Workshop and Conference Reports

Assessment for a Purpose

Sheffield Hallam University, 15 May 2002 - Report on workshop prepared by Pam Bishop

When the LTSN Generic Centre asked all subject centres to articulate the three most important issues on assessment in their subject the LTSN Maths, Stats & OR Network included the need to match appropriate assessment methods to learning outcomes for knowledge, basic skills, understanding and problem solving. This was the second workshop to address these issues.

*1. Measuring Attributes in Statistics**
Peter Holmes, Nottingham Trent University

Peter summarised some weaknesses in current assessment practice: tasks may not match stated outcomes; criteria may not match tasks or outcomes; criteria may not be known to students, or they may not understand them; overuse of one mode of assessment; overload of students and staff; unduly specific criteria which create a straitjacket; inadequate or superficial feedback (from Brown, G (2001) *Assessment: A guide for lecturers*)

Assessment has many purposes but fundamentally it should be to ensure that students have learned and can apply what they have learned. As we have to link learning outcomes to assessment, the outcomes will be worded in terms of how we assess. If there are things we can't assess, we can't put them in an outcome, and don't have them as an expressed aim of our teaching. In statistics, even at school level, we would want students to be able to carry out each aspect of the handling data cycle to solve problems:

- specify the problem; formulate questions; decide on data; what analysis to do; consider inferences
- collect or obtain the necessary data by appropriate survey, experiment or from secondary sources
- process and represent data; turn data into useable form
- synthesise information and interpret results

The vocabulary of learning outcomes is limited to active verbs that are capable of being interpreted objectively. This precludes the use of words like "understand", "appreciate", "discover" or even "think". This is not necessarily a good thing; there are ideas behind these words which are worth trying to tease out into learning outcomes. Peter suggested a hierarchy of words, culled from various sources and based on Bloom's taxonomy of levels of understanding. He matched these with some relevant assessment modes in the following table:

Level of understanding	Active verbs that can be used in learning outcomes	Relevant assessment modes
Knowledge	Define. State. List. Recognise. Show. Label. Name. Identify.	Quiz. Part exam question.
Comprehension	Explain. Clarify. Discuss. Review. Describe. Recognise.	Multi choice. Assignment. Exam
Application	Demonstrate. Use. Calculate. Estimate. Fit. Implement.	Coursework. Apply specific techniques to particular problem.
Analysis	Investigate. Solve. Interpret. Explore. Analyse. Explain. Compare. Contrast.	Analyse a data set. Oral presentation. Case studies. Analyse computer output.
Synthesis	Design. Formulate. Model. Improve. Adapt. Develop. Construct. Devise. Combine.	Design and carry out an investigation. Prepare a report & present. Essay. Open ended questions.
Evaluation	Assess. Criticise. Contrast. Review. Distinguish.	Critically assess others' projects. Defend own presentation.

2. Making the punishment fit the crime* - Neil Challis, Sheffield Hallam University *(with co-workers Harry Gretton and Jeff Waldock)*

The talk began by drawing attention to the confusing contrast between the education-speak of learning outcomes, assessment criteria and programme specifications, and the everyday world of diminishing resources, pressures to reduce time for contact and marking, many students motivated only by assessment, claims of over-assessment, and so on. The task is to reconcile all this by designing assessment which gives feedback and supports learning, encourages a deeper approach to learning, and measures what we say we want students to have learnt.

The Mathematics degree programme at Sheffield Hallam was presented as an example of addressing the various dilemmas arising out of the points above. Overall the programme uses a range of assessment mechanisms to match the wide range of learning outcomes which are desired. The list includes examinations (open book or part open book, with any hand-held technology, some with a PC available as a tool, some with the exam carried out on PC, and a computer file handed in, some multiple choice tests) and continuous assessment (standard mathematical skills coursework and mini-tests, modelling reports and case studies, comparative technology reports, a modelling portfolio and a skills portfolio (both electronic and on paper).

All students do a final year project. In this talk one particular aspect was discussed: the skills portfolio. Learning outcomes like "work collaboratively with peers, discussing mathematical work as required" do not lend themselves to assessment by traditional means, and so they are assessed by a portfolio of skills work, integrated with the other work of the unit, with evidence drawn from all modules across the students' programme of work. Points of note around this include the following:

- The skills portfolio is developing into a progress file.
- Skills work and contributions to the portfolio continue across all years of the course, including the placement year, culminating in project and professional studies work in the final year.
- There was particular interest in the fact that some aspects of the portfolio are electronic and online, with students gathering a range of their work on their own web page, together with online CV, comments, and regular contributions to an online learning diary. This exciting development will be the subject of a publication in the future.

