

Magic in maths Scotland/Comment/Resources



Special subject: maths is traditionally strong in a country that produced John Napier, the 16th-century inventor of logarithms Corbis

Scots strive to be 'hands on'

Scotland may be more stringent about making sure its maths teachers are specialists in the subject, but it too is undergoing change

Fiona Leney

Scotland's mathematicians have an enviable reputation, stretching right back to John Napier, the 16th-century inventor of logarithms, so it is perhaps unsurprising that teaching in Scotland, although not radically different from in England, is deeply rooted in tradition.

The most significant difference from England is that all maths teachers in Scotland must have studied maths for two years during university. Pupils and parents are aware that the teacher working with their child is a real specialist, not a chemistry or biology teacher with a mathematical bent.

Bill Richardson, secretary of the Mathematical Association and the local representative for Elgin in Scotland, says that while maths is seen as a difficult subject at Highers (the Scottish equivalent to A-levels), uptake is strong.

"I would say maths in Scotland is in a healthy state – there is not quite the same shortage of teachers that you get elsewhere, they are given greater respect and, because they come to teaching having done two years of maths at university,

they tend to be better qualified," he says.

But Scotland is also moving to address potential problems. Dr Chris Pritchard of the Scottish Mathematical Council says that the way the subject is taught has been reviewed in light of an international study dating from 1995 – the Third International Mathematics and Science Study (TIMSS) – which suggested that the average scores of Scottish students in mathematics were below the international average (although above those in England).

"In the light of the study, a small delegation was dispatched to high-scoring countries in the far east and Europe. They found that the best practice abroad secures a significantly greater degree of active involvement of pupils in lessons than in this country," he says.

'Greater freedom'

The conclusion was that students need to be offered a wider range of learning experiences, and a more "hands-on" approach to learning maths.

"This greater freedom is being extended through the Curriculum for Excellence programme, which allows for numerous different courses to be developed to suit

'Maths in Scotland is in a healthy state – there is not quite the same shortage of teachers you get elsewhere'

the needs of the learners. But this comes on the back of the redesign of school and local authority management structures. So implementing the Curriculum for Excellence will be a challenge. It will exhilarate some teachers while frightening others," he says.

Elements of the new curriculum are being tested at the moment, with a view to phasing changes in over the next year.

As far as maths goes, the aim will be to emphasise the practical applications of the subject in other areas, and to encourage active and enjoyable learning techniques. An illustration of this is that problem-solving will no longer be a separate element, but it is to be included in all areas of maths. The advent of modern technology, too, will be recognised, with information handling skills to be updated.

Most significantly, methods of assessment will change – albeit gradually over the course of the next few years – with a shift away from exams towards teacher assessment.

One factor that ought to make the process less painful is the high level of collaboration that already exists in some areas between maths teachers, local authorities and professional societies in the country. "The Curriculum for Excellence should increase this process of collaboration between maths professionals," says Trevor Leach, a secondary school maths teacher.

He is convinced the new curriculum is a positive development, not a lowering of standards. "There is nothing wrong with challenge as long as it is presented in a way that kids feel they can meet it," he says.

We have a chance to turn it round



Marcus du Sautoy

Comment

My strong impression is that we are not being brave enough in challenging children with maths, and teachers are too quick to do the easy stuff, which often just turns out to be boring.

Maths is about much more than just arithmetic, but many pupils believe that is all it is. We need teachers to teach the bigger picture of how and why we do maths, why it's necessary and what it is used for, because this might help give young people an incentive.

There are so many stories about maths that need to be explored. It is a little like learning music. In listening to a wonderful symphony you might not understand how it was composed or how to play every note, but it suddenly gets exciting when you realise this is why you have to learn scales and that this level of performance can be something to aspire to.

When it comes to maths, we aren't doing this and we aren't passing on what maths is really all about. So, for example, pupils might find it interesting to know that a footballer is inadvertently solving a quadratic equation in deciding where to stand to take a free-kick.

When it comes to maths, teachers need to get children to ask "why?". Why is this relevant, why are we learning this, why calculus? Even if we don't have a good answer to these questions, pupils should be exploring these issues

because in this way they get to understand the world they live in.

Maths is used in the technology all around them. Most children now have mobile phones, but how many will know that calculus is used to translate your voice into 0 and 1 sequences? Phones use a fantastic piece of maths that allows sound to be beamed up to the satellite and back again.

So maths should be relevant, but it also has value for its own sake. There is a beauty to the subject and an excitement in following it on its logical journey. Unfortunately, too many teachers of maths do not have a maths degree and so do not have the background to be able to answer those questions and pass on that excitement of the subject. They are struggling with it themselves.

This is where the creation of the National Centre for Excellence in the Teaching of Mathematics has a vital role to play – in providing enrichment for teachers. We really have a chance now to turn this around. More space needs to be found in the curriculum to look at the history and background of maths, especially for those who are not as good at the technical side of it to find a way into enjoying the subject.

The publication of the Smith report four years ago showed the government that they are losing the 11- to 14-year-olds, who might have found maths enjoyable in primary school because it was playful, but then get bored.

