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Unfulfilled Promise: formative assessment using computer-aided assessment

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Introduction

'Assessment is one of the most powerful drivers of innovation and change in education, as it defines the goals for both learners and teachers.'
(DfES, 2003, p.32)

Assessment is recognized as probably the most influential factor related to how students learn (Brown & Glasner, 1999), directly linked to effective teaching and learning by rewarding understanding and achievement. Garrison & Anderson state:

'Successful learners most often rely on assessment deadlines and activities to both pace and direct their learning efforts. Effective teachers use assessment activities strategically to motivate learners to engage successfully in productive learning activities.'
(2003, p.95)

The strategic use of assessment as an extrinsic motivator for learning is closely linked with assessment for summative purposes; any assessment forms part of a formative–summative continuum (Brown & Glasner, 1999). At the formative end of the continuum, assessment is regular and provides advice and guidance on progress. At the other end of the continuum is 'end of learning event' assessment. However, assessment can be both formative and summative though it has been argued that over-reliance on assessment as an extrinsic motivator can lead to surface learning approaches (Bull *et al.*, 2002).

Assessment can be used for a variety of reasons, including:

- providing feedback
- grading

- enabling students to correct errors
- motivating students
- consolidating learning
- applying abstract ideas to practical examples
- estimating students' potential
- guiding selection or option choice
- giving staff feedback on how effective their teaching has been
- providing statistics for internal and external uses.

(Brown & Glasner, 1999)

Whilst it is possible to identify varied reasons for assessment, the range of methods deployed remains limited. Brown & Glasner (1999, p.8) claim that 'around 80% of assessments the world over are in the form of exams, essays and reports.' Trehan & Reynolds observe that while:

'examples of critical pedagogies, including those situated online are accumulating, they seldom exhibit corresponding changes in assessment practices'.

(2002, p.280)

A similar observation was made by the author during a recent Association for Learning Technology (ALT) study tour in the Netherlands, looking at innovative uses of e-learning (Calverley *et al.*, 2003). While innovative examples of e-learning were prevalent, assessment practices had changed little.

Providing feedback to students is a valuable part of the learning process and should be ongoing, frequent and comprehensive (Garrison & Anderson, 2003). The traditional practice of formative assessment is text-based feedback, providing advice and guidance on how to improve. But anecdotal evidence suggests that students do not fully exploit this feedback. Elton & Johnston (2002) indicate in their review that students do not take it seriously and are only interested in 'what counts'.

This paper focuses on the use of formative assessment through the deployment of Information and Communication Technology (ICT). Examples are presented and consideration is given to issues that need to be addressed to help fulfil the potential of formative assessment using ICT.

Computer-aided assessment

Computer-aided assessment (CAA) has been increasing within UK higher education, in part driven by the changing higher education environment (increased student numbers, lower unit of resource, modularisation, increased flexibility, etc.). CAA can be used in a wide range of contexts; Bull *et al.* (2002) summarize these as:

- *diagnostic* — ascertaining students' skills levels prior to learning events, i.e. audits
- *formative* — carried out during a learning event
- *summative* — carried out at the end of the learning event.

The common perception of CAA is that of multiple choice questions (MCQs); this approach undoubtedly exploits some of the strengths of using computers, for example providing consistent delivery, immediate grading and feedback and (once the questions are produced) saving time for academic staff. The range of MCQs, or objective question types, has increased markedly. Commercial systems such as Questionmark provide a large number of question types, allowing the integration of images and video, and hence moving beyond the MCQ. Focusing solely on MCQs limits the possibilities of how ICT can be used for formative assessment.

Web technologies provide huge potential for promoting more imaginative applications of CAA. They enable the use of different assessment methods within a range of approaches, including peer-assessment, self-assessment, group-based assessment and objective testing. Assessment methods involving ICT include case studies, mock exams, group projects and the creation of authentic learning tasks (Brown *et al.*, 1999; Peat & Franklin, 2002; Herrington *et al.*, 2002). CAA can encourage collaborative and reflective styles of learning. It is also possible for CAA to be adaptive, in that the outcomes of an assessment can be used to determine further questions or information that the student needs to address. Thus it is possible to guide students through a programme based on their responses at key stages, in a way that is appropriate for their specific learning requirements.

Charman (1999) identifies the following advantages of using CAA for formative assessment:

- repeatability
- immediacy of response to the student — providing a close connection between the activity and the feedback

- immediacy of marks to staff for monitoring and adaptation
- reliability and equitability
- increasing the diversity of assessment
- markers are not influenced by presentation
- timeliness — potential for assessments to be used at the most appropriate time, for example weekly tests
- flexibility of access, especially using the web
- student interest and motivation
- student-centred skills and learning — open access can encourage students to take responsibility for their own learning.

