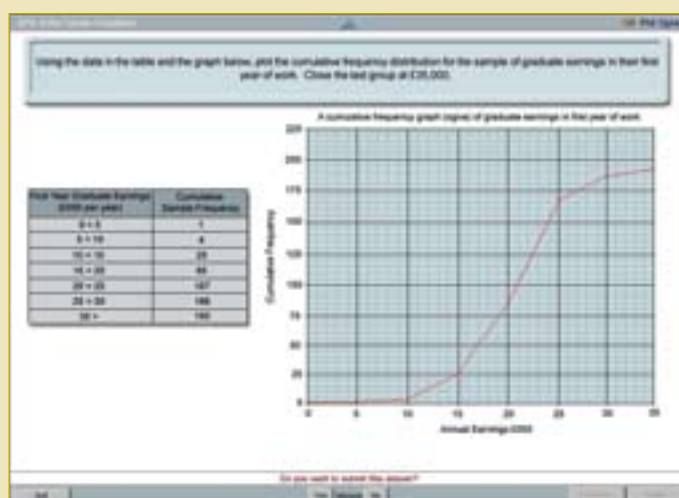
TRIADS can also support **randomised selection** and sequencing of questions and may be delivered on the web, **local area network (LAN)** or CD. Detailed reporting of candidate performance is also provided by the system, helping to pinpoint atypical results that suggest malpractice has occurred.

The Centre for Interactive Assessment Development (CIAD) at the University of Derby provides support for staff in all aspects of test production, including question design, quality assurance, monitoring of delivery and reporting on results.

Rethinking assessment practice

Despite the sophistication offered by TRIADS, 70% of use occurs in the first year of courses at Derby, tailing off to 20% in the second and 10% in the third years. So a further role for CIAD is in widening understanding of how e-assessment can foster the development of higher order skills and reduce the workload for staff. ‘Something I always try to point out is that it is intellectually a lot more stimulating to design an online or e-assessment than it is to sit there marking 300 scripts,’ points out Professor Don Mackenzie, Senior e-Assessment Manager. He recognises, however, that staff may face a double burden of developing e-assessments while still undertaking marking generated by traditional practice, and for this reason, a centralised support unit, CIAD, has been set up.

Measuring the frequency and timing of access to tests has revealed interesting information on how and when students study. This unexpected insight, derived from tracking data, revealed that many students retake the multimedia interactive TRIADS tests, enjoying the challenge of competing to improve on their previous score, as in computer games. Evidence from Derby also suggests that students are more likely to test themselves on a regular basis than when taking pen and paper examinations.



A TRIADS assessment. The student is required to plot a graph of the cumulative frequency of graduate earnings, using the data supplied in the table. The student plots the graph by clicking on each point in turn and the system scores its position.

Waymarking institutional practice

At the institutional level, the impact of e-assessment will be felt in:

- **staff training and support**
- **quality assurance and quality enhancement**
- **IT infrastructure and estates**
- **management of candidate authentication and plagiarism**

Staff training and support

Providing guidance for academic staff in the most effective use of authoring software and in pedagogically sound redesign of course assessments is an especially important consideration for higher education institutions, where assessments are generated within individual departments.

It is worth noting that adoption of e-assessment also creates skills development needs for those staff who support the assessment process: learning technologists, examination

officers, invigilators and IT support staff. This, and other support issues arising from e-assessment and e-learning, can generate a reassessment of models of support and staff development to clarify and realign roles and responsibilities.

Some universities have found it essential to set up a centralised production team alongside, or as part of, the learning and teaching enhancement unit to establish a repository of good pedagogic practice and to mitigate the risk of errors in delivering tests and recording and managing data, as at the University of Derby, where a commercial unit for e-learning and e-assessment – Innovation 4 Learning – has also been set up in response to growing external as well as internal demand for design consultancy and production services.

Other models of staff support include the development of accredited routes to staff development at the University of Dundee, and full staff ownership of the process after initial compulsory training at Loughborough University.

A tool for quality improvement

South East Essex College

The Technologies for Online Interoperable Assessment (TOIA) project was funded by JISC as part of the Exchange for Learning (X4L) Programme. Its aim was to provide practitioners and institutions with a robust online assessment management system that is web based, optimised for standards compliance, customisable and available to all UK higher and further education institutions.

At South East Essex College, the TOIA assessment tool has been used to improve performance in key skills at levels 1 and 2 in communication, application of number and IT by means of rapid diagnosis of learners' strengths and weaknesses.

Past years' key skills papers are uploaded to TOIA to provide mock tests with instant marking, feedback and reporting facilities. Tutors can access reports for each group of learners from the staff homepage on the college intranet, seeNet, and identify at a glance the types of errors each learner has made. With scores immediately available, TOIA has also reduced the marking burden for staff.

Piloted in 2004-2005, the use of TOIA was rolled out for college-wide use in 2005-2006, when a total of 1,769 key skills students were added to the TOIA database. Key skills tutors have reported increased levels of engagement and concentration when learners have the opportunity to complete tests online and receive immediate feedback.

‘e-Assessment must not be seen as a solution looking for a problem. It is a chance to improve the quality of assessment for young people.’

Dr John Guy, Principal, Farnborough Sixth Form College

Quality assurance and quality enhancement

Institutions or departments involved in new approaches to assessment need to develop appropriate quality assurance procedures and provide codes of practice for learners and practitioners. Examination regulations also need to be revised for high-stakes e-assessments.

Nonetheless, e-assessment, whether diagnostic, formative or summative, can form part of an institution’s strategy for quality enhancement, as shown in the case study on The Oldham College on page 34, where diagnostic assessments are linked to online learning resources to provide a personalised learning environment.

The case studies on Farnborough Sixth Form College and South East Essex College in this section reveal further ways in which computer-based – and computer-assisted – assessments are improving the standard of current practice and may even reveal the beginnings of a trend – one in which well-managed e-assessment is viewed as a means of improving quality, rather than diminishing it.

When combined with a **management information system (MIS)**, computer-based assessments also generate rapid, reliable data about the progress learners are making on a course. Given that the first step in tackling problems with retention and achievement is to identify those who are failing to engage, the use of data from online formative assessments at critical stages on a course can indicate which learners are at risk and provide prompts for remedial action.

e-Assessment, whether diagnostic, formative and summative, can form part of an institution’s strategy for improving quality.

IT infrastructure and estates

Because of the high level of resources required, preparing for e-assessment on any scale requires full managerial and financial support and a strategy for sustainability, including the upgrading and replacement of computer stock. Logistically, high-volume computer-based assessment can present challenges for institutions. Some have responded by setting up and equipping dedicated e-assessment centres. Often these are repurposed spaces, but an institution may be prepared to signal its preparedness for technology-rich learning and assessment of learning by investing in new purpose-designed estate.

The British Standard BS7988 (now the International Standard ISO/IEC 23988:2007 – Code of practice for the use of information technology in the delivery of assessments) provides guidance on implementing e-assessment for the first time.

What are the challenges for institutions?

- Developing an e-assessment strategy that incorporates pedagogic and technical aims
- Introducing sustainable ways of supporting computer-based assessments
- Setting up a viable physical and IT infrastructure to support e-assessment to the required scale
- Instituting policies and procedures to ensure the validity of e-assessments



Assuring the security and validity of e-assessments has often been cited as a concern for departmental teams and awarding bodies alike.

Management of candidate authentication and plagiarism

Assuring the security and validity of e-assessments has often been cited as a concern for departmental teams and awarding bodies alike. In the further education and schools sectors, awarding bodies' fears of technical failure and loss of data have decreased as the technology has become more robust. However, the authentication of candidates taking online assessments is still recorded as a risk, according to a 2006 survey report by Thomson Prometric on the acceptance and usage of e-assessment for UK awarding bodies.⁵

It could be argued, however, that authentication is not a problem exclusive to online examinations – a variety of ways of verifying a candidate's identity is likely to be needed, regardless of the mode of assessment. Individual student **logins**, backed up by photographic and other forms of identification – including smart cards, additional codes and passwords or biometrics, where appropriate – together with training for e-invigilators, have proved at least as effective in validating the identity of candidates as systems used in traditional paper-based examinations. Cheating by digital means during examinations – for example, by accessing the internet or sending text messages via mobile phones – is a further issue not confined to e-assessment, for which a general review of examination procedures is needed.⁶

To authenticate the originality of work against electronic sources, the JISC plagiarism detection software provides an online tool which can be accessed via a standard web browser. This is backed up by guidance on implementing plagiarism policies from the JISC Plagiarism Advisory Service. Electronic submission of work and routine deployment of anti-plagiarism policies have provided some safeguards.

However, another – and arguably the most effective – method of ensuring the integrity of submitted work is to adapt the design of course assessments. An example is illustrated in the case study on the BTEC Award in IT Skills for Business at Coleg Sir Gâr on page 30, where assessment is assimilated into the content of the course, occurring as a sequence of short tasks which are also discussed online with tutors and peers to provide an evidence trail.