There is also more contact now between schools and universities, which allows us to help teachers pass on our own excitement and love of the subject, and open up a better dialogue. So things are improving, but we need to stop being so scared of our own insecurities.

Professor Marcus du Sautoy is from the Mathematical Institute and is a Fellow of Wadham College, Oxford. This is an extract from his talk at last year's Christmas Lectures, aimed at young people and organised by the Royal Institution

Students learn by interacting



Sue Johnston-Wilder

Comment

I've recently come back from a wonderful weekend: 40 maths educators and their families aged 3-70, in the Lake District. It was just like the early days of the Association of Teachers of Mathematics (ATM), in the 1950s. We worked on maths and on old maths films. The founders of the ATM made remarkable use of the best technology then available, as we should now. The understanding of Caleb Gattegno, one of the ATM's founders, that children learn mathematics by interacting with things and each other, rather than by being talked at, is alive and needed today. We are archiving these old films on our website at atm.org.uk.

There is much to be hopeful about. And there is also some cause for despair. We are born with maths. Newborn babies recognise the difference between 1, 2, 3 and more. We can reclaim that early potential. Somehow, sadly, people learn that you're either good at maths or not. I've seen maths lessons where children emerge six inches shorter, feeling defeated. Whereas those who believe they can improve, do improve, as Carol Dweck, professor of psychology at Columbia University has shown, because they keep trying and the brain actually develops by use.

My most pessimistic moments come when I look at recent developments such as University Hospital Coventry, where all vehicles drive up to the same congested entrance and think, if only

there had been more mathematical thinking used. What a waste.

I am hopeful about the recent shift in educational policy to continuing professional development (CPD), enabling teachers to think more deeply about what they do. I strongly support the creation of Chartered Mathematics Teacher status being set up in collaboration with the Institute for Mathematics and its Applications. Already available for science teachers, the charter involves master's-level CPD and working with colleagues, for example through a subject association, so that reflection is collaborative. The thing about teaching is that you need time to pause and think.

Maths is a language as well as an art and a science and if you can't speak it, you can't do it. I like the International Baccalaureat because it allows space for pupils to articulate ideas; often, in A-level classes, pupils are unable to articulate even basic concepts.

Yet maths as language, art and science can come together in quite simple moments, such as getting families to explore a Möbius strip at home (you twist a strip of paper, glue the ends and cut it along the long middle. But if you cut it a third of the way across, you get a different outcome). Parents tell you that the whole family was on the floor together cutting out paper, talking. And you say, "Yes, that's mathematical thinking."

That's cause for optimism, as is the growing number of committed teachers, young and old, who work together, as in our Lake District weekend. At last, the government and agencies are recognising the value of experience and fresh energy, spending time together, possibly before it's too late. And I'm optimistic about our young people.

Interview by Victoria Neumark

Sue Johnston-Wilder is associate professor of mathematics education at the University of Warwick and chair of the General Council of the Association of Teachers of Mathematics (ATM)

Resources

National Centre for Excellence in the Teaching of Mathematics: ncetm.org.uk

Mathemapedia: ncetm.org.uk/mathemapedia

Mathematics Matters project is looking at what constitutes the effective learning of mathematics: ncetm.org.uk/Default.aspx?page=13&module=res&mode=100&resid=4685

Further Mathematics Network aims to increase the number of students studying AS- and A-level maths and further maths: fmaths.org.uk

Nrich maths project has mathematics resources for children, parents and teachers to enrich learning: rich.maths.org

Maths Inspirations offers inspiring maths events for sixth-formers: mathsinspiration.com

Making Mathematics Count is a report of Professor Adrian Smith's inquiry into post-14 education: tda.gov.uk/upload/resources/pdf/m/mathsinqury_finalreport.pdf

Maths games and activities for schoolchildren and resources for teachers: counton.org, mathsnet.net, emaths.co.uk, kangaroomaths.com, waldomaths.com, mathedup.co.uk, subtangent.com, tsm-resources.com, mathsisfun.net, mathsisfun.com

Maths associations: atm.org.uk, m-a.org.uk

Centre for Innovation in Mathematics Teaching is a focus for research and curriculum development: cimt.plymouth.ac.uk

Andrew Jeffrey is a maths education speaker: andrewjeffrey.co.uk

Learning and Teaching Scotland

is an online service looks at curriculum changes, curriculum for excellence and implications: ltsotland.org.uk/

Mathematical Council of Scotland: maths.mcs.st-andrews.ac

ICT links

Dynamic geometry software: cabri.com
The Geometer's Sketchpad helps students with visual aspects that can be difficult, particularly 3D solids, lines and planes Sketchpad: dynamicgeometry.com

Texas Instruments' Ranger allows users to collect data on distance, velocity and acceleration and display it on a graph: education.ti.com
Microsoft's Picture Manager transforms or enlarges images by a certain percentage: microsoft.com

Itcam is an interactive CD-rom designed for students by Linda Tetlow: longman.co.uk/ictam

Compiled by Sarah Jewell