'A Maths Toolkit for Scientists and Engineers'

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Attended by 40 delegates, a joint meeting of the Learning and Teaching Support Networks in Engineering, Physical Sciences, Maths, Stats and OR took place at the University of Bristol. The good turnout had much to do with the successful collaboration of the different Networks, with experience among the delegates ranging from trainee schoolteachers, to senior engineering academics, but with valuable input from those concerned about the role of mathematical skills of engineering and science graduates in employment.

I have been to many such meetings over the years in which teachers of student 'users of mathematics' come together supposedly to discuss 'toolkits' or 'courseware', such as the computer aided-learning (CAL) suite Mathwise, only to find that their main interest is in sharing experiences of the progressive impoverishment of their students in drill and practice and other traditional mathematical skills; seemingly to be getting worse year by year. For many such delegates, this may be their first experience of such a public discussion, but they would be surprised to know that the decline in classical skill in mathematics has been an issue going back 30 years. However the problems HE teachers face now are in some cases very acute, with woeful misunderstanding and misconception among students entering programmes with as much as a B grade in A Level mathematics, let alone the majority who are often much less well qualified. Mike Savage, University of Leeds, opened with Getting to Grips with the Maths problem in HE, and cited the following:

$$\int \frac{dx}{4-x^2} \quad = \quad \int \frac{dx}{4} - \int \frac{dx}{x^2} \quad = \quad x/4 + 1/x + C$$

as an anecdote on the response of a physical sciences fresher student to a diagnostic test question. Others present did not seem surprised but Mike pointed out that anecdotal evidence of itself proves very little in the courts of higher education and that hard evidence of decline is needed. Duncan Lawson (Coventry University) provided that evidence in Measuring the Mathematics Problem (the Gatsby Report), [1], in which he showed that fresher engineering and science students with an 'N' grade at A level in 1991 performed as well as or better than C grade students in 1997 in all seven aspects of the same diagnostic test. These data have since been proved to apply to B grade students in 1999. Both Mike Savage and Tony Croft, University of Loughborough, who spoke afterwards, agreed with the LTSN MathsTEAM project and a recent UMTC working party, (Birmingham 2001), that an entry diagnostic test should be given to all students taking mathematics-based courses and that effective follow-up and carefully targeted support be given to all students needing help with pre-degree skills.

In the learning support centre at Loughborough, Tony Croft has produced very high quality teaching documentation for student support. An Algebra Refresher (A1) is now available from the Maths, Stats & OR Network, http://ltsn.mathstore.ac.uk. The virtue of having high quality materials, especially for under-confident and ill-prepared students, was appreciated generally, and reinforced by Martin Lavalle and Robin Horan (University of Plymouth) who spoke about Latex, and Karl Ryder (de Montfort University) talking about WEB tools. Paul Yates (Keele University) gave a concise but amusing user view of being distracted in teaching chemistry by needing to explain mathematics 'ad hoc' because of the shortfall of mathematical skills among his students; he runs a modular library of resources, but with the emphasis on mathematical explanation in the context of the physical sciences. Joe Kyle of the Maths, Stats & OR Network completed the line-up by collating his 'off-the-peg'

thoughts on Remedial Work and the key roles that both CAL and computer-aided assessment (CAA) are now playing, or could play, if FDTL4 bids are sufficiently coordinated, publicised, and made effective.

My impression of the day was that is was not just one of those hand-wringing events documenting the decline of mathematical skill among fresher students. True, it started like that but gradually, the reports, initiatives, and the latest thinking of several teachers and institutions were revealed. If you attend any international event dedicated to teaching mathematics to user students you find that the activities and findings of UK speakers are in the vanguard of thinking; maybe it's because we are more challenged by the knowledge, or the lack thereof, of our students. In any case some of the current ideas are now listed, and the reader will see that technology plays a crucial but component part.

The FACTS:

- Hard evidence now exists of a decline in mathematical drill, skill and practice.
- QAA has expressed concern about high drop out & failure and progression in mathematically-based subjects.
- Growing evidence that the diminution of mathematics leads to the 'dumbing down' of ultimate attainment level elsewhere.
- The willingness/capacity/orientation of university mathematics departments to meet the service need is under question.

But the following MEASURES and IDEAS are being adopted or advised to combat the need:

- Use of refresher or 'shake-down' units in the September prior to the degree.
- Use of testing for freshers as the main diagnostic for first year mathematical study – rather than a more remote entry qualification.
- Provision of effective and focused support to remedy specific knowledge deficit.
- Embedding of a component of diagnosed pre-degree work into the main syllabus and assessment of the first year mathematics unit for those who need it.
- Teaching of mathematics within the general context of its intended use.
- Growth of learning support centers, to supply/ recommend
  - ♦ Pre-sessional material
  - ♦ Paper based diagnostic tests
  - ♦ Help leaflets
  - ♦ Formula flysheets
  - ♦ High quality handouts
  - ♦ Drop-in surgery facilities
  - ♦ Rolling programme of special workshops – e.g. lunchtimes

Add to this the CAL and CAA now becoming available as follows:

- Utilise CAL material in a careful and dedicated way, via a mathematics support centre or elsewhere.
- Use CAA likewise, making clear its role in formative, summative, or self-assessment, i.e. the benchmarking of learning.

Many institutions have common problems and we may 'fraction' them by sharing, eg in assessment resources. Let's hope that FDTL4 can contribute to this.

References

[1] Measuring the Mathematics Problem: Published by the Engineering Council, with the LTSN Maths, Stats & OR Network, the Institute of Mathematics & its Applications and the London Mathematical Society, and sponsored by the Gatsby Charitable Foundation. June 2000.