To ensure the validity of a test, it is also important to note that monitoring the quality of question designs and assessment scoring methods is equally as important as the regulation of student conduct – poor question construction, ineffective grading of tasks and questions, or assessments that are inaccessible to some candidates, can equally undermine the validity of results. Effective procedures for e-assessment begin by ensuring the most appropriate assessment design, revising examination regulations and information given to candidates, and then providing appropriate training for all staff involved in invigilation and technical support.

⁵ Thomson (2006) *Acceptance and usage of e-assessment for UK awarding bodies*, tinyurl.com/yl2jfu

⁶ Underwood, J (2006) *Digital technologies and dishonesty in examinations and tests*, www.qca.org.uk/17712.html

Managing the virtual and physical environment

Farnborough Sixth Form College

Background

With around 2,900 students, Farnborough Sixth Form College is one of the largest sixth form colleges in England. Its principal, Dr John Guy, is an advocate for the modular 16-19 curriculum, and welcomes changes to the assessment system where they offer opportunities for improvement.

The first purpose-built e-assessment centre in an English further education college was opened at Farnborough in 2005. The design of the facilities has been combined with programming developed in house to ensure that computers can be used for both teaching and learning and summative assessment, as required, without prejudice to either activity.

Technologies, systems and policies

Purpose-built e-assessment centres represent a considerable investment and often need to double as learning centres. This poses challenges for network managers who need to support routine learning and teaching, as well as provide a secure environment for high-stakes examinations.

Dr Mike Docker, Director of ICLT at Farnborough, rejected options of setting up separate secured networks, or locking down access to the standard range of software during examination periods. His solution to maintaining flexibility was to write a programme, Invigilator Pro, to provide a secure environment for external examinations on any computer in the college.

Invigilator Pro takes regular screenshots, records all network traffic and logs every keystroke during examinations that are invigilated by staff in the normal way. The information is then compressed and moved to a location on the network where it can be stored securely and analysed in the event of suspected cheating. In practice, however, the presence of the software has acted as a deterrent.

Privacy screen filters have also been used to increase the flexibility of the centre. Designed to provide privacy for executives on journeys, the filters prevent students' work from being overlooked during examinations by making screens viewed at an angle appear black. Easily added or removed, these devices enable computers to be arranged in collaborative oval-shaped islands, rather than in back-to-back rows.

Rethinking assessment practice

Staff at Farnborough are also upgrading standards in coursework using a computer-assisted model. For A-levels in philosophy and in critical and contextual studies in art, learners complete work on computers in supervised timetabled classes. Copies of their work are taken by Invigilator Pro at the start and close of each session. The end product, however, is still printed out and posted to the awarding body in line with current regulations.

With these initiatives, Farnborough Sixth Form College has set a standard for the successful management of online assessments, including the prevention of cheating and accidental loss of data, while still maintaining normal use of the college's computer stock.



Developing strategies to support e-assessment

University of Dundee

Background

The University of Dundee has around 15,000 students supported by around 1,000 academic staff. 150-200 of these use formative and summative e-assessments, mostly in multiple-choice format, but some are now incorporating sound and video files. e-Assessment is applied most extensively in education, law, medicine, life sciences, nursing and languages, but is evident throughout all 15 schools in the university.

The policy for e-assessment at Dundee is supported in three ways: departmental e-assessment performance indicators, a five-week staff development course in online assessment, and a centralised learning enhancement unit. A wide range of strategies, such as online submission, peer-assessment and plagiarism checks, are used to ensure the quality of students' work and their experience of e-assessment.

Technologies, systems and policies

The principal tool used for e-assessment at Dundee is Questionmark™ Perception™. For formative assessments, this is integrated with the VLE, Blackboard®, which itself contains a facility for quiz production. Summative assessments are delivered via a dedicated server running Questionmark Perception through a secure browser. A number of the assessments use randomised question selection. Additionally, there is support for some ad-hoc approaches using JavaScript™ and Perl™.

e-Portfolios are also used for assessment purposes in some schools, and with ongoing exploration of online communication tools, wikis, blogs, and a **free text reading tool**, a broad spectrum of practice is emerging. Other developments include an integrated system for self- and peer-marking of work submitted online, using an in-house system for assessment of textual answers.⁷ Results are sent by email; alternatively, they may be sent by text message to a mobile phone.

To encourage staff to acquire new skills, the university has developed a course in online assessment which forms part of the university's Postgraduate Certificate in Teaching in Higher Education and is accredited under the Scottish Credit Accumulation and Transfer Scheme (SCOTCATS). As it is not just the mechanics of question production that matter, but also the value-added effect of the assessment, the course focuses on the pedagogy of online assessment with topics such as the effective design of questions and feedback, strategies for integrating online assessment into face-to-face practice, and the management of e-portfolios. The course is delivered online and is optional, but has proved its value by attracting applicants from outside the university.

All academics receive a copy of the university's e-assessment policy and procedures and the administration of summative assessments is managed by the Director of e-Learning in the Centre for Learning and Teaching and by staff in the Learning Enhancement Unit (LEU). The LEU delivers training on the design and administration of e-assessment, checks tests before uploading to a server and reinforces the university's policy on e-assessment – for example, it is recommended that any summative assessment is preceded by practice exercises of a similar type.

Rethinking assessment practice

Changes resulting from an institution-wide e-assessment policy can be considerable and support staff play a key role facilitating those changes. Those at the LEU believe that working from the ground up pays dividends – starting with systems and servers that are fit for purpose then focusing on support and staff training, finally ensuring the physical environment is capable of supporting the demand. LEU staff stress the need to work collaboratively with classroom practitioners to successfully manage change – it is not possible to drive through a policy, only to support its acceptance.

case study

'People often talk about the cost of e-learning, which is the wrong attitude. It is about value and what it brings to the institution. The people cost is substantial, but a good investment,' points out Dr Richard Parsons, Director of e-Learning at Dundee.

For lecturers, e-assessment is becoming a vital asset in managing learning in large-group contexts, but there is also considerable value in online assessments for students. With content available on a learning platform, lectures can be used to refine understanding rather than to introduce a topic. e-Assessment can then be used to confirm their grasp of the detail without adding to staff workload.

The use of formative e-assessment at Dundee has been instrumental in upgrading attendance and performance. Significant improvements have been recorded in second-year life science chemistry, for example, where self-paced e-assessments have turned a course from one on which half the students were failing to one on which most are obtaining at least satisfactory results.

What are the challenges illustrated by this case study?

- Encouraging staff to acquire new skills
- Using accredited schemes to enhance the value of staff development in e-assessment
- Identifying appropriate uses of formative e-assessment

⁷ www.dundee.ac.uk/learning/leu/ilt/selfpeer.htm



'People often talk about the cost of e-learning, which is the wrong attitude. It is about value and what it brings to the institution. The people cost is substantial, but a good investment.'

Dr Richard Parsons, Director of e-Learning,
University of Dundee

Waymarking academic practice

From the perspective of academic staff, key issues arising from e-assessment include:

- impact on course structure and practice
- impact on workload
- culture change
- fitness for purpose

Impact on course structure and practice

For academic staff, e-assessment must add value to learning and teaching to warrant the change from traditional methods – e-assessment must enable learning objectives to be more fully achieved, enhance learning and assessment experiences for learners, and provide opportunities to deepen their understanding.

Some transformative course designs have demonstrated the potential of e-assessment in promoting more effective learning, benefiting both staff and learners alike. For example, the REAP project pilot at the University of

Strathclyde, described on page 38, reveals how redesigning assessment can have a profound impact on course structure, in this case moving the focus from transmission of knowledge to a process more explicitly owned and managed by students, who complete individual and group assignments using an online discussion board. This also reduced the time academic staff spent marking.

In a further innovative example, the case study on the BA (Hons.) Learning, Technology and Research degree from Ultraversity on page 33 indicates how use of an e-portfolio as the mode of assessment can fundamentally change approaches to learning and assessment, and with this, the relationship between tutor and learner.

One unforeseen consequence of e-assessment may be to shift the pedagogic focus towards aspects of practice which have previously been less well-developed – the case study below on the role of OpenMentor at The Open University in improving the consistency of tutors' feedback is an example. Nonetheless, these case studies also illustrate how

Ensuring the quality of feedback

The Open University

The Open University (OU) is the UK's leading distance learning university with over 600 courses supporting approximately 150,000 undergraduate and more than 30,000 postgraduate students. Nearly all students study part time, with around 70% of undergraduate students in full-time employment.

Funded by JISC, OpenMentor is an **open source** tool which analyses tutors' grading and feedback and is the result of a collaborative project between the OU and The Robert Gordon University.

A tutor survey identified the need to ensure that consistent feedback is given on assignments submitted electronically. OpenMentor uses Bales' (1970) categories for interaction process analysis⁸ to check that the comments made by

tutors support the marks awarded. With as many as 5000 students enrolled on an OU course, it is essential that every student gets feedback that is appropriate to the grade given, with a balanced combination of socio-emotive and cognitive support.

