INTEGRATED COMPUTER-ASSISTED ASSESSMENT

Susan Watts

Integrated computer-assisted assessment

Susan Watts
Computer-Assisted Assessment Evaluation and Survey Service (CAAESS)
Kingston University
Kingston
KT1 2EE
s.watts@kingston.ac.uk
Telephone: 0208 547 7873
Fax: 0208 547 7497

Abstract

This paper gives an overview view of an integrated computer-assisted assessment system which is being developed from a proven Optical Mark Reader-based activity. Over 20,000 summative and formative tests are administered *per annum* at Kingston University using an OMR system. A new web-based system is being piloted alongside the assessment module in the Blackboard learning management system which is currently being implemented across the university.

The focus for the system is the question bank where objective questions are stored and manipulated. Tests may be set up in the bank in formats which are easily transferred for web-based or paper-based OMR assessment. The software incorporates a range of question styles and allows straightforward cutting and pasting of, for example, chemical structures from ISIS Draw and equations from Word.

The web-based, interactive assessment module will be used primarily for formative assessment and will be complementary to the existing OMR-based activity. Interactive assessment may be used to provide feedback for self-testing if required but a unique feature of the new software is the optional use of a confidence scale which allows students to indicate how sure they are of their responses. The confidence scale particularly addresses issues of mis-information and guessing as well as gender bias.

Assessment results are manipulated in the statistical analysis module. Reports and analyses are made available in electronic or paper versions as required and are also transferred back to the question bank archive both of which assist in the monitoring of question and student performance.

This integrated approach draws on existing resources and extends the possibilities for computer-assisted assessment across the university. It also
has the potential to enhance learning through the assessment process.

Background

At Kingston a strong emphasis has been given to question design for computer-assisted assessment (Rolls and Watts,1998) and much time has been invested in devising challenging questions. It is important that any developments in the delivery of automated assessment allow the re-use and adaptation of existing questions for which a statistical history is available. Similarly, it should be possible to use a range of question types comparable with those already in use and ideally offer increased functionality for computer-assisted assessment. Essentially, a web-based system needs to complement existing resources for computer-assisted assessment and enhance the assessment and learning process.

Computer-assisted assessment based on an Optical Mark Reader was introduced in the Faculty of Science at Kingston University in 1992-3. With the increase in student numbers and the introduction of a modular degree scheme, the OMR system is now used across the University to administer more than 20,000 formative and summative tests a year.

There has been some limited use of interactive testing in the past but the current implementation of the Blackboard learning management system across the university has given impetus to use interactive assessment more widely. To complement the assessment module in Blackboard, it is planned to evaluate other web-delivered assessment systems among which is the system described in this paper.

Integrated computer-assisted assessment

Figure 1: Integrated computer-assisted assessment
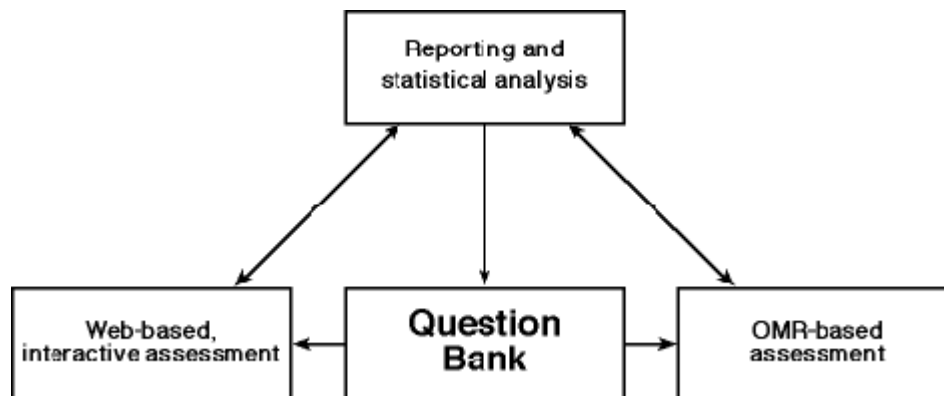
Question bank

The question bank is the focus of the system where questions are stored and manipulated. Questions may be collated and printed for paper-based, multiple choice question and short answer tests; transferred to the Blackboard assessment module or to another web-based system from the question bank for interactive testing.

The question bank module has been used to compile a question bank over the past year and now holds approximately 1200 questions with over 60% relating to chemistry, maths and life sciences. At the present time the question bank is maintained and controlled by the administrator.

Questions are stored in a hierarchy of separate banks determined by the administrator. The software incorporates a range of question types. Questions and diagrams may be imported electronically or input directly as well as through straightforward cutting and pasting of, for example, chemical structures from ISIS Draw and equations from Word.

OMR-based assessment

This part of the system has been in use for several years and is widely used for formative and summative assessment mainly at Levels 1 and 2 and in some cases up to Level 3 of degree courses.

Machine-readable forms are completed by the students and scanned by the OMR. A variety of reports may be printed or downloaded through the software as described below.

