

Magic in maths Raising student interest

From womb to tomb

The drive to increase uptake of maths at university starts in schools. So what's the problem and what's being done to put things right?

Stephen Hoare

Why do so many adults wear their failure to do simple sums or percentages like a badge of honour? To tackle Britain's persistent tail of underachievement and inspire more to take maths at university the Department for Children, Schools and Families (DCSF) and the Department for Innovation, Universities and Skills (DIUS), the national strategies and subject teaching associations are coming up with "cradle to grave" initiatives designed to boost maths at every level.

Lucy Griffin, a year 13 student at Imberhorne secondary in East Grinstead, is taking A-level maths and wants to study physics and chemistry at Cambridge. She says: "Maths is cool and is one of the harder subjects. If you do well at maths, people are

going to be impressed." Jeff Marshall, who is taking maths, physics and chemistry, agrees. "I never liked maths until I started the A-level. But now I'm really turned on to it. It's introduced us to problem-solving like figuring out the speed of a rocket from the rate at which it burns fuel."

Their teacher Peter Hall, an advanced skills teacher with 10 years' experience, believes that improving maths results is down to basic good teaching. "As in all subjects, the successful teachers inspire and motivate by being enthusiastic and knowledgeable."

In 2004, Adrian Smith's report Making Mathematics Count highlighted weaknesses in the UK's maths education. Numbers taking the maths A-level were falling while demand for maths graduates and related disciplines was increasing. A shortage of maths teachers is exacerbating the problem. Imberhorne's experience echoes the findings of the Smith report. Out of a department of 14, only nine have maths degrees.

But maths' resurgent popularity is down to an emphasis on functionality. New teaching materials endorsed by the DCSF and NCETM – Bowland Maths in key stage 3 and StudyPlus for key stage 4 – re-

emphasise problem-solving and investigation through a scenario-based approach. Reforms to GCSE and A-level maths make it more relevant to the world of business and to the functionality demanded by related technology, science and engineering degrees.

Hall varies the pace continuously. He uses online resources from Teachers TV, plenty of group work and discussion and relevant work such as teaching percentages through finding out about bank interest and football league tables.

At A-level the policy has been to reverse the damage done by the disastrous Curriculum 2000 Maths and to bring the pass rate into line with other subjects. And moves are afoot to distribute numeracy skills among statistically-based A-levels such as economics and sciences.

The new vocational diplomas will take advantage of a more functional approach to maths problem-solving. GCSE maths has been simplified to just two levels with a broader spread of grade progression. Mark McCourt, NCETM's assistant director secondary, says: "Under the old system, the bottom third of pupils were effectively written off. Giving every child the possibility of aiming for a C grade

raises aspirations across the board."

Meanwhile the National Teaching and Learning Change Programme, supported by the NCETM, is helping colleges and other providers raise their game. The NCETM is also working with DIUS to provide a strategy to respond to the Leitch report through the DIUS initiative, Numeracy for Employability.

Numeracy hour

From primary level, the national strategies have given teachers a framework within which to teach their subject – something known as the numeracy hour. And they are closely monitoring standards to tie in with the government's Every Child Counts initiative, which aims to raise the maths scores of the 300,000 lowest achieving pupils by 2010.

Constant revision of practice has led to a slimmed-down electronic primary maths framework published in October 2006. Nigel Bufton, senior director primary maths for the national strategies, says: "The new framework is a significant change that will help teachers adapt their teaching in the light of assessment for learning and focus resources on children who need extra support. The target we're now talking about is

raising the proportion of children making two whole levels of progress between key stage 1 and key stage 2. Ninety per cent of children are already reaching level 2 and it would be great if we could achieve those sort of figures for level 4."

The strategies are working with the centre to help primary teachers develop a better subject knowledge of maths.

The Williams review of primary maths announced in July 2007 will focus on a number of important issues including how maths is taught; how teachers and early years practitioners are trained; what continuing professional development they receive. Sir Peter Williams says: "We want to establish how an intervention numeracy programme might be designed to ensure better progression for slow-moving pupils; how we should sequence the maths curriculum; and how we can engage parents and families to support their child's development." His review team is working closely with the Primary National Strategy and the NCETM.

