



Case study 4: Designing interactive assessments to promote independent learning

The Open University

What this case study covers

- **Subject, mode and level:** Introductory undergraduate course in interdisciplinary science delivered via distance learning
- **Assessment topic:** Interactive computer-assisted assessment with multiple levels of feedback
- **Technologies:** Moodle™; OpenMark, a computer-assisted assessment system developed at The Open University; free-text question marking software from Intelligent Assessment Technologies Ltd (IAT)

Background

The Centre for Open Learning of Mathematics, Science, Computing and Technology (COLMSCT) at the Open University has spearheaded an initiative to embed the use of interactive computer-marked assessments (iCMAs) in the Open University's distance learning courses.

S104: Exploring science is one of a range of Open University courses benefitting from the use of iCMAs. As a level 1 course, S104 includes elements of physics, chemistry, earth science and biology and aims to establish the basic principles of science for a range of students – those planning a degree course in a scientific discipline as well as those seeking a general interest course. The course attracts a high number of enrolments and has an assessment framework of eight low-stakes iCMAs, seven tutor-marked assignments and a synoptic assessment.

Rationale

Assessment and feedback strategies that encourage time spent on task and lead to productive learning activities have been proposed by Gibbs and Simpson (2004) as two of the 11 conditions under which assessment can support learning. Formative assessments with interactive features that can be accessed online at times and in places convenient to learners meet the first of these conditions. If the design of the assessment also provides immediate feedback at a level that matches learners' needs, with the option of multiple attempts if questions are answered incorrectly, the assessment acquires still greater potential as a driver of productive learning.

However, the feedback learners receive needs to be of a high quality to enable learners to take further action, whatever their current level of understanding. Therefore, feedback must:

- Be helpful, detailed and appropriate to learners' current understanding
- Provide more detail with each failed attempt
- Identify a means of rectifying errors
- Invite an active response

In a distance learning context, it is especially important that these design criteria are met; learners enrolling on foundation level distance learning courses have limited prior experience of study and may not have developed skills for independent study.

Transforming assessment practice

As a result, the Open University places high value on the interactivity of its learning and assessment resources and on the immediacy and responsiveness of the feedback that learners receive. The Open University's OpenMark assessment system, which supports the development and use of iCMAs matches students' answers with predicted responses, assesses whether answers are right or wrong and then gives appropriate feedback, directing students to relevant aspects of their course materials if an answer is incorrect.

Students receive feedback immediately after each attempt – the timeliness of feedback is crucial to successful learning – and both question and answer are visible on one screen to allow students to make connections between these elements. (A full explanation is given only when a correct response has been made or when there have been too many incorrect attempts.) Correct responses at the first attempt score 100%, with lower percentages awarded for correct responses at the second or third attempt.


To build confidence and lay down skills for effective lifelong learning, question design also ensures that students work out the answers for themselves using knowledge derived from course materials; selecting items from a list of uncontextualised multiple-choice options is discouraged. Instead, students are engaged in an *interaction* with the question which extends learning rather than merely checking what the student does or does not know.

iCMAs can also play a diagnostic role. A pre-course test, Are you ready for Level 1 Science? draws on the bank of questions developed between 2007 and 2008 for S104 and other level 1 science courses to help students establish whether they have the necessary underpinning skills to embark on the S104 course. The approach taken in the test is designed to encourage and assist rather than frustrate learning – students at an early point in their studies need to gain experience of working in an online environment and to enjoy the process of learning, but also have to test for themselves whether they are making the right choice.

The development of iCMAs for the S104 course has not diminished the importance of tutor-marked assignments; online assessments complement rather than replace traditional methods of assessment, producing a mixed assessment strategy in which eight iCMAs, each containing ten questions, operate in a summative but low-stakes capacity alongside seven tutor-marked assignments. At the end of the course, a synoptic written assignment is matched with a longer iCMA to assess the full breadth of knowledge that the course covers.

The iCMAs used on S104 are intended primarily as tools for formative assessment. However, data on students' use of the iCMAs suggests that they engage more fully if iCMAs carry credits. Therefore, a low weighting has been applied to each iCMA. However, because it is impossible to invigilate tests or authenticate the outcomes as the student's own unaided work, the iCMAs are low-stakes assessments, typically representing a small proportion of the marks given to tutor-marked assignments.

The photograph shows an outcrop of granite near Land's End in Cornwall (UK). How is an igneous rock with large crystals (such as this granite) formed?



they are formed from molten magma

Check

Your answer still does not appear to be correct.

You are on the right lines. Igneous rocks are indeed formed from molten magma. But you need to think about what must happen to the magma in order for an igneous rock to be formed. Then think about what you can deduce from the large crystals visible in the photograph. See Block 3 Section 9.2 and Block 10 Section 5.1.1.

