Matching Assessment to Learning

Workshop held on 30 May 2001 at the University of Birmingham

Report prepared by Cliff Beevers and Pam Bishop

In a recent survey the generic Learning and Teaching Support Network for the UK Higher Education community asked all subject centres to articulate the three most important issues on assessment in their subject. The LTSN Maths, Stats & OR Network responded as follows:

1. Issues in computer-aided assessment that include reliability, robustness and ease of use. It should also apply to both formative and summative assessment in the forms of diagnostic, continuous and formal testing.

2. The need to match appropriate assessment methods to learning outcomes for knowledge, basic skills, understanding and problem solving.

3. Coursework and assignments make heavy demands on staff time with regard to submission, marking, monitoring and feedback. In Statistics and Operational Research, project work is very extensive and has special assessment issues including comparability between different types of project and linking project work to the remainder of the curriculum.

Computer Aided Assessment has had much attention in the recent past so the May 2001 Workshop set out to consider the issues surrounding 2 and 3 above.

Relating assessment theory to practice *

In the first session Cliff Beevers and Jane Paterson of Heriot-Watt University sought to relate assessment theory to practice in Mathematics. They considered some educational jargon, discussed key and subject specific skills together with the higher order cognitive skills of analysis, synthesis and evaluation. Some educational theories of assessment were presented with particular emphasis on those of Gagne, Miller, Schoenfeld, Polya and Skinner. The talk concluded with a short description of how the formative assessment policy had been determined for an on-line project called SCHOLAR (see http://scholar.hw.ac.uk). Following a successful pilot year the SCHOLAR Project is delivering the new Advanced Higher programme to over 70% of Scottish schools in the next academic year. Finally, mention was made of the Scottish Centre for Research into On-Line Learning and Assessment (SCROLLA: see http://www.scrolla.ac.uk) which seeks to establish some research infrastructure in this new and exciting delivery medium.

Assessing project work *

The second session was a workshop on assessment of project work led by Peter Holmes of Nottingham Trent University. There were six homogeneous groups of participants - those from pure mathematics, those from statistics, those from applied mathematics and 'others'. Each group worked on devising a piece of project work that would be suitable for a particular set of students in their area of mathematics. They considered the social context (was the project to be done as an individual assignment or as a group), the purpose of the project (what were the students expected to learn through this project experience), the process of organising the project work in the teaching and finally the ways of assessment that would be appropriate for testing the particular qualities that were meant to be developed. At the end of the session there was a reporting back period where different ideas of assessment were shared. There were warnings about passengers in group assessments and wytiwyg (what you test is what you get).

* **Slides, assessment tools and other resources from this workshop can be found via http://ltsn.mathstore.ac.uk/workshops/assess2001**

Appropriate assessment of key/core skills

In the first session after lunch Ken Houston from the University of Ulster described how he has embedded key skills within the first year undergraduate curriculum. Key skills have been defined by Dearing, by the QCA and by Edexel, but when summarised as Reading, Writing, Speaking, Thinking, Questioning, Criticising, Discussing and Explaining it is clear that they can be taught and assessed within a discipline. Several assessment tactics were discussed, based on an "apprenticeship" model for the learning "process", ie observe how "professionals" do it and create learning situations in which students do the same things.

A programme of student seminars will help a student group to acquire knowledge which already exists. An individual or a sub-group reads published material, and possibly interrogates those with the knowledge. They "make this their own", and then share it with the whole group, possibly through written notes, or at a seminar presentation, or both. Key skills required here are Learning how to learn, Reading, Writing, Oral presentations, Using C&IT and Working with others.

Student project work will help a group to acquire new knowledge. An individual or a sub-group investigates, and then shares it with the whole group, as before. This tests the additional Key Skill of Problem solving.

Comprehension tests will encourage critical reading. While reading a given article and preparing for a written test, various questions that relate to the modelling process should be borne in mind such as

- What modelling assumptions have the authors made?
- Would you be happy to make these assumptions or would you make others?
- Can you follow the mathematics through from line to line? Have the authors made any mistakes?
- Have the authors attempted to validate the model by comparing with observations? If not can you suggest experiments that could be carried out?
- Do the authors draw valid inferences and conclusions from the work?

Using ICT in an examination rather than through coursework - colleagues at Ulster have been holding written examinations in a laboratory where students have ready access to their usual mathematical software (Excel and Maple) which they use to help answer the questions.

Standard assessment criteria for a "good" written report, a "good" oral presentation, a "good" poster, and "good" problem solving can be built into assessment tools.*

Assessment of the learning process as well as its products can be done through confidential self and peer assessment of group work.