Such advantages do not apply uniformly to all forms and applications of CAA. Potential disadvantages or barriers associated with CAA must also be recognized, such as development time, potential risks (hardware, software and administrative) and the necessity for students to possess appropriate ICT skills and experience.

The changing environment

The higher education environment is continually changing: higher education institutions in many parts of the world are now addressing issues of modularisation, high student numbers and greater diversity in the student population, and the demands faced by many students who combine their studies with employment. Consequently, conventional forms of face-to-face teaching, learning and assessment are unlikely to meet student needs. (A project at the University of Gloucestershire investigating students' use and perception of flexible delivery methods, including online delivery, revealed that students defined as being 'on campus' were in fact travelling considerable distances — in some cases over 100 miles — to attend the University.)

Peat & Franklin (2002) have identified that, coupled with the need for more support, students have higher expectations for quality formative feedback. This is particularly significant as the demands on students make it increasingly difficult for them to attend on-campus sessions in the 'traditional' manner. Pressures on students' time and changing expectations mean they are demanding more immediate feedback. Alternative means of formative assessment (compared with traditional 'text-based' comments on assignments) therefore need to be considered.

Whilst ICT in learning and teaching has become widespread in the UK, it has yet to make a significant impact on changing learning and teaching practices. In an international survey of ICT use, Collis & Wende conclude:

'ICT use ... has become common place but in a way that only gradually is stretching traditional on campus [teaching and learning] practices.'
(2002, p.7)

The UK Government defines e-learning very broadly as 'learning in a way that uses information and communication technologies' (DfES, 2003, p.4). Higher education teachers will be familiar with students using ICT to research assignments using the Internet or online databases, to collect information delivered through their virtual learning environment (VLE) courses, or to engage in online discussions. Yet in the vast majority of cases, students continue to be presented with assessments consisting of essays, exams and reports. This is one reason why the UK Government, in its e-learning consultation document, emphasizes the need to re-align assessment with how students learn (DfES, 2003), and to develop means of formative assessment which provide individualized feedback and recognise the e-oriented skills students acquire through e-learning.

Using CAA for formative assessment: examples and discussion

Table 1 illustrates ways of employing CAA, which are expanded upon in the following sections.

Computer-based formative assessment

Multiple choice questions (MCQs)

Brown *et al.* (1999, p.11) argue that CAA allows students to monitor progress at regular intervals, thus addressing one of the key elements of formative assessment. According to Peat & Franklin:

'Formative computer based assessment can produce improvement in student learning outcomes and this can lead to positive attitudes to learning.'
(Peat & Franklin, 2002, p.516)

Table 1: Forms of computer-aided formative assessment (after O'Reilly, 2001)

Approach	Method	Example Uses
Computer-based assessment (objective testing)	MCQs	Audit of knowledge and skills, with results and feedback immediately available to students and staff Use in class, allowing groups to discuss responses and get immediate feedback To provide a basis for discussion, useful for technical points such as Law
	Case studies	Allows testing of knowledge against authentic task
	Online portfolios	Students maintain their own web pages detailing their development. Also useful for providing feedback to staff
Group-based assessment	Group discussion for assignment preparation	Feedback on work in progress Weblogs
	Case studies	
Peer-assessment	Weblogs	Feedback on reflective journals
	Peer-assessment	Students provide feedback on other students' assignments
Self-assessment	Online mock exams	Allows students to make a comparison against 'exemplar' material
	Audits; MCQs	Allows students to monitor their own progress

Zakrzewski & Bull (1999) demonstrated a significant grade point increase in final results for students who worked through formative tests.

MCQs can provide feedback in a range of contexts. At the University of Gloucestershire, MCQs are used in weekly tests as part of a first year Marketing module (a popular module with over 300 students). Providing formative feedback on this basis using traditional approaches would be prohibitive. The MCQ tests were introduced to provide students with regular feedback on their understanding of the key principles being introduced throughout the module. Eight

tests, each consisting of ten questions, are made available at weekly intervals during the module, delivered via the University's VLE — WebCT. Initial evidence suggests that students have responded positively to receiving feedback in this way. As an added incentive to completing the formative tests, the best five scores contribute to the summative assessment of the module.

The Genetics programme at Wageningen University and Research Centre in the Netherlands uses Questionmark Perception for formative assessment. Weekly tests, linked to lectures and required reading, are made available for formative feedback; these tests are repeated as part of the final examination and account for 10% of the marks. Staff have found that students welcome doing the formative tests and that it frees up staff time to focus on problems.

