
Maths support for non-specialist students in science and engineering departments

Report on Day Workshop, Monday 10 December 2001, The University of Birmingham

This workshop for academics who are supporting students in science and engineering departments was attended by 29 academics from 23 institutions. Participants were given copies of a Facts and Formulae leaflet, the Algebra Refresher book, a report on Post-16 mathematics within Curriculum 2000, and the handbook on Good Practice in the Provision of Mathematics Support Centres. Further copies of these can be provided on request; bulk supplies of the leaflet are available free of charge, and Algebra Refresher book currently costs £125 for 100 copies.

1. School/university interface - what can students do? What maths skills do incoming students have? **Bill Cox, Aston University**

Bill reported on the results of a series of paper-based tests given over the years to incoming students during their first term at Aston. These tests provide initial assessment, prime student learning and gather information. The results have been analysed by prior qualifications for over 100 topics from National Curriculum Level 5 and the core syllabi for A level and SEFI.

Applying the results gives a valuable idea of what students with a given prior qualification will know and can do, and therefore where to start with the curriculum. With mixed groups, material can be prepared to support the different levels of "probable preparedness", eg problem solving sessions for the better prepared, exercises for strengthening routine skills, pointers to common errors, and careful discussion of deep conceptual points.

Further developments include the gathering of data across all the West Midlands universities through the use of computer-based tests, and the preparation of dedicated support material.

References:

- J Appleby and W Cox (2002) Transition to Higher Education. In P Kahn and J Kyle, *Effective Teaching in Mathematics and Statistics*, to be published by Kogan Page
- W Cox (2002) *On the expectations of the mathematical knowledge of first year undergraduates*, IJMEST, to be published
- W Cox (2001) *Understanding Engineering Mathematics*, Butterworth-Heinemann
- W Cox (2000) *Predicting the mathematical preparedness of first year undergraduates for teaching and learning purposes*, IJMEST 31, 2, 227-248

2. Holistic support materials - Tony Croft, Loughborough University

Tony runs a Maths Support Centre at Loughborough for students from across the university. The experience is that tutors can't 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
- 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. Engineering Mathematics using Mathcad - Rob Beale, Oxford Brookes University

The objective of the Engineering Mathematics course at Oxford Brookes is to get students to use the appropriate mathematical tool to solve an engineering problem. Rob gave an account of how the use of Mathcad is embedded into the whole course so that students develop an understanding of its capabilities and relevance. During the first year students get used to Mathcad through re-working analytical solutions to calculus problems. In the second year they use it to investigate convergence, learn about parametric derivatives, solve matrix algebra problems and systems of non-linear

equations, and encounter numerical methods. In the third they have a mini-project involving second order differential equations, practise techniques of finite differences, gain familiarity with arrays and numerical algorithms and appreciate their limitations. There is also an optional module on finite elements.

4. Matlab (Symbolic Toolbox) materials for engineering maths courses - Grant Keady, University of Western Australia and Birmingham

Students can benefit from computer algebra assistance in doing routine engineering maths sums. It provides a tool for their engineering courses, and for their later careers. Generic cautions:

- Don't want students to lose much time on syntax puzzles
- Only worth while if sums are "hard enough", and later maths lecturers will build on students' computer algebra skills

In engineering departments where Matlab is the main maths software tool for engineering courses, Matlab with its Symbolic Toolbox is appropriate.

Grant presented a range of materials from books to websites that can be used to support students in their use of computer algebra, whether Maple, Mathematica or Matlab. The web version of this report contains full details. Looking to the future, he expects students to have weaker skills in maths, balanced by greater skills in computing, so that students+software will be able to do the sums students could do without software 15 years ago. The challenge is to exploit the positive element in this, and to develop lower-level engineering maths texts/CD-ROMs which include computer algebra materials.

5. Good Practice in the Provision of Mathematics Support Centres - Duncan Lawson and Margaret Halpin, Coventry University and Susan Starkings, South Bank University

Duncan reported on a project funded by the 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.

As part of the project Margaret had visited seven sites where there is a Maths Support centre, and she described the different approaches taken at six of them:

- Napier runs MathsPlus on Wednesday afternoons in a library at each of its three sites, on a drop-in basis. There is one-to-one help, 8 computers and three tutor rooms nearby for informal classes.
- Sheffield Hallam has MathsHelp in the maths part of their library from 12-2pm each day, in an

alcove accommodating 40 students. They also run *Maths for the Terrified* once a week.

- Edinburgh's MathsHelp has a dedicated room in the first year teaching block, open all day and staffed for half the week. The emphasis is on one-to-one help, with lots of handouts and two computers
- Coventry staffs its BP Maths Support Centre for 33 hours a week. There are lots of handouts, two computers and online help is also offered
- Loughborough's provision was summarised in para 2 above
- Huddersfield has an Open Learning resource centre in its Maths and Computing block. There is a resources shop, an area for desks and another for computers. One-to-one help is available for one hour a day, but students like working there and feel motivated.