3. Teaching, Learning and Assessment* Ros Sutherland, InterActive Education Project, University of Bristol

The overall aim of the InterActive Education project is to examine the ways in which new technologies can be used in educational settings to enhance learning. The project centres around subject design initiatives which are characterised by:

- teacher and researcher working in partnership to develop a learning initiative focused on a particular area of the curriculum
- use of diagnostic assessment as an analytical tool for reflecting on teaching and learning
- use of video of classroom processes as an analytical tool for reflecting on teaching and learning
- teachers supporting pupils to focus their attention on the object of learning

Learning geometry with Cabri is a study in inner-city primary school with 10-11 year old pupils in partnership with teacher Pat Peel. The aim is to teach 10-11 year old pupils to recognise particular polygons, to characterise geometrical shapes by their properties and to classify geometrical shapes by their properties. Before the project the majority of pupils could recognise and name a square, rectangle, parallelogram, rhombus or kite, but could not recognise a trapezium or articulate the properties of quadrilaterals. Typical statements:

- Parallel lines are like train tracks which never cross.
- These lines are not parallel because if a train went along them it would crash.
- These lines are not parallel because they are too short (referring to shorter opposite sides of a rectangle).

They used Cabri to enter a mathematical world and investigate figures, asking questions like:

- Are the sides all the same length?
- Has it got parallel lines?
- Has it got any right angles?

Learning about sequences with a spreadsheet is a study in a City Technology College with 16-17 year old A-level students in partnership with the teacher Leila King. The aim is to teach A-level students that a mathematical sequence can be constructed from a formula or an inductive definition; the properties of arithmetic and geometric sequences; and the behaviour of sequences when n is large. Peer assessment includes the use of presentations with PowerPoint.

4. The Role of the Computer in Assessment* Cliff Beevers, Heriot-Watt University *(with co-worker Helen Ashton)*

Cliff looked at forms of assessment available on the computer and the way that the CUE system can present Diagnostic tests to identify strengths; Self-tests to give fast feedback; Continuous assessment for monitoring purposes and Summative assessment - grades that count

for an award. The CUE* system:

- has an editor for authoring and amending questions
- uses content MathML and XML
- includes randoms
- possesses the educational features of key parts and steps for partial credit
- has a flexible marking capability
- provides for test delivery in a variety of modes to cater for wide spectrum of students
- has a web front end
- gathers results incrementally
- records results in database for subsequent report generation
- is accessible using JAWS (screen reader software for visually-impaired computer users)
- has a growing number of answer types (as well as those normally available in testing software it includes Numerical answers, Algebraic answer checking - very extensive and a variety of marking styles for Multiple choice and multiple response)

Cliff showed how the use of "key parts" within CUE can enable students to gain partial credit in cases where they are unable to answer a question in its entirety but can make a good attempt at part of it. Examples of the different kinds of question available can be browsed through via "Try a test" at http://www.calm.hw.ac.uk/cue.html

CUE is able to test several levels of mathematical understanding, as categorised by the taxonomies of B S Bloom et al (*Taxonomy of Educational Objectives: the classification of educational goals volume 1/2;* Longman, London, 1956/64), or by G Smith et al (*Constructing mathematical examinations to assess a range of knowledge and skills,* Int J Math Educ Sci Tech, 27[1], 65-77, 1996). But there are now new opportunities for encouraging higher level mathematical learning as indicated in the article by Chris Sangwin in the maths-caa-series. This features the AIM* software, which uses a computer algebra system to check the correctness of a non-unique answer. Students can be asked, for example, to construct examples of mathematical objects which demonstrate given properties.

5. Measuring Higher Order Attributes in Mathematics - Michael McCabe, University of Portsmouth*

Michael drew a parallel between the use of computers to aid assessment (CAA) and the use of a vehicle to aid travel (a car). Assessing a number of students over time with a certain question type can be likened to carrying passengers for a distance over a type of terrain, with the important issues being availability of software and technical support (petrol and garage mechanics), the adequacy of security (car insurance), need for managerial approval (MOT), the reliability of hardware (the engine) and the level of congestion on computer (road) networks.