Web-based, interactive assessment

The web-based system that is being piloted integrates with the current OMR software. It is IMS (Instructional Management Systems) and QTI (Question and Test Operability) compliant and will run on any Perl enabled web server.

This part of the system will complement the existing substantial OMR activity and also the assessment module in Blackboard. For the time being, the system will be used for formative testing with small groups (<50) of students or where simultaneous testing of large groups is not required.

Increasingly diagnostic tests are carried out in the first semester at Level 1 and it is planned to use on-line testing to identify students' prior knowledge.

There is clearly a need for the facility to provide self-testing for students so that they

may evaluate their progress and understanding. If they know *why* a response is incorrect or correct rather than just knowing if it is wrong or right it will arguably enhance their learning (Zakrzewski,1999).

A unique feature of this web-based system is the option to ask students to indicate on a 5 point scale how sure they are of the response they have selected. Self Assessment Computer Analyzed Testing (SACAT) addresses the problem of certainty of knowledge in objective testing and gives a measure of whether the student is informed or misinformed when answering the question (Hunt, 1982; Hassém and Hunt, 1994). If for example, a student gives the incorrect response to a question but indicates that they are 'very' or 'extremely sure' that the answer given is correct then the student is misinformed. Asking students to indicate their certainty of answers addresses not only misinformation but will give more cautious candidates credit and will tend to discourage guessing as a strategy for answering objective questions which, among other things, is considered to be affected by gender and cultural background (Gafni and Melamed, 1994; Hassém and Hunt,1997).

Individual students may be provided with a self assessment (SA) feedback report which will help them to identify areas of weakness in their subject knowledge or understanding and flag areas of their learning that need attention. From the teaching point of view, SACAT gives a useful indication as to where there may be a lack of understanding of subject matter on the part of students.

By giving students the opportunity to assess their understanding through SACAT and with self-testing, students receive feedback on progress; help in learning and an opportunity for active learning. Such approaches are identified by McDowell (1995) as encouraging deep approaches to learning and addressing student diversity.

Statistical analysis

Scoring is set up in this module which allows different weighting for questions to be applied and for marking of sub-tests if required. The statistical analysis module manipulates the test data for the output of reports and analyses for both OMR and web-based assessments and output is either in hard copy or in electronic format. Analyses may also be transferred electronically to the question bank for monitoring individual question performance in a given test.

Reports on student's scores may be arranged by student name and ID number as well as by rank Overall test statistics include the mean, standard deviation and the Kuder-Richardson test (KR20) which is a measure of overall test reliability. An audit report showing each student's response to each question .
and an item analysis report containing the statistical analyses are also available.

The item analyses include: point biserial correlation coefficient (PBCC); 33% item discrimination; question facility and answer frequency. A very useful indicator of

question performance is the histogram signifying the relative performance of each of the 20 percentile groups of students

The item analysis report assists in the quality assurance process. Over time it has been possible to encourage question authors to further improve questions by reviewing the statistical feedback that is received. Similarly, those new to question design and who have asked for their questions to be edited are greatly encouraged by the feedback on question performance as indicated by the statistical reports.

When selecting questions for a test, the item statistics held in the question bank indicate how a question has previously performed and whether modifications might be appropriate before a question is used again.

Conclusion

From a practical point of view, the system currently being piloted offers a realistic opportunity to provide an integrated computer-assisted assessment facility which minimises effort in administering objective tests in whatever format is appropriate for a given assessment and group of students. The implementation of such a system will also utilise the existing investment in question authoring and make the best use of limited resources. Such an integrated system will also serve to maximise the potential benefits of computer-assisted assessment in the learning and assessment process.

References

Gafni, N. and Melamed, E. (1994). Differential tendencies to guess as a function of gender and lingual-cultural reference group. *Studies in Educational Evaluation* **20** 309-319.

Hassém, P. and Hunt, D. (1997). *What it means to know something.* Stockholm, Stockholm University. (Department of Psychology report, 835)

Hassém, P. and Hunt, D. (1994). Human self assessment in multiple choice testing. *Journal of Educational Measurement* **31** 149-160.

Hunt, D. (1982). Effects of human self-assessment responding on learning. *Journal of Applied Psychology* **67** 75-82.

McDowell, L. (1995). Effective teaching and learning on foundation and access courses in engineering, science and technology. *European Journal of Engineering Education* **20** 417-425

Rolls, D. and Watts, S. (1998). *Objective question design.* Kingston, Kingston University.

Zakrzewski, S. (1999). *A structured approach to mass implementation of computer-based assessment (CBA*) **in** Brown, S. *et al* Computer-assisted assessment in Higher education*. London, Kogan Page.*

The software suite described is commercially available from Speedwell Computing Ltd of Northampton   and includes: Multiquest   (OMR paper-based examination and statistical analysis software); General Purpose Question Bank (to manage the question bank and statistics for Multiquest and WebEx) and WebEx (the web-based, interactive testing system).