

## Day Break Event: Developing Links between Teaching and Research University of Birmingham, 18 January 2004

Workshop Report by Douglas Quinney, email [d.a.quinney@keele.ac.uk](mailto:d.a.quinney@keele.ac.uk)

This meeting was arranged with a view to covering a range of approaches that may be developed to introduce research topics and techniques into undergraduate mathematics programmes. In particular, the four-year M.Sci and M.Math programmes usually require a significant project component where specialised research topics may be addressed. The day was intended to prompt participants into developing and extending their departments' approaches to integrating research components into courses, based on the expertise and knowledge base available and sharing their experiences with colleagues.

### **1 Setting the scene and developing further opportunities – John Blake, University of Birmingham**

Professor John Blake, Director of the LTSN Maths, Stats & OR Network, began the day by giving a brief overview and description of the Network, its mission statement and the role of the Learning and Teaching Support Network in general. He also alluded to the recent EPSRC review with respect to weakness in the area mathematical sciences and the recruitment of students, and possible remedies involving redefining the role of teaching at universities and forging links between research and teaching. In particular, recent controversies as to whether it was necessary to be strongly research active in order to be a good teacher.

### **2 What teaching can learn from research and what research can learn from teaching: practical case studies – Chris Budd, University of Bath**

Professor Budd began by picking up the points raised by John Blake and dispel the myths that researchers are bad teachers and vice versa. By using a simple example involving Celtic knots he demonstrated how problems could be posed and solved a variety of different levels and that the frontiers of knowledge, where research activities abound, are not that far away from some of the material that is currently taught in undergraduate courses. This frontier was then highlighted a superb "card trick", after which Chris illuminated the process by showing that it was an application of a fixed-point theorem. Professor Budd then went on to give some example of research type problems that had been used in undergraduate courses.

Example 1: Why is the weather in February usually worse than December when the heating from the Sun is at its weakest?

This apparently difficult, and intriguing, problem boils down to modelling the atmosphere by a first order differential equation  $ay' + by = C \sin(\omega t)$ ,

where  $y(t)$  is the mean temperature of the atmosphere at a particular position and  $C \sin(\omega t)$  is a driving force due to the heating of the Sun. Projects might consider investigating the effect of the parameters and lead to the solution in the form  $y(t) = D \cos(\omega t - \phi)$  which illustrate the phase lag in the solution inherent in such a model.

Example 2: Fluorescent Tubes. A model for fluorescent lighting had been developed at a European Study Group with Industry (ESGI) that results in a dynamical system modelled by a difference equation in the form

$$x_{n+1} = x_n(ax_n^2 + bx_n + c),$$

and how the solution of such recurrence relations can be used to investigate the cold starting of light tubes.

To end, Chris gave a demonstration of a double pendulum that he uses at all levels to encourage students at all levels and concluded with the suggestion that ESGI is a rich source of mathematical material for mathematical undergraduate research projects.

### **3 Interdisciplinary research: links with mathematics – Neil Challis, Sheffield Hallam University**

Neil Challis illustrated some of the case studies that had been undertaken at SHU. As a particular example, he looked at a mathematical model related to a number of road traffic accidents that had occurred when lorries carrying rolls of newsprint navigated a round about when the loads became unbalanced even at low speeds. Neil used this to illustrate how this was used to provide modelling experience for undergraduate mathematicians and argued that this type of research should be just as valuable.

Neil concluded by arguing that projects should be used to help mathematics students to see real examples, and provide real motivational material, for their mathematical studies.

#### **4 Linking Teaching and Research in Applied mathematics – John Blake**

After lunch John Blake gave some example of the type of projects undertaken by mathematics students at the University of Birmingham as part of a compulsory project requirement. The range of projects is extensive and included critiques of research papers and investigations in the history of mathematics.

#### **5 Undertaking action research into teaching undergraduate mathematics – Chris Sangwin, University of Birmingham**

Chris Sangwin gave examples of the work he was currently undertaking which involve the use technology in undergraduate teaching and the effect this is, and will have, on pedagogy. He gave a presentation of AiM that

is used extensively at Birmingham, and elsewhere, for teaching a variety of courses. The emphasis of his current research is designing suitable and effective feedback for students using CAL (Computer Assisted Learning) materials.

#### **6 Discussion**

The day ended with a panel discussion. In particular Professor Blake reminded the participants of the forthcoming call for proposals to host Centres for Excellence in Teaching and Learning, and the need for the mathematics community to ensure a complete involvement with this activity.

Editor's note – some resources from the workshop can be found at <http://ltsn.mathstore.ac.uk/workshops/link04>, others are available on request

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### **Day Break Event: Teaching Statistics to Non-Mathematicians Coventry University, 18 February 2004**

**Workshop Report by Jenny Freeman, Institute of General Practice, University of Sheffield**

The course was aimed at individuals who teach statistics and research methods as a service course to other university departments and was presented by Neville Hunt ([srx033@coventry.ac.uk](mailto:srx033@coventry.ac.uk)) and Sidney Tyrrell ([srx035@coventry.ac.uk](mailto:srx035@coventry.ac.uk)) of Coventry University. It was a practically orientated course that offered the opportunity for participants to meet with fellow teachers based at other institutions, exchange ideas and pick up tips and fresh inspiration that they could feed into their teaching practice.