Maths begins in the nursery. Elizabeth Carruthers, head of Redcliffe Early Years Centre, says: "Even before they can write, children are exploring number concepts through marks on paper."



A-level maths student Lucy Griffin: 'If you do well at maths, people are going to be impressed' Andrew Hasson

Williams review

During November the NCETM is running an online survey among primary teachers and early years practitioners to feed in to the Williams review of primary maths conducted for the DCSF.

The centre is keen to find out more about teachers' experiences of training and development, where existing support is coming from and how good it is.

Improving maths at primary level is all about subject knowledge and appropriate pedagogy – making sure teachers are up to speed with the most successful

practice in teaching maths concepts and making links between maths topics.

Alison Brunt, assistant director of primary and early years for the NCETM, says: "The focus of our survey is to find out what teachers think are their needs and what forms of continuing professional development they would find most helpful. There may be areas of subject knowledge that we don't automatically think about." **SH**

To register your views on the Williams review, go to nctm.org.uk/news/6369

Further Maths Network

It is one of the great success stories of maths. In 2005 the Further Maths Network, a government-sponsored project run by the charity, Maths in Education and Industry (MEI), received funding from the Gatsby Foundation (a charitable organisation that is part of the Sainsbury Trust). It was to run a pilot to reverse the decline in further maths A-level and boost the quality of students applying to university to study maths and mathematics-related degrees.

Following the success of the pilot the DfES (now DCSF) funded the roll-out of the network and in a short space of time the results have been impressive. In 2005, when the network started, student numbers taking further maths AS level have risen by 89% and 39% for the A2 level. Charlie Stripp, the network's national programme director, says: "What was regarded as one of the most difficult A-levels has been revitalised."

But the numbers are still relatively small – around 7,800 students currently take the subject. But this has to be set against the earlier collapse of numbers

following the disastrous Curriculum 2000 revisions which saw the pass rate at maths drop from 95 to 75%. By the time of the Smith report, Making Mathematics Count, in 2004, further maths had virtually disappeared from school and college curricula.

In addition to its programme of twilight sessions across its 46 regional centres, the network aims to raise student numbers by working with the NCETM to upskill maths teachers. Half of all schools, sixth-form and FE colleges offering A-level maths have signed up.

The network is working with a group of 40 universities whose science, technology, engineering and maths departments inform student applicants that further maths is an ideal pre-entry qualification. Stripp says: "I believe that as many as a third to a half of the 60,000 students currently taking a maths A-level should take further maths, and we are helping schools and colleges build capacity."

He says further maths is ideal preparation for the increasing statistics, IT and maths content driving a host of degrees from engineering to economics. **SH**

Universities take up the challenge

Schemes such as More Maths Grads are steadily helping to steer more students towards mathematics degrees

Stephen Hoare

Maths at university has been under threat and over the past decades several university maths departments have closed. The good news is that maths is now considered a special case by the Higher Education Funding Council for England (Hefce) and the government, which launched the More Maths Grads project in August to widen participation in maths as well as science, technology and engineering.

The number of UK students applying for maths degrees is rising steadily. According to the Higher Education Statistics Agency (Hesa), there are 23,155 studying maths and a further 26,500 on maths-related degrees such as statistics and mechan-

ics. When economics, science and engineering are included this rises to around 400,000. From 2003-4 to 2005-6 numbers of first-year maths students rose from just over 6,225 to 7,150 and Hefce believes this figure can rise a lot further.

More Maths Grads is funded to the tune of £3.3m over three years to run three pilot projects across the UK. These identify interventions that have succeeded in raising student recruitment on undergraduate degrees. They include university "taster days" for GCSE students, maths workshops and careers seminars. Some of the funding is helping to further develop the website, mathscareers.org.uk.