At Portsmouth both formative and summative assessment has been carried out with the various generations of CAA in a number of courses. Banks of objective questions have been built up through the conversion of traditional questions, the use of templates and the use of verbs associated with learning outcomes.

To the taxonomies of Bloom and Smith mentioned above were added the knowledge levels of Anderson and Krathwohl, namely

- Factual (terminology, elements, items)
- Procedural (algorithms, techniques, methods)
- Conceptual (theories, models, principles, structures)
- Metacognitive (personal learning strategies, styles, strengths)

Learning levels are often hard to classify, since there are ambiguities relating to application (of mathematics), evaluation (of a formula or a result), analysis (of a function), solution (of an equation) and proof (of a theorem). The latter is vital for level 2 computer science undergraduates, who need to understand mathematical proof in order to cope with advanced algorithms & formal methods. Michael demonstrated some ways of testing proof by computer, the question properties and types including Selection (choose the most appropriate proof method), Order (given the steps in a proof, put them in the right order), and Fill-in-Blanks. Students are recommended to work questions out on paper before entering the answers on the computer, and the results have proved comparable to paper marking. Questions such as "identify method", "use method", "locate errors" are used to assess high level learning outcomes.

The availability of Group Response Systems has removed the restriction to traditional objective questions for summative and formative assessment. A question is posed, for example, "How would you prove that $1+2+3+\ldots+n = \frac{1}{2}n(n+1)$?", and students choose from alternatives such as deduction, contradiction, induction, exhaustion and contraposition. The (anonymous) results are available immediately, and the lecturer can be involved in the assessment process and encourage student discussion. Quite different styles of questions are now available:

- tryout and trial
- polling and evaluation
- ambiguous and indiscriminate
- provocative and incorrect
- imprecise and ill-defined
- sequential steps
- conditional branching

Finally, the following questions are relevant for the conversion of questions to automatic assessment:

- Is there an equivalent objective question?
- Can the question be fitted into a standard template?
- What about learning levels and complexity?

- What about partial credit and staged questions?
- Are the learning outcomes assessed?
- How quickly can the question be authored?
- Is there an existing question bank?
- Can CAA provide breadth of coverage?

Round Table Discussion

This drew out some interesting points and shared experiences. In some institutions learning outcomes may be "hard-wired" into bureaucratic procedures that are not equally suitable for all subjects. Modularisation, for example, can often result in mathematics students being assessed too early. This can be addressed by restricting assessment to lower level skills on earlier modules, leaving the higher levels till later. The building of a portfolio can also help; assignments assessed at the time of submission can be included in a portfolio which itself contributes to the final grade. Feedback on a regular basis is vital for motivation; other students can be involved here, either from the peer group or within a mentoring relationship with a student from an earlier cohort.

*** Resources from this workshop and references for the software mentioned can be found at http://ltsn.mathstore.ac.uk/workshops/assess2002 Previous resources are in directory /assess2001**

Maths Support for Students in Science and Engineering Departments

Bell College, Hamilton, 18 June 2002 - Report prepared by Christine Hirst c.hirst@bham.ac.uk

1 Alastair Gillespie, University of Edinburgh: School/University Interface - what maths skills do incoming students have?

Alastair, who is Head of Department for Mathematics and Statistics at the University of Edinburgh, led an interesting discussion looking at the maths skills of entrants into UK institutions. Worked examples by students were presented as the delegates' discussion focused on the serious lack of numerical and algebraic skills amongst undergraduates and a marked decline in analytical powers when faced with simple problems requiring more than one step. Alastair's presentation provided a positive interactive discussion, which enabled the delegates to exchange ideas about the different levels of skills students were presenting and the mathematical preparedness of new undergraduates.