Following a brief introduction to the day and to the Daybreak programme (<http://ltsn.mathstore.ac.uk/workshops/index.shtml>) in general by Prof Vic Barnett of Nottingham Trent University, the day kicked off with an overview of the problems faced by staff teaching Statistics to non-mathematicians. These included motivating students who are numerophobic, who may have had bad prior experiences of school-level mathematics, or who do not see the relevance of statistics to their current degree course. In addition to student resistance there may be a lack of support from the students' host department who may be equally uncomprehending of the importance of statistics, and more generally research methods, to their degree course programmes. Various solutions to this lack of interest and motivation were offered, all predicated on the principle that 'we need to convince our students that the course and each class is worth teaching'. There was a need to ensure that the statistics teaching was relevant to both the particular subject area and to the wider context. The importance of the teacher and their enthusiasm for the subject should not be underestimated. Further ways of motivating students included introducing visual aids to illustrate particular concepts, the use of anecdotes and discussion of personal experiences of statistics.

Participants were then divided into small groups of 4 or 5 and set to work scrutinising the morning's papers for topics that could be used to form the basis for either individual teaching sessions or a whole course. Given the range of newspapers on offer from the Times, Independent & Guardian, through the Daily Mail and Express to the Sun, there was much to look at and think about. This amply demonstrated the ease with which one could use current newsworthy topics in order to draw students into appreciating the relevance of statistics to both their particular discipline and to a broader context.

One of the major barriers to teaching statistics to non-mathematicians is its association with 'fearsome formulae' and the remainder of the morning was taken up with presentations and discussions concerning the use of mathematics and computational methods in teaching statistics; or rather ways in which they could be demystified for students with little or mathematical knowledge. It was generally agreed that the fewer formulae used the better, though this is not without its problems; it is difficult for students to fully grasp the meaning of the standard deviation without calculating it at least once. Advice included using only the bare

minimum and introducing formulae and concepts as and when needed rather than in advance. In addition, ensuring that students collect and analyse their own data can encourage participation as it gives them ownership of both the results of analysis and the conclusions drawn from the results.

Following lunch, the afternoon began with a 'tell your neighbour' session of good and bad assessment experiences, the results of which were then fed back to the whole group. The remainder of the afternoon was devoted to methods of assessing students and a demonstration of a variety of available teaching resources. When assessing students four principles were outlined: assessment should maximise student's engagement on the module, minimise the opportunities for cheating, minimise time spent marking and maximise the feedback to students so that students can learn. The benefits of having a transparent and rigid marking scheme were

outlined to ensure that both students and those marking the assessment were clear about the criteria on which students were assessed. A novel method for individualising assignments using the merge facility in word to merge data from an Excel spreadsheet into a word document was outlined. The day concluded with a look at a variety of web-based resources available for teaching statistics including STARS ([stars.ac.uk](http://stars.ac.uk)), all of which can be accessed through Sidney Tyrrell's excellent homepages, which can be found at <http://www.mis.coventry.ac.uk/~styrrell/resource.php>

In conclusion, it was an interesting day and allowed participants to meet fellow teachers from other universities across the country to exchange ideas and discuss potential solutions to what is a perennial problem, and one which will probably remain an issue for the foreseeable future.

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### **Day Workshop: Mathematics for Computing University of Glasgow, 24 March 2004 Workshop report by Mark McCartney, University of Ulster**

This one-day event organized jointly by the LTSN Maths, Stats & OR Network and LTSN Information and Computing Science brought together a wide range of delegates from places as far afield as Galway, Aberdeen and Canterbury to discuss the teaching of mathematics to computer science students.

#### ***Computer Scientists and Mathematics***

An introductory talk by Mark McCartney considered results from a recent online questionnaire to UK academics about their maths teaching to computer scientists. One important issue highlighted was that by far the most common entry qualification of freshers is grade C in GCSE mathematics. This, it was argued, raises serious issues about what we can expect our students to learn in a single module in discrete maths.

#### ***The Glasgow Maths Support Centre***

An important support mechanism, which has been used by a number of universities, is that of a dedicated mathematics support centre. Iain Gibson gave a talk on the trials and successes of the new centre at Glasgow.

#### ***Resources for Maths Support***

Pam Bishop then gave an overview and demonstration of the wide range of resources available through the Maths, Stats & OR Network to support maths teaching with particular reference to discrete maths.

#### ***JISC Resource Guide for Engineering, Mathematics and Computing: Sarah Kelly, Heriot-Watt University***

Sarah Kelly gave a virtual tour of the JISC resource before a well-earned lunch break, and the morning's talks

formed the basis for the conversational diet over sandwiches and coffee.

#### ***Statistics-support for research projects: Ewan Crawford, LTSN Maths, Stats & OR Network***

Ewan Crawford gave a wide-ranging survey of web resources for statistics, which included a range of interactive applets, data sets, and even 'genuine' random number sets.

#### ***Supporting students with Dyscalculia: Jim Boyle, Strathclyde University***

The formal presentations were concluded with a talk on Dyscalculia – its definition, prevalence, and support. This talk drew many questions and produced animated debate on issues such as the existence of the condition and whether students suffering from it should be discouraged from enrolling on numerate degrees.

The whole afternoon was wound up with an open discussion on the day's proceedings, and an essential final cup of tea. Those wishing to investigate further will find this report with lab sheets and links at <http://mathstore.ac.uk/workshops/computing>