The tool has also been used for training tutors – a display shows the most appropriate mark for the feedback they have given in training exercises, ensuring consistent and balanced feedback no matter who has marked an assignment.

OpenMentor has been tested with 100 tutors. This research and development project is unique to The Open University and highlights the importance of good quality feedback to student retention and performance.

⁸ Bales' Interaction Process Analysis [1970], www.cultsock.ndirect.co.uk/MUHome/cshtml/groups/groups4.html

‘The role of pedagogically sound, imaginative design for e-assessment on the part of tutors is often a significant factor in its success.’

Roadmap for e-Assessment Report for JISC
(Open University, 2006)

e-assessment has enthused practitioners, many finding new approaches to assessment a welcome opportunity to rethink course objectives and pedagogic models.

Impact on workload

It is well documented that the degree of effort normally required by academic and support staff in the post-assessment period shifts with e-assessment to the preparatory phase, when test development, establishing equivalence with paper-based elements, test runs, and trials of ancillary systems are a significant undertaking. The development of effective e-assessments and associated practices means that staff will require additional support during a transitional phase in which they manage traditional and new methods of assessment simultaneously.

Some institutions fund departmental e-assessment champions to provide peer support. One such scheme has successfully promoted e-learning (ILT) in the further education sector, but these initiatives require medium- to long-term rather than short-term funding. The adoption

For academic staff, e-assessment must add value to learning and teaching to warrant the change from traditional methods.

of wide-scale e-assessment will undoubtedly bring an increased workload for support staff and investment in a centralised unit to support e-assessment development is a likely outcome.

Culture change

Few higher education departments use e-assessment at a summative level. This could reflect a failure to imagine what can be achieved, as much as any real risk posed by technical systems, now considered by many to be robust enough for the task. Resistance to changes in cultural practice may, however, be as potent a restriction on innovation as the reliability of technology.

The impact of innovative assessment practice is still emerging and will support much ongoing research. To support this process of change, the sharing of successes and solutions to problems is beneficial. Using case studies to review and develop current practice is recommended.

What are the challenges for practitioners?

- Allocating time for e-assessment-related skills development
- Ensuring the accessibility of e-assessments for a diversity of learners
- Achieving a best fit between e-assessment design, course objectives and the needs of learners
- Developing confidence and expertise in a full range of e-assessment approaches
- Assimilating changes in working practices



Fitness for purpose

The nature of teaching and learning is changing across all parts of the sector and assessment practices have come under scrutiny as a result. Traditional pen and paper examinations often fail to illuminate the existence of critical thinking, effective decision-making, collaborative skills, or the ability to apply to solve practical problems. The use of technology in assessment may offer opportunities to correct these deficiencies. However, the application must be pedagogically led and appropriately selected – or justifiably rejected in some cases when, for example, the course content, the context of assessment or the ICT skills of potential candidates places its appropriateness in doubt.

For many academic staff, the appeal of e-assessment lies in its ability to capture aspects of learning previously considered impossible to assess. One example is confidence-based marking (CBM) which has shown how objective tests in higher education – often thought to be appropriate only for low-level knowledge testing – can assess higher order thinking in a consistently rigorous way. CBM also promotes a deeper level of learning by challenging students to evaluate how certain they are of their answer, so that they address the gaps they discover in their knowledge.

Testing knowledge acquisition through short, self-paced tests in subjects in which the emphasis falls on accuracy of recall –

such as pharmacy, medicine and law – is an almost guaranteed role for e-assessment. But subject disciplines differ in terms of learning objectives and in appropriate assessment methodologies. Computer-assisted assessment, such as the use of bulletin board and discussion tools to foster peer- and self-assessment, may be more suitable applications of e-assessment in subjects in which assessment criteria focus on the candidate's ability to evaluate and demonstrate conceptual thinking, rather than on the recall of factual knowledge.

In general, e-assessment may be best used to free staff for tasks that humans do best. Administrative functions performed by the computer – scoring, recording, and transfer of data – will ensure greater accuracy and objectivity than is achieved by humans. However, a uniquely valuable attribute that e-assessment can offer to learners and practitioners is an **authentic assessment** experience. Computer-based assessments can be taken in the workplace, acquiring an immediate relevance. They may also replicate an authentic context through simulations, virtual worlds or use of audio or image files, so that the activity seems more real and purposeful for the candidate. The use of gaming software as a preparation for, or as part of, a summative assessment, increases the stakes in this respect, and, where development funding is available, has the potential to revolutionise assessment practice.

‘CBM encourages students to think: “How would I justify this answer? Is there something else that supports it out or casts doubt on it?”’

Professor Tony Gardner-Medwin, University College London

Raising the stakes with confidence-based marking

University College London

Background

Confidence- or certainty-based marking (CBM) has been used for ten years in the medical school at University College London (UCL) to assist good study techniques and to encourage deeper reflection and understanding. It requires students to state the degree of certainty they have for each answer in an objective test and can be used with any type of right/wrong question and with existing item banks.

Technologies, systems and practice

Students rate their certainty on a scale of 1-3. They gain 1, 2 or 3 marks if correct, but 0, minus 2 or minus 6 marks if wrong, depending on the degree of certainty expressed. The CBM questions are stored on a server, and when a student engages with a test, the files are downloaded from the server onto the student’s computer. As a result, formative CBM assessments can be taken anywhere and at any time. Summative assessments, however, are completed under examination conditions on paper using specially designed optical mark reader sheets.

Rethinking assessment practice

One of the perceived problems for tutors with computer-based assessment (CBA) is that they have only the student’s answer – written responses, online discussion or face-to-face contact may reveal the basis for the answer and whether a student can justify it, or was merely guessing. CBM can provide a better indication of what the student knows, or does not know. Reliance on rote-learning is countered because students need to accurately assess their confidence in an answer to get good marks. In this way, CBM can stimulate students to link ideas and to challenge their assumptions. It can also enable examinations to gain statistical reliability.

Students have found CBM easy to use and the immediacy of feedback beneficial, as instant loss of marks prompts further study where knowledge was sketchy or incorrect. The approach can also stimulate deeper levels of thinking even when the answer was correct, rather than merely rewarding what could be the results of rote learning. ‘CBM encourages students to think: “How would I justify this answer? Is there something else that supports it out or casts doubt on it?”’ says Professor Tony Gardner-Medwin, who developed the system at University College London.

CBM is well suited to follow-up exercises after classes. Mixing easy questions, for which confident answers should be expected, with difficult questions can stimulate deeper and more specialised lines of thought. CBM, however, is intended to complement rather than replace other assessment methodologies and has particular value in subjects such as law and medicine, in which a broad spectrum of knowledge is important.

Preparing for summative computer-based assessment

University of Manchester

Background

The School of Pharmacy and Pharmaceutical Sciences at the University of Manchester had several years' experience in diagnostic and formative computer-based assessment (CBA) before exploring its use for summative purposes.

Pharmacy – a factual subject with large student numbers and an emphasis on accuracy – is a discipline that lends itself to CBA, but a lack of established examination protocols, the possibility of computer failure and fears for the security of the assessments presented concerns at the start of the six-month pilot scheme.

A total of 240 students, some with disabilities, taking first year modules in cell biology and biochemistry were involved in the pilot. The outcomes, published in 2006 in *Pharmacy Education*,⁹ indicate that not only can CBA be valid and reliable, but it can also offer advantages over traditional methods when applied to the pharmaceutical sciences.

Technologies, systems and policies

The pilot scheme was run according to the existing University of Manchester framework for examinations, but consideration was also given to the SQA guidelines on online assessment for further education.¹⁰ The assessment tool in WebCT® – the VLE of choice at Manchester – was used to deliver the assessments, since data from the university student record system could be fed directly into the VLE and used in setting up assessments. Examination questions written by academic staff in Microsoft® Word were imported into WebCT using Respondus® 3.0, a tool for creating tests offline which uses a Windows® interface.

The online assessment team have since investigated additional tools to increase the efficiency of this process – experience has shown that import software does not always offer a total solution at this level. For example, the use of

decimal points, commonly used in the writing of numeric questions, caused question import filters to stumble in ways that are difficult to predict. Hence, some final editing had to be carried out within the VLE.

Student identity was authenticated by students logging on to the VLE using their normal university username and password, and was backed up by the invigilator checking that students taking the examination could be identified from photos on their university ID cards. Timed release was used to ensure that examinations could be accessed only during the timetabled period and, for additional security, a test-specific password was issued. This was given to candidates only when the examination commenced.

The possibility of a technical failure on the day of the examination remained a concern. To prepare for this eventuality, paper versions of the tests were produced as a backup and, as a further fail-safe mechanism, candidates were asked to enter their responses online and on an optical mark reader sheet. This prevented the examination from being a fully computer-based one, in which random ordering of questions could take place, but nonetheless enabled a useful comparison between different methodologies during the pilot. The process relied on the assistance of a support team, a backup server operated throughout the examination and computers were booked at 90% capacity to allow for the breakdown of more than one machine.

