Something's not adding up

Professor Helen Atkinson, President of the Engineering Professors' Council, explains why maths needs to be strongly underpinned early if students are to be ready for university…

The Vorderman Report ('A world class mathematics education for all our young people') was published in August but was rather lost in amongst the welter of reporting in the aftermath of the riots. Within it, I was struck by the following statement: 'We find it hard to understand how a situation in which large numbers of students are systematically under-prepared for their degree courses has been allowed to arise…The mathematics element of many degree courses is often a common cause of failure, drop-out or general disaffection for students. This failure of the system, therefore, inflicts an enormous personal cost to the individuals as well as other direct financial costs to the taxpayer who will have invested a considerable amount of money in every student's education to that point.'[1]

The report got me thinking about my own mathematics education. At the primary school I went to, tables were drummed into us. I remember the head teacher coming into the class in Year 3 (age eight) and saying: 'I want you to know your tables so well that if I woke you up in the middle of the night and said 9 x 7 you would say 63 without even having to think about it.' Those who were good at mathematics were encouraged to fly through the curriculum and by the time we were in the top year at primary school we were covering some trigonometry.

I then had the very interesting experience of moving schools because my father moved his job. At the new school I realised I was the only child in that top primary year who really knew their tables. So I was ahead – tables gave me the mental facility to zoom through the arithmetic and hence the scope to tackle the more difficult concepts.

At secondary school in this new city I again observed that hardly anyone else in the class of 30 knew their tables. Sensing the advantage it gave in terms of the pleasure of doing well, I would chant multiplication tables as I cycled into school. Mathematics is like music, tables are like scales – they keep the mental cogs oiled ready for the stretch of producing demanding runs and arpeggios in complex pieces. Of course, they are boring at times but scales are part of a musician's life and the basic mathematical facility that goes with tables and mental arithmetic is part of learning mathematics. It is a language that needs practising again and again.

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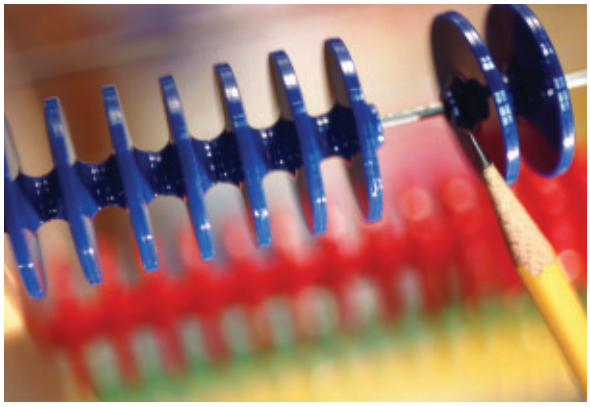

You could argue that I was naturally good at mathematics and so my enjoyment of having that mental facility was unusual, but I remember talking to a friend who taught maths to low achievers at a secondary school and she had decided that she would focus relentlessly on achieving that mental facility with these 15 year olds. They had a fantastic time honing up their tables and mental maths. They immensely enjoyed being able to do it. No-one had ever done that kind of work with them, coming back again and again (but in a fun way) so that the wheels were really in motion and they had basic arithmetic nailed. I doubt very much that any of their employees when they left school at 16 would have complained about basic numeracy skills.

What has all this to do with engineering? Mathematical skills are central to engineering education. There are two problems here. The first is that a lot of undergraduates

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with As and Bs in Maths A-Level are coming to university lacking at least some of that facility in mathematics that we should be able to take for granted. If we cannot, in teaching first year engineering undergraduates, assume that students will know that, for example log A + log B = log AB, then the students are immediately at a disadvantage in learning the much more advanced concepts that they must learn in order to be professional engineers. They are like my fellow 11 year olds who were already behind me because they did not know their tables as securely as I did.

And, interestingly, our overseas students mostly do 'know' these things. They are rather puzzled when they find some of their peer group in the first year (and I emphasise with As and Bs in Maths A-Level) simply do not have the basics securely enough ingrained.

The second problem is with the fact that you can get a Maths A-Level without covering certain key concepts that engineers at university need to have a keen appreciation of. When I was at school we became completely immersed in what standard deviation is at age 16. We were not allowed to use a calculator so we worked standard deviation out from scratch with sets of numbers. This meant that we became completely familiar with what standard deviation really means and even now I can look at a set of numbers and estimate the standard deviation in my head. I was completely stunned recently to discover that my daughter, who has an excellent grade in Maths A-Level, does not know what standard deviation is. If you do not do the Statistics Module at A-Level you can emerge having never covered this, and yet understanding the Normal Distribution (in essence, that there is a mean and a variation around that mean) is fairly central to understanding society, never mind making measurements in engineering.

The Engineering Professors' Council has been working with a number of other organisations including the Engineering Council, The Institute of Mathematics and its Applications, and the National Centre for Excellence in the Teaching of Mathematics to isolate what mathematics is really needed in order to feel comfortable with the mathematics in the engineering curriculum at university. Basic geometry, trigonometry and the ability to manipulate algebraic equations have consistently been found to be the key essential needs irrespective of the type of engineering course considered. These elements, together with further important topics such as differentiation and integration, have been included in the new 'Mathematics for Engineering' (M4E) certificate created to be the equivalent to Maths A-Level but taught in an applied context with examples of real world applications of each curriculum topic.

We need to aspire higher with mathematics in schools. It is like learning a musical instrument. You need to practice almost every day. Sometimes that will be a chore but then you will have that immense pleasure of the technical facility which you can bring to the more advanced pieces. The Vorderman Report identifies how critical that mathematical facility is to employers and hence to our economy, with big companies crying out for highly skilled engineers.

[1] Vorderman Report, page 10

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