2 Tony Croft, Loughborough University: Holistic Support Materials

Tony runs a Maths Support Centre at Loughborough for students from across the university. Tutors who staff this centre find that they cannot prepare for the sort of question they might be asked. Student background is extremely varied - on some courses students with only GCSE sit alongside those with A level mathematics. And lecturers' expectations may be way out not only on what students can do mathematically, but also what they can do for themselves. Senior university staff are not fully aware of the problem, and are sometimes appalled at the low level of what is being taught. There is a range of provision within the Centre:

- Pre-sessional: the Algebra Refresher is sent out in advance to 300 engineering students so they can practice their skills before starting the course. This is well received
- Paper-based diagnostic test - helps to inform the Support Centre what materials should be in place
- Hundreds of help leaflets, each less than two sides of A4. Some of these are in a series, eg Business Maths Foundations, or Engineering Maths First Aid Kit **[1]**
- Formula sheets, useful for students and for staff
- A programme of lunchtime workshops, run by an ex-schoolteacher, covering basic topics on a rotating basis. The programme is emailed to all students
- Drop in surgeries. Students want someone to sit down with them on a one-to-one basis, and this can happen in the afternoons when a rota of mathematics staff are timetabled to spend an hour in the Centre

There is little use of computer-aided learning materials by either tutors or students, but students use tools like spreadsheets, Maple or Matlab to do mathematics when required by the tutors.

3 Diana Mackie, Napier University: Use of IT to Support Mathematics Teaching

Diana presented an interesting discussion and demonstration of the use of IT for science and engineering students. IT supports the teaching of mathematics throughout the four-year programme for "Science with Management Studies". The first and second year courses within the programme use the TI-83 calculator, Derive, Mathwise and Statistical Software. For those students in the fourth year module the study of discrete and continuous models involves using Mathwise and the TI-86 Graphics Calculator. Mathwise is used for revision and reinforcement, and the TI-86 is used to plot solutions of differential equations, to construct phase plots and to explore solutions of discrete models. The TI-86 is available on loan to the students taking the course and is used in the exam.

4 Duncan Lawson, Coventry University and Donna Ellis, Robert Gordon University: Good Practice in the Provision of Mathematics Support Centres

Duncan reported on a project funded by the LTSN Maths, Stats & OR Network, which carried out a comprehensive survey of Maths Support Centres in HE institutions. He summarised the background, the project methodology, the results and the outcomes, which include a handbook detailing good practice.

Donna is Teaching Associate / Applications Supervisor at the Robert Gordon University and she presented information on the type of support offered to students by the Study Support Centre there. The interesting and informative presentation provided background and focused on the overall holistic approach to the students. The different facilities available include individual or group tuition, diagnostic assessments, self-study materials and generous opening hours. The centre presents a "friendly informal environment" where students can gain support through various methods.

Duncan ended this session by talking about the development of online provision at Coventry. The site can be viewed at http://www.mis.cov.ac.uk/maths_centre

5 Tony Croft and Christine Hirst: The LTSN MathsTEAM Project

Christine presented information about the LTSN MathsTEAM project - see http://ltsn.mathstore.ac.uk/mathsteam for details. The delegates briefly commented on the project asking about the resources and the timing for the publication of the case studies. The discussion then focused on the need for a UK Mathematics Learning Support Centre as discussed earlier by Tony Croft.

Reference

[1] The Engineering Maths First Aid Kit, by Anthony Croft, Prentice Hall (2000) ISBN 0 130 87430-2, price £166.99, consists of 75 photocopiable help leaflets. Once an institution has purchased a set they can be copied and distributed freely.
Contact Customer Services at Pearson Education,
tel 01279 623322/623928
email enq.orders@pearsoned-ema.com

Institute for Learning and Teaching in Higher Education Annual Conference 2002
Learning about Learning

Heriot-Watt University, Edinburgh, 26-28 June 2002 - Report by Judy Ekins, j.m.ekins@open.ac.uk

With over 300 teachers in HE at the conference all eager to share their research and their ideas on teaching, the conference was a very stimulating atmosphere. All the sessions were lively and useful. Presenters were keen to share their work and discuss it with others. There were almost no cancellations. It was very different from many conferences, which I have attended.

The programme consisted mostly of a choice of smallish one or two hour sessions (up to 25 participants), with one large plenary session per day.

The conference began with a choice of three pre-conference workshops:

- Lecturing: what do we do in lectures and what do our students do?
- Working with different racial groups in HE
- Approaches to legislation: practical steps to meeting the requirements of the new disabilities legislation, both through and to technology

I chose the latter and learnt a great deal about the new legislation, which requires us to be much more pro-active in providing reasonable adaptations for students with disabilities. We in mathematics may have problems in meeting the requirements of the legislation, as much of our software is not very accessible. Perhaps there is a need to put pressure on the software companies to make the next versions compatible with adaptive software.