Non-traditional Assessment of Understanding Outcomes *

The next session considered Non-traditional Assessment of Understanding Outcomes at the Open University presented by Judy Ekins. Judy explained that several years ago, the Open University replaced its level one mathematics foundation course and two mathematics service courses for science and technology, by an entry suite of courses. The first of these, Open Mathematics (code MU120), aimed to be very accessible. Because many mature students are weary of examinations, it was decided to have a consolidation end-of-course assessment instead. The structure of the assessment was:

- formative assessment on the preparatory material for the course;
- continuous assessment during the course; and
- end-of-course assessment.

Students needed to pass both the continuous assessment and the end-of-course assessment. Devising the end-of-course assessment for the first OU level one course without an examination was a challenge. Something to encourage consolidation of the knowledge and skills developed during the course, a fair assessment of the course outcomes and yet manageable for staff was wanted.

The course covers quite a range of mathematical and statistical topics all introduced via an everyday context e.g. prices, earnings, health, music and movement. Each unit has outcomes and there are course outcomes. Assessment is attempted for both the technical knowledge and skills and the key skills, which are embedded in the course. It is hoped that students are able to demonstrate what they have learned and because of this each end-of-course assignment will be very personal to the student.

The University rules on non- examination end-of-course assessments, which were designed for higher level project courses, have to be satisfied. So students have to make a plan of what they intend to do and discuss it with their tutor, who is asked later to verify that it is the student's work. If the tutor does not feel that they can verify a student's work, then the student has a viva voce examination for verification. There is also a multiple choice (computer marked) assignment to try to assess

specific knowledge, techniques and skills, from the whole course. In order to encourage consolidation of strands, which run throughout the course one question asking for a reflective account of progress in one (out of three or four) aspects of the course is posed. This gives the students the flexibility to show what they have achieved. For the other questions they have a choice of topics. In most of these questions the students are asked to choose one piece of work which demonstrates their understanding of the topic. Their understanding of the topic is supported by reference to the chosen piece of work and the rest of the course, including at least two other uses of the concept from different parts of MU120. Hence, the course outcomes rather than a string of unit outcomes are assessed. One option is to write a program and associated documentation for the course graphics calculator. It too requires students to integrate skills and knowledge from different parts of the course. The marking criteria are: demonstration of mathematical achievement, relevance, accuracy and presentation. In this way key skills as well as mathematical ones are being tested.

The range of examples chosen by students is great: activities from course units (perhaps using supplied activity sheets), part of a tutor-marked assignment or a computer marked assignment, handbook notes (which they are encouraged to build up throughout the course). Achieving consistency in marking, across about 50 markers (volunteer tutors) and 2000 scripts is difficult. Extensive marker notes and examples of marking early scripts are produced. All markers mark the same three photocopied scripts and receive feedback. The Examination and Assessment Board monitor a sample of all markers' scripts and re-mark all borderline scripts. All of this is more time-consuming than marking an examination. However, 25% of students surveyed say that the absence of an exam was a major factor in their course choice. The reflective account of progress through the course also enables tutors to verify student's work more easily and discourages plagiarism. In the verification vivas no cases of plagiarism have been encountered.

Personal Development Planning (PDP) and Peer Group Assessment*

In the final session John Gillespie from the Centre for Developing and Evaluating Lifelong Learning, School of Education at Nottingham University described the role of personal development plans in the assessment of students. PDP can help students to enhance strengths and remedy weaknesses, to monitor and review their own progress and to be prepared for seeking and succeeding in employment.

It should also help academic staff and departments to improve the quality and effectiveness of personal tutoring systems, academic support and guidance systems, monitoring of student progress and the recording of career-related skills and capabilities. It also provides meaningful evidence for employment references and quality of support in external review processes.

A personal tutoring system such as the Personal and Academic Record used at Nottingham is only one element of PDP. Others include purpose designed modules, individual and group projects, research projects and dissertations, work placements / experience, extra curricular activities and paper based or electronic logs.

It is worth noting that many employers welcome graduates who have developed key skills and can show evidence in support. Peer group assessment can help to develop these skills by aiding reflection and self-analysis, increasing understanding of group work, taking consequences of actions in teams, accepting reasons for others' judgements, and developing the ability to assess against criteria.

A round-up session attempted to draw some threads together from the day's activities. The following ideas emerged:

There was a feeling that today's students are driven more by assessment and that the willingness to learn needs to return to the process of learning. It was suggested that the role of the computer should be in the learning process and leave the humans to do the assessing though this was disputed. It was noted that from the QAA reports there was a 40% failure in the assessment process in Mathematics Departments. This suggested that there was a need for a Staff Development approach in this area. As a community we should be sure not to miss the core job of assessment before going to trendier ways in the delivery of tests. At this point it was proposed that a look at traditional examinations might be a useful exercise and that there was scope for the sharing of resources in assessment beyond collaborations in computer-aided assessment. The discussions concluded with the observation that further pressures on the curriculum were now evident through the introduction of, for example, entrepreneurial skills.

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