At the University of Gloucestershire, MCQs have also been used to encourage discussion and understanding, both in class and with online groups. As part of a university-wide study skills module, MCQs are presented to a whole class using a web-based assessment package. They provide a focus for discussion and promoting shared understanding, with students having to justify their choice of answer and if necessary putting it to a vote. In a Local Administration Law module, delivered online, students are presented with a number of MCQs, which are subsequently used as the basis for discussion on the course bulletin board. Students are again encouraged to explain their choices and argue their case with peers. In the first case, the use of MCQs provides the students with immediate feedback on their group decisions, located within their discussions and decision making. In the latter, the use of MCQs provides students with immediate feedback on their choices, allowing them to then engage in an online debate with their peers.

Case studies

The Wageningen University & Research Centre has also utilized MCQs within a Marketing module. Students are presented with a weekly case study on which they are asked a series of questions. This approach tests the students' application of their knowledge against authentic examples, rather than testing recall of key facts (Calverley *et al.*, 2003). The use of MCQs to augment inquiry-based learning has also been successfully used by Honey & Marshall (2003) in nurse education. In a Pathophysiology course students were presented with case studies to help develop their critical thinking skills. Honey & Marshall found that the use of MCQs in this way encouraged active learning, and that students particularly valued the timeliness of the feedback.

Group-based assessment

Collaboration

Online communication facilities can promote peer support, the creation of authentic and applied tasks, and an environment for reflection and continuous engagement in iterative assessment tasks. Iterative and continuous involvement in discussion areas provides a potentially valuable means for students to develop ideas and understanding, and to receive formative feedback from peers and tutors within a safe environment.

A recent development in web-based technology that supports collaborative learning is weblogs (also known as 'blogs'). A blog is a web page containing a series of short frequently updated postings in chronological order, in effect providing a personal publishing tool. This allows individuals to post reflective messages to which peers can then respond, so providing feedback, questioning and so forth — in other words, it can be used as a group tool. Robinson (2003) reports examples where teachers provide information for students to submit assignments and where students provide feedback to each other using weblogs.

Elton & Johnston (2002, p.15) note that 'formative assessment thrives on students' openness, while summative discourages it.' Formative assessment requires students to put forward their initial ideas and understanding for 'critique' and sharing. Students need to be encouraged to make public their ideas and the development of their thinking. Online methods can actively encourage this approach, and at different levels. The use of MCQs provides a more closed environment for students to test their ideas. The use of online discussion areas or online journals exploits the collaborative potential of the web. Research shows that submissions to online discussion areas encourage more reflective contributions (Garrison & Anderson, 2003). Participation is a key component of e-learning — engaging in the sharing of ideas and experiences and recognizing the value of 'exposing' students to the sharing of 'written' ideas. If formative assessment is a continuous process of feedback and support, it does not only have to come from the tutor. Participation can be encouraged through the use of well-designed, authentic tasks; indeed, Garrison & Anderson (2003) believe that education should be a collaborative constructive experience, where understanding is developed in a critical community of inquiry.

Peer-assessment

Involving the student in peer-assessment can encourage motivation, both through students looking at peers' work and knowing their own work will be peer reviewed; this can be a valuable experience, allowing students to measure themselves against others and compare their own assessments with those of their peers. A peer's comments may also have more impact than a tutor's; the author's personal experience suggests that peers can be more critical. Brew (1999) makes a distinction between peer marking and peer feedback, indicating that peer feedback can help focus learning and be positive for a group of learners, whilst peer marking can be disruptive. It is obviously important that the process is managed to ensure consistency; this means ensuring clear criteria and encouraging the students to develop the skills to evaluate and provide feedback.

In an online environment, bulletin boards are used as a medium for the iterative exchange of work to support peer-assessment, providing a forum for social engagement among students and the opportunity for students to test out and explore ideas: 'the ebb and flow of constructive criticism is important for learning' (Robinson, 1999, p.95).

The potential for using online bulletin boards as a forum for personal reflection, combined with collaboration, creates an ideal environment for personal development. Examples of this include the MED in Networked Collaborative Learning run by the University of Sheffield. Here participants working in small groups engage in individual projects and activities, within a larger collaborative group which provides support and guidance. This culminates in a process of peer-assessment and review on the individual projects, prior to final submission (McConnell, 2000).

At the University of Gloucestershire, the module 'Collaborating with Communities' practises community development in its delivery¹. A group online assignment forms part of the assessment for the module and students work in small groups on a negotiated assignment to produce a short report. This requires the students to share ideas, resources and information. Whilst the final report forms part of the overall summative assessment, the process provides a forum for students to collaborate and give each other feedback on their contributions to the completed project.