Rethinking assessment practice

The pilot study revealed that some adaptations were necessary. A disadvantage of the WebCT marking tool, for example, was its inability to interpret the range of inaccuracies in spelling that could occur in otherwise correct answers. Results from preliminary practice assessments showed that small errors, such as the inclusion of a hyphen, could be marked as incorrect by the computer, even though allowed by a human marker.

case study

As a result, a subject-specific word list of approximately 1,500 correctly spelt key terms was added as an HTML file in WebCT. A link to the list was provided next to each question, so candidates could cut and paste the correct spelling into their answer box. Using this word list to ensure consistency of spelling reduced the discrepancy between hand marking and computer-based marking to less than 1%.

Comparisons between the methods used in the pilot indicate that, with adaptations, computer-based summative tests can prove more accurate than the substantially slower traditional method in which scripts are marked manually. CBA also proved beneficial for students with dyslexia – cascading style sheets allowed them to customise the display using accessibility options provided by the browser.

What are the challenges illustrated by this case study?

- Building confidence in the potential of CBA to provide secure and valid assessments
- Developing effective protocols for the administration and invigilation of CBA for summative purposes
- Developing and modifying existing tools and systems
- Providing institutional support for running and evaluating pilot schemes in summative e-assessment

⁹ Aojula, H, Barber, J, Cullen, R and Andrews, J (2006) Computer-based, online summative assessment in undergraduate pharmacy teaching: the Manchester experience, *Pharmacy Education*, 6(4), 229-236.

¹⁰ SQA (2003) *SQA Guidelines on Online Assessment for Further Education*, [www.sqa.org.uk/files_ccc/GuidelinesForOnlineAssessment\(Web\).pdf](http://www.sqa.org.uk/files_ccc/GuidelinesForOnlineAssessment(Web).pdf)



Not only can CBA be valid and reliable, but it can also offer advantages over traditional methods when applied to the pharmaceutical sciences.

Waymarking learner-focused practice

A number of wider developments can help to establish a more learner-centred approach to assessment. These include:

- a technology-rich learning environment
- on-demand testing and item banks
- interoperability of systems
- e-portfolios as assessment tools

A technology-rich learning environment

Some aspects of technology are now well embedded in classroom practice – for example, interactive whiteboards in schools and colleges and digital resources on a VLE in higher education institutions. Effective pedagogic models for online, work-based and distance learning are also more fully developed. However, a learning environment that harnesses the potential in emerging technologies can offer much more than this. Virtual world scenarios, simulations, mobile and games technologies are providing new dimensions to the concept of e-assessment.

The Altered Learning concept illustrates this groundbreaking use of emerging technologies in assessment – in an adaptation of the Bioware® and Atari® computer game, *Neverwinter Nights™*, by tutors at West Nottinghamshire College, players have to improve their numeracy and literacy skills to progress. Completed tasks are then banked in an e-portfolio for assessment, with significantly improved success rates in basic and key skills assessments.

The portability and speed of mobile technologies can also introduce a new perspective to assessment practice. An example is the use by tutors of an HP iPAQ Pocket PC at West Suffolk College to record stills, sound and video files of trainee chefs at work. Such evidence provides a more authentic alternative to written work in an e-portfolio, and can also be transmitted to the tutor's laptop via Bluetooth® technology to illuminate discussions in theory classes.

On-demand testing and item banks

For learners in further education, a testing-when-ready policy offers an opportunity to manage the burden of assessments,

Merging formative and summative assessment

Coleg Sir Gâr

Coleg Sir Gâr has developed an online BTEC Intermediate and Advanced Award in IT skills for learners in small businesses accredited by Edexcel.

Delivered via the internet with tutor support online, this is a skills-based course which allows learners to progress at their own pace and has no formal examinations.

Assessment is ongoing and assimilated into the structure and content of the course – as learners complete tasks, these provide evidence of their achievement. At the end of each assignment and each unit, a self-assessment exercise can be completed to obtain formative feedback.

Every possible aspect of the assessment process is automated. Elements in an assignment are marked as correct or incorrect – the self-assessment questions are devised to be either right or wrong – and decisions recorded online. Emails are sent automatically to the learner and tutor before the results are saved in a secure part of the database. Any wrong answers generate text advising the learner to revisit an activity. The process can be completed in minutes and both internal and external verifiers can access the records. As a more formal exercise, a final tutor-marked assignment assesses all the skills covered in the unit.

The systems used, including the VLE – Virtual College – and the multiple-choice question tool, were developed in house at Coleg Sir Gâr to provide rapid feedback for learners – an essential ingredient in maintaining confidence and morale on a distance learning course.

Virtual world scenarios, simulations, mobile and games technologies are providing new dimensions to the concept of e-assessment.

but, importantly, also encourages them to assess their own preparedness. Online mock tests have proved beneficial for this, especially if they can be accessed by learners in their own time and in different contexts, with immediate and appropriate feedback to both correct and incorrect answers.

This is where an item bank becomes important. Item banks supply questions of similar difficulty by a randomised selection process, allowing candidates to sit an assessment at different times to others in their group without invalidating the test. However, interoperability and IPR issues remain considerations for the development of item banks, if tests or individual questions are shared between institutions or subject disciplines.

Interoperability of systems

These developments bring into sharper focus the need to join up IT systems within and between institutions. Most UK further and higher education institutions have large and complex systems, which have developed in an ad-hoc way. Many of these systems are 'monolithic', that is, they have been developed for particular purposes and cannot interface with other systems.

'One of the things we found out early on with our lifelong learners is that they all learn at different rates and in different ways and get deeply frustrated if they are forced to learn at a rate that is not their natural rate.'

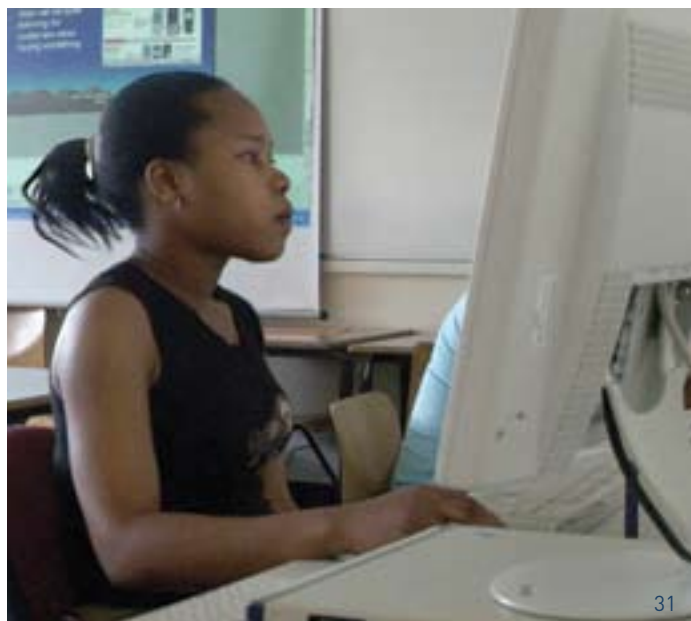
Professor Tony Toole, Director of Online Services,
Coleg Sir Gâr

The JISC **e-Framework** aims to establish more flexible ways for IT systems to be used to allow each element to act as a 'service' rather than a discrete package so that the data held within it can be opened up for use by other elements. Put simply, this means that the essential technologies that support e-assessment – for example, email, learner record systems, VLEs and assessment tools – can interoperate, producing the speeded-up processing and reporting of results described in some of the case studies. Interoperability enables e-assessment to be used to its full advantage and facilitates the interaction between e-portfolios and the services they draw on to evidence lifelong learning.

Key to the achievement of this vision for a joined up learning system is the development of common standards. These smooth the path to updating accessibility features in software and enable, amongst other requirements, e-assessment questions to be shared between item banks. The IMS QTI specification already provides a basis for this to happen, if the systems used are QTI compliant.

What are the challenges for learner-focused practice?

- Issues of interoperability, copyright and IPR relating to item bank development
- Adoption of common technical standards to facilitate interoperability between systems
- Managing the availability of on-demand testing
- Harnessing the potential of new technologies in assessment practice



e-Portfolios as assessment tools

An e-portfolio is defined in *Harnessing Technology* (DfES, 2005) as an electronic means of recording personal learning and achievement supported by reflective activities through which learners can gain greater understanding of their development and progress over time.

In this interpretation, the key purpose of an e-portfolio is developmental – it provides opportunities to reflect on stages in a lifelong learning journey and to plan ahead. It may well draw on evidence generated on different programmes and in different institutions, posing issues of interoperability and long-term ownership and storage.

However, an e-portfolio can be used as tool for assessment wherever a repository of evidence, combined with a reflective analysis of the process and outcomes, is prepared for assessment and validation against a set of external criteria. While still considered in many ways innovative, use of an e-portfolio for assessment has for some time been a feature of a number of vocational programmes.