South Bank University attracts mature students, and Susan Starkings has been running maths workshops there since 1993, continuing when the maths degree closed down. "Fast track maths" is an intensive six week revision course funded by HEFCE under its widening participation programme, and is heavily oversubscribed. It takes place within a Learning and Development Centre which also covers dyslexia and English. Timetabled support for core maths skills is provided in a maths room to students from a wide range of courses, staffed mainly by teachers who come in part time from the FE sector. These are trained to ensure they know what is available for students, and what level of skills they can expect to find.

Duncan ended this session by talking about the development of online provision at Coventry. This had been enhanced by adding a bank of test questions. Some 800 tests were taken each month during April and May. For each topic not answered successfully, students are referred to a handout. The site can be viewed at http://www.mis.cov.ac.uk/maths_centre

6. The MathsTEAM project - Christine Hirst (project coordinator)

Christine presented information about the project - see <http://ltsn.mathstore.ac.uk/mathsteam> for details.

Delegates commented on what they would like to see as project outcomes:

- case studies where Mathwise or other computer-aided learning packages are being used as a tool for teaching
- case studies on team teaching between engineers and mathematicians
- case studies on how to promote a support service - sometimes there may be a very good provision which students do not use

- a website with all this information so lecturers can easily find examples categorised by engineering discipline, with a 3-4 line commentary for each resource, and pointers to more substantial items such as videos.
 - an extension to the Loughborough Maths First Aid kit to take it into the second year - or first aid for the tutors!
- There was also general discussion which raised the following points were raised:
- Maths teaching should be grounded in the student's discipline - in the case of engineering this can be provided via problems that are real and motivational at the first year level. A bank of examples from all engineering disciplines is needed - textbook examples are too sanitised
 - Maths-in-a-box is a series of videos on modelling in Mechanical Engineering, carried out with the University of Leeds. This includes some very motivational engineering case studies. However, much smaller things are also needed, eg a 5-line story that leads to a double integral.

A fuller version of this report, with live Web links and resources, is available at
<http://ltsn.mathstore.ac.uk/workshops/maths-support/report.htm>

Diary

Further details and all Web addresses can be found via
http://www.ltsn.gla.ac.uk/events_diary/index.asp

March 2002

Maths support for non-specialist students in science and engineering departments workshop: Imperial College London, 15 March. Speakers will include Peter Saunders, Phil Ramsden, Tony Croft, Duncan Lawson and Susan Starkings, with a presentation from the MathsTEAM project. Contact info@mathstore.ac.uk

AMET: "What makes a good maths teacher?" Manchester Metropolitan University, 16 March.

Simulation Workshop, Operational Research Society, Birmingham, 20-21 March.

April 2002

ATM Conference 2002: Edge Hill, Ormskirk, 2-5 April.

UniServe Science Conference: Scholarly Inquiry in Flexible Science Teaching and Learning, University of Sydney, 5 Apr.

Joint British Mathematical and Applied Mathematical Colloquium: University of Warwick, 7-12 April. Featuring a symposium on current developments in learning and teaching in mathematics, with Chris Budd, Stephen Hibberd, Chris Sangwin and Mike Savage. When registering for the conference, consider submitting a poster of current developments in your department.

Personal Development Planning and Higher Level Key Skills for Science, Technology and Engineering: York, 30 April. Organised by the Centre for Developing and Evaluating Lifelong Learning.

June 2002

Assessment for a Purpose: Sheffield Hallam, 15 June. Bring your own assessment tasks for development. Contact info@mathstore.ac.uk for details.

International Symposium on Forecasting (ISF2002): Dublin, 23-26 June. Major interdisciplinary conference on Forecasting. Contact John.Haslett@tcd.ie

International Conference on Trends in Mathematics Education: Beirut, 26-28 June. For more information contact May Abboud mabboud@lau.edu.lb or Samer Habre shabre@lau.edu.lb

MathML2002: Chicago, 28-30 June.

July 2002

2nd International Conference on the Teaching of Mathematics: Crete, 1-6 July.

Bridging Mathematics Network Conference: Auckland, 4-6 July. Primarily concerned with the transition to tertiary education, especially for students without the usually assumed background in mathematics, with presentations from practitioners and researchers.

Mathematics Education Research Group of Australasia (MERGA). Auckland, 7-11 July. Research oriented conference, across the whole of mathematics education.

VISIT-ME-2002: Vienna 10-13 July. International Symposium on Integrating Technology into Mathematics Education. Featuring the 5th international Derive and TI89/92 Conference and 7th ACDCA Summer Academy.

IMECT3: 3rd International Conference on Mathematics Enrichment with Communication Technology. Cambridge, 11-13 July.

September 2002

RSS annual conference 2002. Plymouth 2-6 Sept.

ALT-C 2002. Sunderland, 9-11 Sept.