Self-assessment

Audits

At the University of Gloucestershire, online 'quizzes' are used to assess students' subject knowledge as part of a Primary Science module². A range of tests assessing understanding and knowledge is made available to students as they progress through the module. Students can access the tests whenever they need and they are able to repeat them, obtaining feedback on all their attempts. The rationale behind this approach is to encourage students' confidence and interest in the ideas they will ultimately be teaching in school. In addition, as trainee teachers, they have to provide a portfolio of evidence, and the tests provide them with evidence which can be included. Comments from students highlighted that they welcome feedback in a more flexible way, being able to monitor their own progress as and when they wish. The formative tests also provide grounding for a summative assessment: at the end of the module formative tests are replaced by a summative 'exit' audit, which is completed under exam conditions. This approach provides the students with ongoing feedback whilst also preparing them for summative assessment.

Mock exams

Peat & Franklin (2002) employed a range of approaches in a Biology course, including weekly quizzes, a mock exam (which students could self-mark against web-based information), and the development of self-assessment modules. They believe this approach has led to 'significant benefits for staff and students', allowing more time for face-to-face interaction and providing students with more opportunities to gain valuable feedback at a time to suit them.

Institutional issues

The introduction of online learning requires a significant culture change and investment in staff development over and above the investment in technology. Many academic staff have not experienced any form of online and/or collaborative learning and may be inclined to perpetuate teaching and learning in a form with which they are familiar; likewise, when they were students they probably experienced a limited range of assessment methods (Alexander *et al.*, 2002). Two factors are required to facilitate assessment online: explicit valuing

of collaborative learning in communities; and cultural change in academic communities (Angelo, 1999; O'Reilly, 2001). The utilization of CAA, as with any form of e-learning, must be accompanied by investment in staff development.

The use of CAA does have potential problems: the risks associated with using technology; the assumption of computer skills in students; and the potential for plagiarism. For students there may be feelings of isolation due to lack of face-to-face contact. The impact of these concerns can be reduced, depending on how online assessment is implemented; if the full potential of online learning is used to encourage collaboration, reflection and formative assessment, the feelings of isolation are reduced and 'managed' out of the system. Plagiarism through the use of the Internet is now widely recognized as a serious area of concern in higher education. As a consequence, the Joint Information Systems Committee (JISC) set up the Plagiarism Advisory Service (http://online.northumbria.ac.uk/faculties/art/information_studies/Imri/Jiscpas/site/jiscpas.asp), which focuses on detecting plagiarism in traditional written assignments.

The impact of student profiling must also be considered by universities in the UK; this is recognized in the Department for Education & Skills (DfES) e-learning strategy and coincides with the development of Managed Learning Environments (MLEs). Indeed, as Ryan *et al.* state:

'the movement towards the integration of assessment and teaching applies across all forms of web-based teaching and learning ... the 'electronic record of student activity', or profiling, is also significant The IMS project will lead to the establishment of common standards for such student profiles that will be linked to the student as they move from one piece of courseware to another.'
(2000, p.139)

Conclusions

'Online assessment in the 21st Century has come to mean many things to a range of people in various educational contexts.'
(Northcote, 2002, p.623)

The examples in this paper illustrate the range of methods CAA can bring to formative assessment, and show how they meet some of the advantages identified by Charman (1999). Whilst online assessment provides benefit to students, teachers and administrators, it also brings challenges and potential risks, thus it demands to be managed and invested in appropriately.

Does introducing online formative assessment improve outcomes, i.e. raise student marks? There is mixed research on this; Peat & Franklin (2002) show that it did not raise outcomes and Charman (1999) cites examples where evidence is inconclusive, yet Zakrzewski & Bull (1999) provide evidence that it does. In this paper I have attempted to provide examples showing that online formative assessment can bring benefits in terms of flexibility and immediacy of feedback. However, introducing online learning on its own will not produce results; Alexander & McKenzie (1998) and Laurillard (2002) emphasize that it is also necessary to change the assessment. Without this culture change and recognition that CAA is more than MCQ then there will be unfulfilled promise.

Notes

1. This case study is one of the Learning Environment and Pedagogy (LEAP) Case Studies on the LTSN Generic Centre web site and can be viewed in full at: <http://www.ltsn.ac.uk/genericcentre/index.asp?docid=18375>.
2. This case study is one of the Learning Environment and Pedagogy (LEAP) Case Studies on the LTSN Generic Centre web site and can be viewed in full at: <http://www.ltsn.ac.uk/genericcentre/index.asp?docid=18375>.

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