Using an e-portfolio as a tool for assessment introduces an important shift in approach, in that the route to the qualification no longer takes the form of universally applied tasks. Learners may select what is to be included in the e-portfolio and also choose the format and media to be used. Thus e-portfolios have the potential to introduce a degree of personalisation into assessment. They also demonstrate additional personal skills that are valuable in the workplace – for example, command of software, use of web technologies and digital images – as well as recording achievement of course objectives.

Learners' ownership of the process is a distinguishing feature of this mode of assessment. For the BA (Hons.) Learning, Technology and Research degree offered by Ultraversity, students exhibit the findings from research undertaken in their workplace for critical feedback from their colleagues. Their findings, together with the feedback, are then presented for assessment in an e-portfolio, demonstrating how a mode of assessment can capture the process as well as the outcomes of learning. The students' experience of assessment is more authentic, since much is based on their own experience of the workplace, so for many students this approach is empowering as well as demanding. It also develops skills valuable in a 21st century workforce: communication, problem-solving, presentation and collaboration.

From a marker's perspective, however, this is a potentially complex and time-consuming mode of assessment, as noted in the UK Centre for Recording Achievement (CRA) study of efficient assessment of portfolios.¹¹ On the other hand, evidence assembled in an e-portfolio gives employers a more rounded picture of a learner's achievement, and how it was achieved – it is a particularly relevant mode of assessment for vocational or work-based courses.

¹¹ Strivens, J (2006) *Efficient Assessment of Portfolios*, <http://cetl.open.ac.uk/pbpl/pics/d58920.pdf>

'That's the beauty of this degree, it's "forcing" me to be brave and do things that I feel I cannot do, but really I can. You've given me ownership of my learning and...I'm hanging on to it.'

Kath Marshall, third-year student

The e-portfolio route to accreditation

Ultraversity, Anglia Ruskin University

Background

The BA (Hons.) Learning, Technology and Research (BALTR) degree course at Ultraversity – a distance learning arm of Anglia Ruskin University – is delivered and assessed without a single face-to-face meeting before graduation. Designed by Ultralab, the course supports a wide variety of learners studying from home and from the workplace. The first cohort of 140 students graduated in summer 2006.

Technologies, systems and policies

BALTR is designed as a research-based degree. Modules depend on action research rather than on course content, and include development of the skills needed to undertake research enquiries. Students, or researchers as they are known, take charge of their own programme of learning, negotiating with their personal facilitator a range of activities based around their work environment.



They upload evidence of learning outcomes into their own portfolio space on Plone™, a platform selected because it is open source and considered simple to use and flexible.

For Ultralab project manager, Stephen Powell, the course ethos of personalised and negotiable learning was the deciding factor behind the choice of software. FirstClass® – a conferencing software which facilitates group collaboration and document sharing – is used alongside Plone to establish an online community to provide a network of support and to enable peer review of outcomes.

From the outset, researchers take ownership of the technologies they use and are encouraged to set up their own weblogs and use other emerging technologies outside of the conferencing software to reflect on the progress of their learning. They can choose to keep their space on Plone private or can upload resources, such as images or podcasts, for peer review – a comment box on Plone offers the opportunity for this if peer-assessment is selected as a learning pathway by the researcher. The decision is theirs.

Rethinking assessment practice

Those opting for the BALTR degree are typically 35-40 years old and unable to commit to traditional face-to-face courses. The design of the assessment allows them greater flexibility in how they demonstrate their learning, and, in doing so, provides a sense of empowerment. 'That's the beauty of this degree, it's "forcing" me to be brave and do things that I feel I cannot do, but really I can,' was the feedback from one third-year student.

Their research may also make a lasting impact on the way their workplace operates – at the end of the course, researchers exhibit their findings for critical feedback from a selected audience. The critical feedback and outcomes from the exhibition are then assessed in a 'patchwork' of evidence connected by a text or audio commentary within the e-portfolio.

Supporting learners through diagnostic assessment

The Oldham College

Background

The Oldham College has improved learner achievement through a blend of online diagnostic assessment and personalised learning resources. Diagnostic and mock online tests for basic and key skills were introduced in 2005 on the college VLE, Serco (Teknical) Virtual Campus™, with top-up resources provided alongside to target specific learning needs.

Around 30,000 individual online assessments and 3,000 nationally recognised online qualifications were completed by learners at The Oldham College during 2005-2006. The system has been established over two years and is credited with having raised achievement on basic and key skills by 18% in the year 2005-2006. The cost of the scheme has been partially offset by the higher rate of course completions.

Technologies, systems and policies

A designated e-assessment centre was set up in 2005 to provide a venue for summative tests, including those for City & Guilds, Edexcel and OCR qualifications taken throughout the year, as well as providing accommodation for mock and diagnostic tests. The e-assessment centre is located in the library and learning resource centre, signalling the close synergy between learning and assessment. A testing-when-ready policy ensures that the centre is in continuous use.

All enrolled learners undergo five diagnostic screening tests on entry and take mock online tests before undergoing formal assessments in basic and key skills. The results are available within days via learners' home pages on the VLE and indicated by traffic light colours – green for 'achieved' and red for 'not achieved'. Scores are automatically transferred into the college management information

system (MIS) to create an individual learning record, and to generate class lists for teaching staff. EasyOCIS – a system built in house as a front end to the Fretwell-Downing MIS – enrolls learners on mini virtual courses on the basis of test results. Personalised learning resources that are appropriate for those results are then generated.

For example, a learner may achieve a pass score in a basic skills numeracy test, but the test may reveal an underlying uncertainty about fractions. Once the result is delivered, appropriate learning resources and quizzes appear as links on the home page when the learner next logs in. These will have been uploaded as IMS-compliant objects into the VLE.

The results of the screening will also generate different levels of support for different learners, from one-hour per week group sessions in the learning resources centre, to one-to-one support in the classroom if required – the college provides about 6000 support hours per annum. Learners' progress can also be tracked via EasyOCIS.

Rethinking assessment practice

Over 2,000 learning resources were created in support of the scheme over an 18-month period, using re-purposed National Learning Network (NLN) materials. The creation of such a high number of online resources was initially time-consuming and required the services of a full-time administrator. However, the benefits are now visible.

These have included a raised profile for the library and learning resources staff, who are now more likely to be approached for assistance in locating suitable resources. Practitioners were able to have guidance from the administrator in the production of online quizzes – an unanticipated benefit from the initiative has been the improvement in staff ICT skills. While the quizzes produced so far have been mainly multiple choice, sound files and

case study

digital images are more frequently used, reflecting the increasing confidence of staff in developing their own formative e-assessments.

For learners, fast tracking has now been made possible by the provision of personalised routes to qualifications. Some learners will even complete their basic and key skills tests within two months of enrolling, if the initial screening indicated this was appropriate. Learners can then progress at their own rate – something that is important both in terms of maintaining morale and in managing the high throughput.

‘We know we couldn’t do this in a traditional way,’ says Head of Learning Resources, Roger Clegg, who has led the initiative to produce the top-up online learning resources that target weaknesses identified by the tests.

The scheme is now being extended to foster achievement in other curriculum areas and to support learners in the workplace. Resources in a wider range of media are envisaged to promote self- and peer-assessment – for example, the use of videos created by learners to explore their own and others’ performance for elements of the BTEC National Diploma in dance.

What are the challenges illustrated by this case study?

- Exploring the role of e-assessment in supporting personalised learning
- Funding the development of individualised learning resources to raise learners’ achievement
- Aligning institutional strategies for e-learning and e-assessment to ensure that diagnostic assessments lead to supported learning experiences



‘We know we couldn’t do this in a traditional way.’

Roger Clegg, Head of Learning Resources,
The Oldham College



Looking to the horizon

Much that has already happened in the field of e-assessment would not have been predicted ten years ago, so how can we envisage changes to come in the next decade? This section questions some assumptions about e-assessment and explores the most likely developments on the horizon for practice with e-assessment.

Which aspects of e-assessment will be established as mainstream practice by 2017?

In the assessment of the 14-19 curriculum, much will change. Traditional paper-based summative assessments will continue to migrate to computer delivery, led by new qualifications, such as the cross-curricular Specialised Diplomas, currently under development in England. Increasingly, aspects of courses that lend themselves to objective question types, or that use assessments based on visualisations of concepts or procedures, will be completed online. These strategies are likely to be combined with short-answer questions, marked by computer and checked by humans, to probe the learner's ability to form links between areas of knowledge.

The value placed on traditional literacy is not likely to yield. Nonetheless, assessment will become a more varied and richer experience which will include some computer-based or computer-assisted assessment in tandem with other approaches. All 16 to 19-year olds will have used technology as part of their assessed programme of study and will be proficient in its use. Evidence of their creative achievements or wider key or core skills is likely to be required in multimedia formats, either in an e-portfolio record of achievement, or as part of a formal assessment. Dependence

by UCAS on A-levels as a determinant of entry to higher education is also likely to be reduced by 2017, in part due to the availability of information about applicants' interests, achievements and performance provided in e-portfolios.