The opening plenary was an informal lively discussion between Maxine Alterio, co-author of *Learning through Storytelling*; Angela Glasner and Sally Brown, authors of *Assessment matters in HE*; and Freda Tallantyre, PVC Derby covering Access and Lifelong Learning.

Peter Honey gave a keynote speech on "Learning about Learning". He gave a lively, amusing and informative talk about learning styles illustrating the problems when people bypass some essential stages in the learning cycle, eg experience, reflection or conclusion.

The closing plenary was a panel from Scotland, chaired by Roni Bamber of Heriot-Watt. It included Noel Entwistle, author of *Understanding Student Learning* and co-author of *The experience of Learning*; Loraine Stefani, researcher into assessment of student learning, peer and self-assessment strategies, accessible curriculum; and Sarah Mann, researcher into understanding the teaching and learning process in HE.

Paul Clark, the chief executive of the ILT then commented on a misleading article in the current Times Higher

Education Supplement, which cast doubt on the finances and the future of the ILT, implying some merger with the LTSN organisation. He reassured the conference that the ILT finances were better than previously predicted and that the ILT was keen to investigate how it could work more closely with the LTSN subject networks.

The small sessions focused on the following themes:

- Using research on student learning to inform teaching and learning support
- Helping students to understand how they learn best and how to achieve their full potential
- Developing and implementing assessment practices and strategies
- Exploring how Communication and Information Technology can impact positively on learning
- Making our teaching and assessment practices inclusive
- Identifying ways in which lifelong learning habits can be fostered in students after they leave HE
- Exploring how we can continue our own learning through Continuing Professional Development

I chose a variety of sessions listed below and would be happy to send additional information and/or discuss the sessions with any interested people:

- Skills mapping by Margaret Wilkins
- *Using interactive multimedia to support students' skill development* by Peter Hartley, Sadie Parr & Richard Gibson
- *Oral Assessment and the 'lived object of learning'* by Gordon Joughin
- *Supporting disabled students* by Mike Wray
- *Sit back and relax – A guide to reading from a computer screen* by Bruce Ingraham
- *HE teaching and communication expertis*e by Alistair Duff
- *SCHOLAR Project at Heriot-Watt – successful implementation of a virtual learning environment* by Cliff Beevers, Phillip John, Michael Steel, Peter John and Gerry Toner
- *Getting published* by Sally Brown
- *Researching learning and teaching using the Ideal** inventory* by Lin Norton and Trevor Williamson
- *Inclusive assessment – how hard are compulsory questions?* by David French and Chris Lewis

There were a number of interesting exhibitions and posters, a choice of cultural social events and a very enjoyable ceilidh (Scottish country dancing) after the conference dinner.

The 6th International CAA Conference

Loughborough University July 2002 - Report by Bill Foster, w.h.foster@ncl.ac.uk

This looked a very interesting conference, with a wide range of papers covering interesting topics including the TRIADS work, the development of automated free text marking, more work on MCQ methods and closer to my own interest the attempt to categorize question types. I had also hoped to find some work on the design and implementation of assessment engines within VLEs, but this topic was touched on in various talks and not explicitly covered. I will only report on the talks I attended, or on papers I found particularly interesting – so please excuse my selectivity.

The Conference was very well organized with good accommodation, reasonable food and excellent entertainment where Champagne (or at least the academic version of it) flowed as thousands were won and lost.

Keynote Talk – CAA Centre

The conference started with the keynote talk, Dr Joanna Bull and Professor Grainne Conole, reprising the work of the CAA Centre at Luton and presenting an evaluation of its work. The outcomes of the Centre have been particularly valuable and informed many of us, and it is to be hoped that the generic work on CAA will be continued. Myles Danson at Loughborough is hoping to set up a web-site acting as a portal for CAA.

Mathematics Assessment Issues

The papers by Jane Paterson and Martin Youngson were of particular interest to the MSOR community and spring from the work in Scottish Universities. The first that Jane gave, *Linking On-Line Assessment to Cognitive Skills* showed the problems in trying to apply Bloom's taxonomy to CAA in Mathematics and claims to demonstrate that automatic assessment can test the two lowest cognitive skills and that MCQ cannot test the higher levels. Also that the design of automatic assessment questions needs to be task focused in order to test skills and not rely on simply translating paper based assessments.