Michael Grove, maths lecturer at Birmingham University and a member of the Higher Education Academy, is spokesman for More Maths Grads. He believes that universities must join forces with schools to inspire the next generation of mathematicians. "I think the whole maths community – the NCETM, the Association of Teachers of Mathematics (ATM), Mathematics in Education and Industry (MEI) and the national strategies – are having



Michael Grove: 'Mathematicians can be their own worst enemy'

an input into the process of raising standards of teaching and numbers applying to study the subject at university."

Young people need to be better informed on choices of career. "Sometimes mathematicians are their own worst enemy. We don't always communicate the career opportunities out there for young people. A lot of UK maths graduates are going in to investment banking, IT, computer gaming, aerospace, defence and engineering. Some have probably gone into law firms. Google famous maths graduates and you might be surprised to find that Art Garfunkel has an MSc in maths, as does Desperate Housewives actor Teri Hatcher. And Brian May from Queen has a PhD in physics and astronomy."

But leaving aside role models, maths graduates have transferable skills that can open up a wide range of careers. Grove says: "Maths graduates have got very high employability. They've got logic, reasoning, problem-solving and analysis."

Sadly, just 13% of maths graduates head for teaching, a great deal less than the numbers that head for the MSc in

finance, a post-grad degree that equips maths graduates and other students from numerate disciplines for high-flying City careers in investment banking. Professor Mark Shackleton, from Lancaster University School of Management, says: "We're getting quite a lot of maths graduates on our MSc. It's seen as a passport to the big money. To be a key player in the City you have to have a high level of mathematical dexterity."

Golden hellos are proving an incentive to graduates considering teaching as a long-term career. University education departments offer enhancement courses in maths for non-maths graduates and bursaries of £7,000-9,000. David Miller, senior lecturer in education at Keele University, says: "The bursaries have definitely helped recruitment. Without that I think numbers would have collapsed."

Weblinks

More Maths Grads: www.moremathsgrads.org.uk
Maths Careers: www.mathscareers.org.uk

Magic in maths Professional development

A problem shared...

Activities such as engaging with online groups can help maths teachers improve their success and enjoyment in the classroom

Steve McCormack

In an ideal world, every maths teacher would have a regular slot of time to step back from the job's immediate demands and consider the bigger picture. What am I teaching, how am I teaching it, and what are the students learning? But in reality, time's a little tighter, and the fact is that continuing professional development (CPD) is done largely on the hoof. But that needn't mean it is low quality.

Plenty of schools and colleges have formal and informal systems in place that successfully enable teachers to continue their own learning process, alongside that of their students.

But there's more than one way to skin a cat, and advancing technology particularly is increasing the variety of CPD opportunities out there. That's why the National Centre for Excellence in the Teaching of Mathematics (NCTEM) is engaged in a research programme to study some of the most successful current practice and, in so doing, distil the characteristics associated with the most effective CPD, given the realities of 21st-century school and college life.

Over the next year and a half, researchers will immerse themselves in 30 different CPD projects around the country, from early years to adult education. Some are school or college-based, some run by the local authority, and others centred in higher education.

"We are very excited about the breadth and wealth of the CPD currently practised by the institutions who've become our partners," says Rosamund Sutherland, professor of mathematics education at Bristol University and associate director of research for the NCETM.

Underlying the exercise is an acknowl-

'Good engagement in strong CPD can be the thing that makes the difference to a teacher's motivation'

Langley Park 'We were encouraged to take risks in the classroom and then discuss them together'

Jenny Brown is deputy in the maths department at Langley Park school for girls, an 11-18 comprehensive, with a mixed sixth-form, in Bromley. Two years ago, along with six other maths teachers from Bromley schools, she went on a course (five days spread over three months) based on the approaches in Improving Learning in Mathematics that was supported by the NCETM regional team.

"It was the most inspiring course I've even been on," she recalls. "It's changed my practice in the classroom." After the course, she went back and gave presentations to the maths department at her school, and she now goes on

occasional twilight sessions with past course participants to keep communication going on current classroom practice. Three other maths teachers from Langley Park have now also attended the course and, like Langley Park, other Bromley schools have found the course to be a powerful instrument of professional development. It is now one of the 30 projects nationwide that the NCETM is studying in depth.

So what did the course offer that made such an impression on Brown and her teaching?