Universities, driven by increased participation in higher education courses, will continue to undertake research and development activities related to e-assessment, including some groundbreaking work in the use of virtual world scenarios for summative and formative assessments. Written assignments will routinely be submitted and marked electronically to combat plagiarism and to provide retrievable evidence of previous levels of attainment.

Mobile and audiovisual technologies will play a more prominent role in the capturing of evidence from the workplace or from enquiry-based and work-based learning, in many cases for submission via an e-portfolio. The assessment of professional skills – for example, in clinical practice in medical and pharmaceutical sciences, health and social care – will have been advanced by the exploration of digital video, video conferencing and mobile communication devices to improve the validity and authenticity of practice-based assessments.

What will be the key achievements by 2017?

The introduction of technology will have prompted a greater understanding of how to design effective assessment strategies. By 2017, a drive for inclusivity and personalisation in assessment will have challenged the 'one-size-fits-all' assumption that dominated assessment practices in the 20th century.

It will be accepted as effective practice that opportunities must be provided for all learners to demonstrate their achievement. As a result, computer-based and computer-assisted assessments will form part of a wider portfolio of methodologies from which assessment designers can choose. These will include vivas, practice-based assessments, e-portfolios, group tasks, self-directed enquiry-based assignments, peer- and self-evaluation, as well as traditional essay-based examinations. As a result, it will become possible for a wider diversity of learners to achieve the qualifications of their choice, demonstrating their attainment in ways that are more relevant to, and more revealing of, their level of skill and attainment.

An increase in distributed learning on a global scale, as higher education institutions forge partnerships with universities in the emerging world, will also encourage a continuing re-examination of the value systems and practices inherent in assessment.

Simulations in which both learning and assessment of learning can take place will have demonstrated the value of aligning learning objectives with assessment methodologies. One such example is the second phase of development of the Transactional Learning Environment (TLE), underway at the University of Strathclyde.¹² This simulated learning environment allows postgraduate law students to rehearse skills in legal transaction and negotiation in a virtual town, Ardcalloch, supported by databases of legal documents. Students learn from and are assessed by what they do – in the safety of a virtual world. The TLE is transferable to any professional discipline within higher and further education

and, by 2017, will no longer seem an innovative way of developing and assessing professional skills.

What concerns will remain by 2017?

A drive to introduce e-assessment presupposes that candidates are competent in, and willing to engage with ICT. For some learners, this could create a new layer of disadvantage, if they feel unable or unwilling to participate in courses and assessments that take place in a computer-mediated environment.

The increased diversity of approach will continue to fuel a debate over standards. A flexible and responsive assessment regime brings with it issues of equivalence between different methods of assessment – for example, is it as hard to complete a multiple-choice test as it is to write a 1,000-word essay under examination conditions? Can there be parity between qualifications that have been assessed in strikingly different ways?

For a vision for e-assessment to be realised with more certainty, it is necessary to explore more fully the institutional and pedagogic dimensions to e-assessment, addressing issues of sustainability and culture, as well as technological barriers. We need to know, for example, how technology can be utilised to enhance assessment practices, rather than simply make them more efficient, and how to deploy e-assessment alongside other modes, so that each complements the other in the range and type of skill assessed. Finally, we need to explore how best to develop the confidence of all concerned in learning and teaching in the efficacy and appropriateness of computers in assessment.

¹²www.jisc.ac.uk/whatwedo/programmes/elearning_innovation/eli_simple.aspx

'I found it very beneficial, at the time... I did not realise how much I was learning.'

Student, basic psychology course, University of Strathclyde

Understanding the role of assessment in learning

The REAP project, University of Strathclyde

Background

Traditional assessments result in a high workload for tutors, and yet may do little to encourage learners or improve their ability to learn. The Re-engineering Assessment Practices (REAP) project, based at the Centre for Academic Practice and Learning Enhancement at the University of Strathclyde, is exploring enhanced assessment practice across a broad spectrum of pilot schemes, with special emphasis on large first-year undergraduate classes.

Technologies, systems and practice

One pilot has been undertaken with the first-year basic psychology course at the University of Strathclyde, which introduces students to key theories and debates in this popular field of study. With a class size of approximately 550, opportunities for feedback on assessments were limited.

Course assessments were redesigned for the pilot using **online communication tools**. Students were divided into groups of six and asked to use the assignment drop box and the discussion board in the university's VLE. After an initial induction task, students posted responses to tasks of increasing difficulty in the same topic area over a four-week period, the length of responses ranging from 50 to 300 words.

The first postings required an individual submission followed by discussion with other group members before an agreed group posting. Subsequent tasks involved longer shared answers based on group discussions. In all cases,

after submitting their answer, students were able to compare it with those produced by other students, engaging in individual thought, peer dialogue and self-assessment in relation to these tasks. Tutors monitored and allocated marks for participation but did not moderate the online discussions.

Rethinking assessment practice

The scheme was based on work by Nicol and Macfarlane-Dick (2006)¹³ which identifies seven principles of effective feedback. Formative assessments that demonstrate the application of these seven principles can improve all students' ability to learn autonomously by developing skills in evaluating their own and others' work.

Other pedagogic features of this re-design of learning and assessment were *task scaffolding* (building on knowledge and comprehension established in earlier tasks to support later task engagement) and *social scaffolding* (individual learning supported by peer dialogue and interaction).

The pilot demonstrated how a course structure, aligned with the use of readily available technology and the seven principles of effective feedback, can transform the social dynamics of learning and improve students' sense of ownership of course content. The results have shown enhanced engagement, confidence and autonomy in learning, as well as deeper processing of content by students.

As a result, the Department of Psychology has redesigned the structure of first-year classes – in 2006-7, the number of scheduled lectures has been halved and similar online group work now spans all topic areas. Student feedback also indicates a positive effect: 'I found it very beneficial, at the time... I did not realise how much I was learning... it was learning without thinking about what I was doing.'

¹³Nicol, D J and Macfarlane-Dick, D (2006) Formative assessment and self-regulated learning: a model and seven principles of good feedback practice, *Studies in Higher Education*, 31(2), 199-218

It is estimated that around 70-80,000 e-assessments took place at Loughborough University in 2006.

Embedding an institutional policy for e-assessment

Loughborough University

Background

Loughborough University has been developing and refining e-assessment practice since 1996. Large-scale deployment of e-assessment is now a reality rather than a vision – it is estimated that around 70-80,000 e-assessments took place at Loughborough University in 2006.

Technologies, systems and policies

Developments have been driven, as elsewhere in the sector, by the desire to reduce marking workload, while also achieving appropriate and rapid feedback for students. The focus of work has been on three fronts: increasing the efficiency and usability of systems, responding to a need for greater sophistication in questioning techniques, and dealing with the logistical issues arising from increasing demand for e-assessment.

For these reasons, Loughborough uses both computer-based and computer-assisted assessments. Paper-based optical data capture, in which scripts are scanned and digitised, occurs alongside computer-based assessments developed and delivered through Questionmark Perception™.

Rethinking assessment practice

Loughborough University has used Questionmark Perception since 1999. As part of an earlier JISC-funded project, Questionmark Perception was embedded into an emerging managed learning environment with single login. Each student then received an individualised menu of assessments depending on their course registrations. This system is used for objective diagnostic, formative and low-stakes summative assessments. Being web-based, the assessments can be accessed from anywhere and at any time. Major users have been modern foreign languages, chemistry, mathematics and engineering departments.

In a range of strategies for computer-based assessment, objective tests have been used in conjunction with case studies to assess responses to complex scenarios, online surveys to establish levels of knowledge prior to the course, and confidence-based marking to test the level of certainty a student has in a selected answer.

However, increased numbers have meant that computer-assisted approaches using optical mark readers also play a vital part in a holistic policy for e-assessment. A system has been devised for optical data capture using Remark Classic OMR® software and has been refined over time to provide opportunities to assess higher order skills. This paper-based solution avoids the need for large-scale, high-security IT suites and complex contingency plans. It is also popular with staff and students.

An e-assessment system, however, is only as good as the content on it and the vision and skill of its users. Appropriate compulsory training for users, combined with clear definitions of roles and responsibilities across teams and departments, are also considered by Loughborough University to be key to the successful implementation of e-assessment.

Conditions: 504731 v012
Module: 00-00000000
Assessment: OMR01 Statistics and Chemometrics Outcomes Part 1

A SRM was analysed twice to determine its Cu content. The first analysis was carried out with ICP-AAS and the second analysis employed ICP-OES. The following results were obtained.

| ICP-AAS result | ICP-OES result |
|----------------|----------------|
| 18.0 | 18.2 |
| 18.0 | 18.0 |
| 14.4 | 13.9 |
| 18.2 | 18.0 |
| 18.3 | 18.7 |
| 14.8 | 15.1 |
| 18.2 | 18.0 |
| 18.1 | 18.0 |

a) Perform a significance test to show whether the ICP-OES method differs from the ICP-AAS method in precision. Report numeric answers to 2 decimal places. Note that a two sided test is required.