Martin Youngson et al in *Partial Credit in Mathematics Exams- a Comparison of Traditional and CAA Exams* compared traditional Mathematics examinations at the level of Scottish Higher school examinations with CAA exams using CUE asking the same questions. There were three CAA exams; one with steps towards the solution that students can optionally ask for and answer in order to acquire partial credit (OS), another with the same format except that the steps had to be answered

(CS) and the third with no steps. The students answering the no-steps CAA exams were asked to write all their working in rough. This last format was marked in two ways; their final CAA answers giving one score (NS), the rough work marked as in a traditional exam giving another score (NSW). It was found, amongst a welter of other results and comparisons that the there was no evidence of difference between the NSW and OS scores. However, there were significant evidence that the NS scores were significantly lower than those with steps. This indicates strongly that it is a mistake to directly translate traditional exams into CAA without steps.

MCQ Issues

The developments of MCQ are legion. It is clear that this is the CAA method most widely used. Phil Davies gave a very good talk on *There is no Confidence in MCQ....* But this controversial title spilt no blood as the talk introduced the idea of asking students to enter how confident they were about answering an MCQ question before they saw the options. Interesting, but in my opinion the heuristic approach he adopted needs more testing and I would like to see some sort of model. However a more blood-curdling sentence for devotees of MCQ can be found in the paper on *Item Selection and Application in HE* – A Boyle et al. Here they baldly state that their tests indicate MCQ may not be appropriate to test outcomes at undergraduate level. However, this paper was not overwhelmingly convincing in its test results and I am certainly not convinced by the Item Response Theory model used. It is felt strongly that the higher level cognitive skills, using Bloom's taxonomy for example, are not tested by MCQ. But I have not seen convincing evidence of this despite Jane Paterson's paper above, although I believe it whole-heartedly!

Hobby-Horses and Heuristics

It is at this point that I get on a particularly high hobby-horse and ride full-tilt and quixotically at the windmills of heuristics. The second keynote talk, *The Development and Evaluation of a Computer-Adaptive Testing Application for English Language* – M Lilley and T Barker, used the following mathematical model (logistic model) for the probability that a student with ability θ, however that is defined, to answer an MCQ item correctly:

$$P(\theta) = c + \frac{1-c}{1+e^{-1.7a(\theta-b)}}$$

where a is item discrimination, *b* is item difficulty, *c* the probability of getting it right by chance.

What is the evidence for this model? Has this three parameter logistic model ever been fitted to experimental data or is there a generic model derived from a deep theory of stimulus-response? Or is this model a gigantic Heuristic, useful as it gives curves of the right shape, has roughly the right properties at the ends and looks suitably mathematical? How do you find question difficulty and the other parameters? Calibration seems to be circular as question difficulty and student ability are inextricably linked. Examinations and assessment traditionally measure student performance throughout the course or at the end of a course. Using the word ability is in my opinion dangerous and could be open to misuse.

Free-text marking

In the same, but slightly less choleric vein, it is time to discuss the papers presented on the marking of free text. This is a very difficult area, and I was curious to see the approaches of two papers. The first, *Automated free text marking with Paperless School* – O Mason, I Grove-Stephensen, uses three key stages Knowledge, Understanding and Analysis with numeric parameters derived for each of these (looking for key words, connections between them and analysis of syntactic patterns). 30 essays in the set are then marked by hand, and a regression is used to weight the parameters so that scores from these weighted parameters are as close as possible to the human marking. However, what to do if the regression is not a good fit was not discussed and could be a major problem. Also style and structure are not part of the marking scheme. This, in my opinion, will lead to schematic essays which can give good marks with little or no attempt to be readable or to express the ideas properly.

The other paper, *Towards Robust Computerised Marking of Free-Text responses* – Mitchell et al, is less reductionist in that it uses templates for syntactic analysis, together with spelling and semantic processing methods to analyze short free text responses. This type of approach may be more suitable for assessments in MSOR.