Try again

An iCMA question of the type used in S104

Each OpenMark question for the S104 course is produced by an academic member of the course team, implemented by a media developer and checked by both the academic author and an experienced consultant. iCMAs designed to support more discursive aspects of the course – for example the question on geology shown above – now support free-text answers of around 20 words in length. The answer matching for these questions is written by a member of a course team using an authoring tool developed by Intelligent Assessment Technologies (IAT) integrated into the OpenMark system. (IAT uses computational linguistics to compare student responses against the set of predicted responses.) In these cases, each student response is sent from the OpenMark server to an IAT server in order to verify it and trigger appropriate feedback.

However, trials in 2009 have shown OpenMark's answer-matching capability in short-answer free-text questions to be on a par with both the IAT system and human markers. As a result, questions requiring free-text answers that are currently supported by the IAT software will migrate to OpenMark from 2010.

Lessons learnt

Producing interactive assessments with high-quality feedback is a time-consuming and complex process for which a sound business case must be made. To function well, questions must support a range of ability levels and play a confidence-building role while still communicating course expectations to learners. Subject and technical expertise need to be combined with question and feedback authoring skills and each question must be rigorously tested for impact, usability and accessibility if it is to be employed for summative purposes.

Although individual tutors at the Open University can produce iCMAs (authoring tools are being made available within Moodle for this purpose), the university's Learning and Teaching Solutions Unit is involved in the development of most iCMAs used on Open University courses. This situation is likely to change as the benefits of iCMAs become more widely recognised, but iCMAs for summative purposes will still require rigorous checking by expert authors.

Advantages gained

iCMAs offer learners a range of benefits:

- Opportunities to assess progress and understanding anytime, anywhere

- Instantaneous feedback to correct misconceptions and build confidence
- A variety of approaches and formats to sustain interest and encourage time spent on task
- Multiple attempts at a question to reinforce and deepen understanding
- Opportunities to obtain feedback that is responsive to individual needs

For academic and administrative staff, the advantages include:

- Easier tracking of students' progress in very large groups
- Reduction in the burden of marking
- Development of a bank of reusable tests
- Increased administrative efficiency if links are possible with other online systems such as student records

Most importantly, the S104 iCMAs enable students to see immediately how they are progressing and give tutors an insight into what students find difficult. Tutors follow their tutees' progress through the tests by automatically generated reports that are stored in Gradebook in Moodle; evidence of widespread difficulty feeds into a redesign of those parts of the curriculum.

Key points for effective practice

- **Online formative assessments with differentiated feedback increase the capacity to learn independently**
- **Interactivity in assessment design prompts deeper and more active learning**

Learner perspective

'I enjoy the challenge of the iCMAs and particularly like knowing instantly whether I am right or wrong. I found these very useful in highlighting weaknesses that require further study.' Student, S104: Exploring science

Tutor perspective

'One of the best innovations of S104 is the interactive computer-marked assignment (iCMA). I was sceptical of them at first but they are nothing like the multiple-choice questions of older-type CMAs. Students can give their own answers in their own words and the careful feedback for incorrect answers helps them to see where they have gone wrong and to try again. Even though each iCMA is worth very little towards the course grade, my students take them just as seriously as tutor-marked assignments. This is a great example of how online assessment can aid learning.' Tutor, S104: Exploring science

'The data locked up in students' answers cannot be argued with. It is incredibly powerful feedback for teachers on the success of their teaching.' Sally Jordan, COLMSCT Teaching Fellow and Co-Chair of S104: Exploring science

References

Gibbs, G. & Simpson, C. (2004) [Conditions under which assessment supports students' learning](#), *Learning and Teaching in Higher Education*, 1, pp. 3–31

Key words

Interactive computer-assisted assessment, feedback, formative assessment

Further reading

COLMSCT (2009) ['Development of online interactive assessment for S104: Exploring Science and other level 1 courses'](#)

Jordan, S., Brockbank, B. & Butcher, P. (2007) [Extending the pedagogic role of online, interactive assessment](#)

JISC (2009) [Review of Advanced e-Assessment Techniques \(RAeAT\) Final Report](#)

JISC (2009) [Short Answer Marking Engines](#) pp. 7–11

Links

COLMSCT, [E-assessment for learning – The iCMA initiative](#)

[eAssessment at the Open University with open source software](#) (a Moodle site describing and demonstrating how the Open University is adding OpenMark features to Moodle)

[S104: Exploring Science](#)

The Open University [Centre for Open Learning of Mathematics, Science, Computing and Technology \(COLMSCT\)](#)

Further information

OpenMark is an open source product compatible with Microsoft® Internet Explorer® and Mozilla Firefox®, and with Moodle™. The Open University adopted Moodle as its VLE in 2006.

Reflect and discuss

What policies are applied in your context to ensure that formative assessment provides feedback that is tailored to students' needs and enables students to self-correct?

See also: JISC Innovative Practice with e-Learning video case study, University of Strathclyde [Active collaborative learning](#) and a podcast by [Dr Helen Ashton](#), SCHOLAR programme, Heriot-Watt University