$F =$ $F_{crit} =$
Null hypothesis is therefore (Enter retained or rejected in the test box)

b) Perform a further significance test to determine whether the two methods differ significantly in the mean concentration.

$t =$ $t_{crit} =$
Null hypothesis is therefore (Enter retained or rejected in the test box)

An example of a fill-in-the-blanks question from a statistics and chemometrics test devised at Loughborough University.

Working towards effective practice

A tool for implementing effective practice with e-assessment

Use this checklist to explore and discuss with others the implications of implementing e-assessment in your context.

| Issues to consider | Working towards effective practice |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose (reason for implementing e-assessment; alignment with e-learning and other strategies). | Consider the rationale for e-assessment and internal and external evidence (including case studies) that supports it. Review how the proposal aligns with related institutional strategies. |
| Learners (their prior experience, ICT skills, rights, responsibilities; and access to resources and feedback; the appropriateness of the approach taken). | Consider the appropriateness of the pedagogic approach and likely benefits for learners. |
| | Review the availability for learners of technologies, digital resources, ICT support and codes of practice. |
| | Consider accessibility and regulatory requirements. |
| Context (face to face or virtual; tools, facilities and services; staffing requirements; IT infrastructure; support and training for staff). | Identify adaptations needed to the IT and physical infrastructure. |
| | Consider strategies for sustaining and updating the IT and physical infrastructure. |
| | Review models for staff training and support. |

Figure 4 A tool for implementing effective practice with e-assessment

| Issues to consider | Working towards effective practice |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Development (suitability and innovation in assessment designs; compliance with standards and quality assurance procedures; accredited routes for professional development; interoperability of systems).</p> | <p>Consider the design, pedagogic approach and ability to assess a diversity of skills, including those not covered by traditional methods.</p> <p>Review quality assurance procedures and how they relate to the design and development of e-assessment, e-portfolios, item banks and the use of multimedia in e-assessment.</p> <p>Consider the professional development needs of all staff involved, including learning technologists, IT support teams, administrators and invigilators.</p> <p>Review the suitability and compatibility of technologies used with other institutional systems. Explore adaptations to tools and systems to improve security and efficiency.</p> |
| <p>Implementation (contingency plans; choice of and adaptations to systems; authentication procedures;).</p> | <p>Review the outcomes of pilot schemes.</p> <p>Explore protocols and procedures for authenticating candidates and ensuring the security of summative e-assessments.</p> <p>Review contingency plans for summative assessments. Consider the quality and immediacy of feedback in formative assessments.</p> |
| <p>Evaluation (measuring achievement of objectives).</p> | <p>Identify how achievement of objectives will be measured. Review methods for obtaining evaluation data.</p> |





Glossary of key terms

Accessibility: The conditions needed to ensure that all learners, including those with disabilities and learning difficulties, can access places of learning and learning resources, including e-learning content.

Audience response systems: A means of introducing interactivity and assessment of understanding during presentations and lectures which uses wireless handsets and a receiver connected to a computer to capture audience responses to questions. Designated software converts the signals into displays for whole-group discussion.

Authentic assessment: An assessment that places candidates in a real-life or simulated scenario that requires them to apply appropriate knowledge and skills.

Awarding body: An organisation or consortium that awards qualifications. To be eligible to award accredited qualifications in the non-HE sectors, awarding bodies must meet the requirements of the regulatory authorities.

Blog: A shortened form of 'web log' – a web page containing periodic entries compiled by either an individual author or as a collaborative exercise by a group within a community of practice. For further information, see: <http://en.wikipedia.org/wiki/Weblog>

Computer-assisted assessment (CAA): Used in this publication to refer to assessment practice that relies in part on computers, but also used in a generic sense, broadly synonymous with e-assessment.

Computer-based assessment (CBA): Used in this publication to refer to assessments wholly delivered and marked by computer, but also used in a generic sense, broadly synonymous with e-assessment.

Confidence-based marking (CBM): Measurement of the extent to which a candidate believes his/her answer to a question is correct.

e-Assessment: The end-to-end electronic assessment processes where ICT is used for the presentation of assessment activity and the recording of responses. This includes the end-to-end assessment process from the perspective of learners, tutors, learning establishments, awarding bodies and regulators, and the general public.

e-Learning: The process of learning which is supported by the use of ICT. Also used loosely to describe the actual content delivered on screen, and the more general use of ICT to contribute to learning processes.

e-Framework: An international effort to develop a service-orientated approach to the development and integration of computer systems in the sphere of learning, research and education administration.

e-Portfolio: An electronically-based portfolio which can act as a repository of files including reflection and self-evaluation assembled for the assessment of a particular course. An e-portfolio may also be used as a complete record of lifelong learning and achievement.

Free text reading tool: Software that enables candidates' responses to essay-style questions (typed rather than handwritten) to be analysed and marked electronically.

High-stakes assessment: One in which the outcomes are of high importance to both the centre and to candidates and affect progression to subsequent roles and activities.

ILT: An abbreviation for 'information and learning technology', the term commonly used in further education to refer to the application of technology to the institution's core functions.

IMS: The IMS Global Learning Consortium Inc., the USA-based agency developing specifications for educational computer systems in education.

Intellectual property rights (IPR): Rights granted to creators and owners of works that are the results of human intellectual creativity. For further information, see www.jisclegal.ac.uk/ipr/IntellectualProperty.htm

Interoperability: A feature of computer systems components that allows the components to interact according to technical standards that define functionality useful to the user. The IMS QTI specification is an example of an interoperability specification within the e-assessment domain.

Intranet: A network of computers within an organisation, which functions (from a user's perspective) similarly to the internet, potentially providing additional services to users, while also preventing unauthorised external access.

Item bank: A storage facility for items, which allows them to be maintained and used for automatic and manual test generation purposes (to create tests on paper and/or on screen).

Learning platform: A generic term covering a variety of ICT systems that support online learning.

Local area network (LAN): A computer network in a single physical location, which is characterised by high-speed high-reliability interconnections between client computers and servers. A LAN with a local server is regarded as the most reliable infrastructure for running e-assessments.

Login: The unique user name and password entered to access a computer system.

Low-stakes assessment: One which is of low importance, with results recorded locally.

Management information system (MIS): A computer system used in educational institutions which stores administrative information (such as student administrative records and financial information) about the enterprise, its staff, learners and programmes.

Medium-stakes assessment: One in which results are recorded locally and nationally, but is not life-changing.

Online communication tools: A generic term to refer to asynchronous forms of electronic communication. These include instant messaging, chat, email, blogs, wikis and use of discussion forums in VLEs.

Objective tests: Tests containing questions to which the response can be marked right or wrong without the need for expert human judgement.

Open source: Software applications and components for which the source code of the application is made available to customers so that they can maintain and modify the application themselves.

Optical mark reader: A device that scans paper-based tests and converts marks made by the student using pen or pencil into digital data.

Personalisation: The configuring of a system by students to suit their personal requirements, including more complex customisations of the user experience to meet personal learning needs.

Question and Test Interoperability (QTI): Specification for tests and items which allows these to be authored and delivered on multiple systems interchangeably. It is designed to facilitate interoperability between systems.

Randomised question selection: The selection of individual questions from a predefined set. In e-assessment, randomisation is used to generate alternate test forms from an item bank. It can also be used to alter the sequence in which items are presented to different candidates, or the order of distractors.

Regulatory authority: Government-designated statutory organisations required to establish national standards for qualifications and secure consistent compliance with them.

Service-oriented approach: An approach to the design of applications in which each becomes a 'web service' so that other applications or services can use it.

Simulation: An imitation of a real phenomenon with a set of mathematical formulas and rules in such a way that a student can interact with it – an experimental model of reality.

Technical standards: A publicly available definition of a hardware or software component. For a range of systems to be able to work together and exchange data, they must conform to a set of common technical standards.

Unique learner number: An ongoing English project run by the DfES to provide each learner with a unique identifier in order to improve administration processes. In Scotland, the equivalent is the SCN – Scottish Candidate Number.

Virtual learning environment (VLE): A set of learning and teaching tools based on networked computer resources which provide a focus for students' learning activities and the management and facilitation of those activities, along with the content and resources required to help make the activities successful.