Statistics in Higher Education Workshop

University of Northumbria, 13 February 2002 - Report by Karen Wynne karen.wynne@unn.ac.uk

The purpose of this workshop was to assist new lecturers in their induction into teaching and enable experienced staff to share and reflect on their experiences. The day was divided into four sessions, which were led by a variety of people involved in statistics each from a different institution.

The first session was led by Professor Neville Davies, Director of the RSS Centre for Statistical Education who informed us of various joint initiatives in statistics between the LTSN and RSS and discussed some of the issues facing the statistics community. Professor Warren Gilchrist (Sheffield Hallam University) then demonstrated various learning models considered useful when teaching the broad band of students we now deal with. After a break for lunch the afternoon resumed with a very entertaining talk by Dr Neville Hunt (Coventry University). Neville's talk was very 'hands on', demonstrating how to use Excel spreadsheets to illustrate regression analysis to first year undergraduates on a non-mathematical degree. The time was also used to explain how a lecture might be 'stage-managed' in order that the students (and yourself) might benefit the most. The afternoon finished with a very lively discussion on various methods of assessment led by Peter Holmes (RSS Centre for Statistical Education). The audience, which included lecturers from the local Universities (Newcastle, Durham and Northumbria), contributed many differing views on assessment before the afternoon was drawn to a close at 4pm.

The day certainly gave everyone food for thought regarding how students learn, how we lecture, how to use different methods of assessment or which new websites which could be useful. Feedback from one of the delegates the following day summed up the conference '*I found the workshop most useful - it's so infrequent that we get the opportunity to stand back and consider what we are doing in our teaching, how we can think of different ways of delivering and I guess most importantly, how students learn.'*

Flexible Learning in Statistics

Open University, Milton Keynes, 9 May 2002 - Report by Adrian Bowman, adrian@stats.gla.ac.uk

This workshop was held in conjunction with the Statistical Computing Section of the Royal Statistical Society and the Open University. The aim was to discuss a variety of initiatives which different universities have undertaken on forms of teaching which extend the more traditional approaches. Distance learning, at both undergraduate and postgraduate levels, was a strong theme, as was the use of educational technology. The day provided an excellent overview and the speakers have kindly written up their material in a form suitable for *Connections*. Mike Talbot also gave a talk on the SMART project based at BIOSS in Edinburgh. An article on SMART appeared in the February 1998 issue of *Maths&Stats* - see http://www.stats.gla.ac.uk/cti/activities/reviews/98_02/smart.html. An update on that project may appear in a forthcoming issue of *Connections*.

The title of the workshop was Flexible Learning. This raises the question of what is meant by the word 'flexible'. Is it flexible in geography, which is expressed in the alternative phrase distance learning? Is it flexible in time, so that students from the same geographical location have the opportunity to work around other commitments? Is it flexible in learning style, so that teaching is conducted in a manner which enables those who learn in different ways to handle the course? Is it flexible in background, recognising the different levels of preparation which maybe present in the class. It was useful to distinguish these, as discussions often mix them together in the context of IT, distance and open learning.

The traditional approach to teaching in higher education is through lectures, tutorials and labs, but these can now be augmented by a whole host of other support mechanisms. This might include lecture notes on the web, an electronic glossary, various forms of on-line interaction amongst students and or teachers, the use of dynamic graphics to explain concepts, quizes for assessment and problem solving material for higher level forms of learning. If flexible learning means that the traditional structure of lectures, tutorials and labs is removed then there are substantial issues of course organisation and it was extremely interesting to see how these were tackled by the speakers in the workshop.

The word integration seems a key one. Integration of design is important so that the course hangs together and as a coherent set of resources and activities addressing important aims. Equally important is integration of delivery so that the different resources can be accessed in an easy and flexible manner. The idea of a virtual learning environment is now well established and some of the talks at the workshop gave interesting insights on how these might be used. From a more statistical perspective integration of analysis and other types of software is also important and the most promising vehicle for achieving this currently seems to be R.

Some clear themes emerged from the contributions at the workshop. One of these is the very substantial cost of developing material in this area. Another is the need to maintain the material and a third is the possibility of sharing developed material so that others need not reinvent what already exists. Possible ways of addressing these issues are through collaborative projects, the development of common standards and a swapshop or library system where material can be shared. We would be delighted if the website http://ltsn.mathstore.gla.ac.uk could be used for this purpose and we would encourage everyone to consult it to view the material already there and to make further contributions.