"The focus of the course was Assessment for Learning (AfL), and I confess I didn't really know what that was before I went on it. But it is doing things in classrooms that encourage students to do more thinking themselves about what they are learning."

"During the course, we were encouraged to go back to our schools and take risks in the classroom, and then discuss them together when we got back for a day of the course."

Brown identifies several areas in which her teaching has changed, among them peer assessment and use of mini-whiteboards. She now does more of both.

"As an example of peer assessment, I now get students, after marking

Farnborough 'No one is reluctant to seek advice and suggestions from others'



Berwick Mitchell has fostered an environment in which teachers can speak openly about their successes and failures

Walk into the maths department office at Farnborough sixth-form college and you're as likely to hear an exchange of views about how to teach an algebra topic or introduce a new concept at A-level as you are a conversation about last night's football or plans for the weekend.

In fact the informal, unscheduled sharing of experience among the 14 maths teachers is central to the department's approach to CPD. And head of department Berwick Mitchell encourages it as much for his own sake as for the department's.

"I will walk into the office and say I've just had a bit of a nightmare of a lesson, and because teachers hear that, no one is reluctant to admit to having had difficul-

ties themselves, and seeking advice and suggestions from others," he says.

More formally, Mitchell makes sure there's as much peer classroom observation as possible among maths teachers, and he tries to ensure that time is spent during departmental meetings "talking about what we are about to teach".

Recently, for example, teachers broke into four or five small groups, each discussing a different area of maths about to be introduced to year 12, and looking at ways of increasing students' independence – a current CPD theme across the college.

"There was no planning or preparation, and my one expectation of the meeting was that everyone went away with one or two things that they might do differently.

"The approach in maths and across the college is to encourage teachers to choose for themselves what to try in the classroom and not to try to undertake too much at any one time."

Farnborough's maths teachers do occasionally go on outside courses, but it's not central to ongoing CPD. "We don't do a huge amount," says Mitchell.

And, although he knows of "two or three" department members who use website forums to observe, or participate, in discussions about subject teaching, he doesn't do it much himself.

"There's enough going on within the department that we don't feel alone, so the urge to browse is less urgent," he says. **SM**

One-stop shop to back teachers online

The NCETM's web 'portal' is an organic, collaborative resource to help teachers build confidence and skills

Steve McCormack

The last five years have seen such an explosion of internet material for teachers that it can be seriously confusing knowing which way to point one's mouse.

For maths teachers, the NCETM's website, or portal as it's called, at www.nctem.org.uk, aims to solve that problem by being a one-stop shop, offering answers to most, if not all, queries that present themselves during the term. There are links to scores of other maths-related and general

education websites, and to more than 150 resources for use in classrooms.

But its principle function is to assist teachers' continuing professional development. "Our aim is that anyone using the portal is prompted to reflect on their teaching in some way and, if possible, go on to do something different," says Janie Iremie, executive director of the national centre.

Most of the site is available to any visitor but, to get the best out of it, teachers have to register. To date, 8,250 have done so: a smallish number perhaps, given there are 25,000 secondary maths teachers and nearly 10 times that many primary teachers, who have to cover all subjects. However, Iremie regards it as "not a bad position" less than 18 months after the site's launch.

The hope is that the recent addition of a self-evaluation tool on the site will attract more users and, more important, prove the



Stephen Froggatt: 'This should be the first port of call for any teacher' Anna Gordon

catalyst for valuable professional development. This tool enables a teacher, or group of teachers, to pick a subject area, and then answer a series of questions about their own teaching strengths. Based on a teacher's responses, the tool will then send the teacher to various other areas of the site, where help and advice can be found.

Among these is a section called Math-empedia, a living reference and discussion area, created and constantly added to by members of the site. There are also forums and blogs covering a wide range of real classroom-centred teaching issues.

"This is full-on maths and should be the first port of call for any teacher," says Stephen Froggatt, head of maths at Oaks Park high school in Essex.

The more teachers that come to that view themselves over the next few years, the greater the site's power to help teachers and, in turn, learners, will become.