Virtual world scenarios: Scenarios in a computer-simulated environment for users to inhabit and interact with. For further information, see: http://en.wikipedia.org/wiki/Virtual_World

Wiki: A type of website that allows the visitor to easily add, remove, and edit content, making it an effective tool for collaborative authoring. For further information, see: <http://en.wikipedia.org/wiki/Wiki>



Further information

For further information about the organisations, publications, software and products mentioned in this review:

JISC

For further information about JISC www.jisc.ac.uk

For further information about JISC work in e-assessment
www.jisc.ac.uk/assessment.html

JISC publications on e-assessment and e-portfolios

e-Assessment: An overview of JISC activities (JISC, 2006)
www.jisc.ac.uk/uploaded_documents/ACFC6B.pdf

e-Assessment Glossary (JISC/QCA, 2006)
www.jisc.ac.uk/assessment.html

e-Portfolios: What institutions really need to know (JISC, 2006)
www.jisc.ac.uk/uploaded_documents/JISC-BP-ePortfolio-v1-final.pdf

Roadmap for e-Assessment Report for JISC
(Open University, 2006)
www.jisc.ac.uk/assessment.html

JISC services offering guidance on issues related to e-assessment

Cetis – Assessment Special Interest Group
<http://assessment.cetis.ac.uk>

JISC infoNet www.jiscinfonet.ac.uk

JISC Legal Information Service www.jisclegal.ac.uk

Netskills www.netskills.ac.uk

JISC Plagiarism Advisory Service www.jiscpas.ac.uk

JISC Regional Support Centres (RSCs)
www.jisc.ac.uk/whatwedo/services/as_rsc/rsc_home.aspx

TechDis www.techdis.ac.uk

e-Assessment tools and resources funded by JISC

FREMA www.frema.ecs.soton.ac.uk

IBIS www.toia.ac.uk/ibis

OpenMentor <http://openmentor.comp.rgu.ac.uk>

TOIA www.toia.ac.uk

Other tools and software

EasyOCIS www.oldham.ac.uk/easyocis

FirstClass® www.firstclass.com

HP iPAQ Pocket PC
www.hp.com/country/us/en/prodserv/handheld.html

Invigilator Pro
www.farnboroughsfc.ac.uk/invigilator_pro/index.html

JavaScript™ <http://javascript.internet.com>

Macromedia® Authorware®
www.adobe.com/products/authorware

Macromedia® Flash®
www.adobe.com/products/flash/flashpro

Plone™ <http://plone.org>

Questionmark™ Perception™ www.qmark.co.uk

Remark Classic OMR® www.gravic.com/remark

Respondus® www.respondus.com

Perl™ www.perl.org

TRIADS www.derby.ac.uk/assess/newdemo/mainmenu.html

VLEs

Blackboard® www.blackboard.com

Fretwell Downing (now part of Tribal Group plc)
www.fdggroup.co.uk

Moodle™ <http://moodle.org>

Serco (Teknical) Virtual Campus™ www.teknical.com

WebCT® www.webct.com

Qualifications

BA (Hons) Learning, Technology and Research
www3.ultralab.net/projects/ultraversity

BTEC Intermediate and Advanced Award in IT Skills
for Business
www.colegsirgar.ac.uk/english/courses/search?view=647

DiDA <http://dida.edexcel.org.uk>

GCE Moving Image Arts www.ccea.org.uk/movingimagearts

National Unit Assessments www.sqa.org.uk

Specialised Diplomas
www.dfes.gov.uk/14-19/index.cfm?sid=3

UK awarding and regulatory bodies

Assessment and Qualifications Alliance (AQA)
www.aqa.org.uk

City & Guilds Institute www.city-and-guilds.co.uk

Council for the Curriculum Examinations and Assessment
(CCEA) – Northern Ireland www.ccea.org.uk

Department for Education and Lifelong Learning and Skills
(DELLS) – Wales
<http://new.wales.gov.uk/topics/educationandskills>

Edexcel www.edexcel.org.uk

OCR www.ocr.org.uk

Qualifications and Curriculum Authority (QCA) – England
www.qca.org.uk

Scottish Qualifications Authority (SQA) – Scotland
www.sqa.org.uk

Wider initiatives and projects

Accessibility in e-Assessment Guidelines (Edexcel, 2006)
www.techdis.ac.uk/index.php?p=9_1_11

Altered Learning www.alteredlearning.com

BS ISO/IEC 23988:2007
[www.bsi-global.com/en/Standards-and-Publications/
Industry-Sectors/ICT](http://www.bsi-global.com/en/Standards-and-Publications/Industry-Sectors/ICT)

Confidence-based marking www.ucl.ac.uk/lapt

Colleges Open Learning Exchange Group (COLEG) Online
Assessments (COLA) www.coleg.org.uk/coleg

Glow www.glowscotland.org.uk

IMS Question and Test Interoperability (QTI) Standard
www.imsglobal.org/question

Innovation 4 Learning www.i4learn.co.uk

Key Stage 3 ICT www.qca.org.uk/7280.html

Lifelong Learning UK (LLUK) www.lluk.org

National Learning Network (NLN) www.nln.ac.uk

Pass-IT www.pass-it.org.uk

Project e-Scape www.qca.org.uk/14830.html

REAP project www.reap.ac.uk

SCHOLAR <http://scholar.hw.ac.uk>

For further research

Becta www.becta.org.uk

Centre for Recording Achievement (CRA)
www.recordingachievement.org

Harnessing Technology (DfES, 2005)
www.dfes.gov.uk/publications/e-strategy

HEFCE Strategy for e-Learning
www.hefce.ac.uk/pubs/HEFCE/2005/05_12

Higher Education Academy www.heacademy.ac.uk



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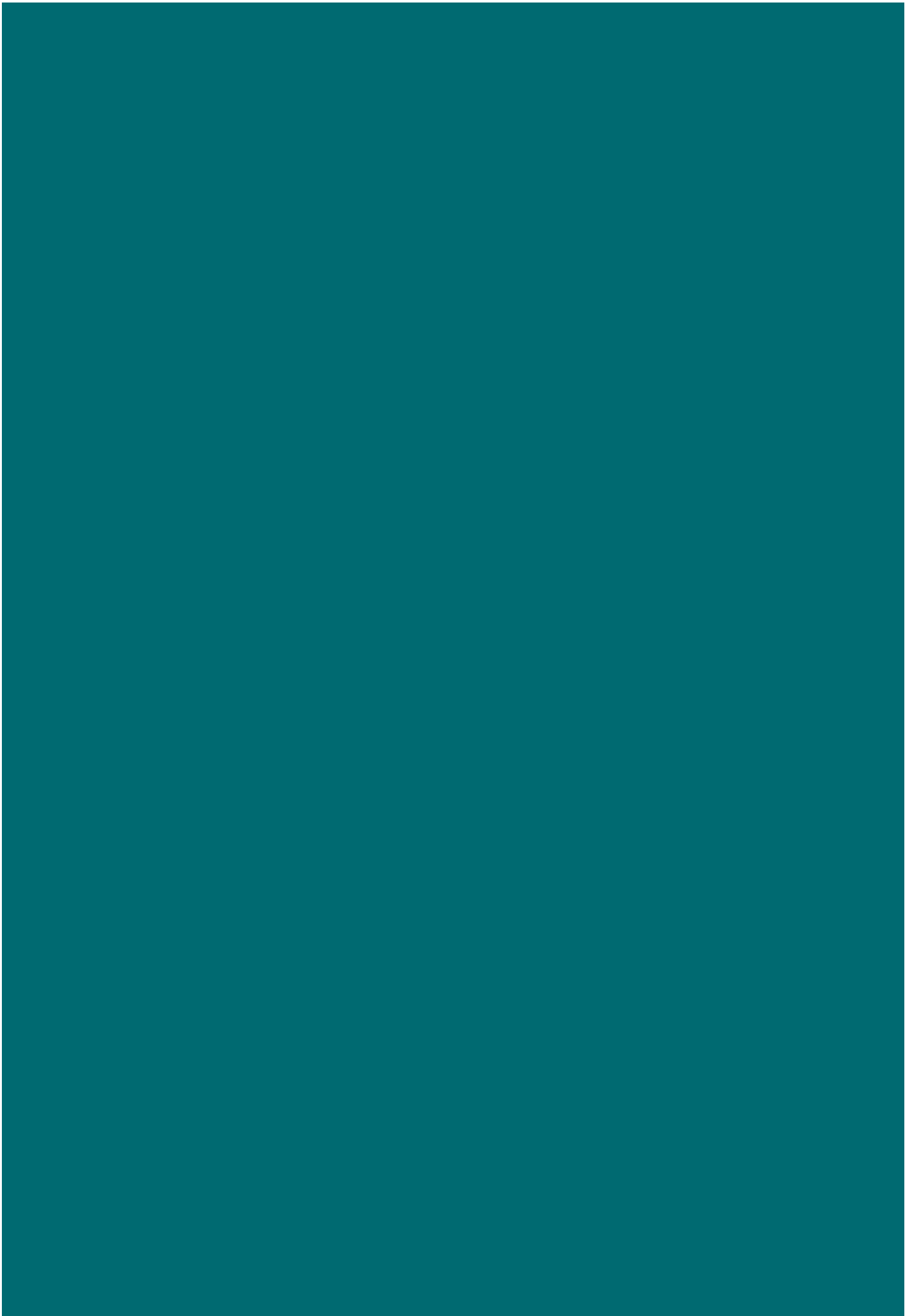
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