Secondary & Further Education Magazine 94

National Centre for Excellence in the Teaching of Mathematics

Welcome to Issue 94 of the Secondary Magazine (incorporating FE)

The Christmas holiday will provide a change in routine and time to take stock of the academic year so far. A good time to think about the direction your teaching is taking and to re-think your principles about good quality teaching and learning in your classroom in preparation for the New Year. This issue will provide some ideas for your pedagogy, some new resources and some things to ponder over during the festive season. Have a restful break and best wishes for 2013.

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From the editor: Mathematics across the curriculum

The Ofsted Inspection handbook includes a key paragraph about mathematics:

> 38. Inspectors will consider the impact of teaching and outcomes across the range of the school's provision and will use the evidence they gather to inform the overall evaluation of pupils' achievement, the quality of teaching, and the impact of leadership and management on raising standards. When making the key judgements, inspectors will give particular attention to the teaching of literacy, including reading, and mathematics.

So what does that mean for us as teachers and leaders of mathematics in school? I'd like to start by thinking what that might mean for pupils; the ideal would be that as they move through the school they encounter consistent use of mathematics whatever subject they are working within and when they encounter discrepancies, their teachers are aware of the differences and can talk confidently about why they occur (a curved *line of best fit* would be a pertinent example!). Seems reasonable doesn't it? But in practice that doesn't always happen.

Take the time to go for a walk around your school. Take a camera with you and collect some examples of good consistent practice and points for future conversation. You may want to spend some time in Humanities (especially Geography), Science and Design Technology but don't ignore Modern Foreign Languages (bingo in the target language) and Art (negative space or perspective) for example.

Note down some of the engaging contexts that these subjects provide which can be used in our mathematics lessons; the formulae sheets provided in the triple science physics examination could be a valuable source when we are considering skills of substitution and rearranging. And, as I mention rearranging, how do your science department enable pupils to rearrange the speed = distance/time formula for example? You could make a video and upload it to your school VLE or YouTube which could then be used in science lessons and mathematics lessons?

Our Tales from the classroom recently considered the issue of numeracy in a secondary school and there is a Departmental Workshop, Working with other departments, which considers some other possible actions that could be taken. Do tell us how you are giving your pupils a consistent experience across the curriculum.

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A resource for the classroom – Number and Shape Mystery

In order to equip our pupils to function mathematically in society, they need to be able to solve problems using mathematics. I don't think there is much controversy about that, is there? What is difficult is how we, as teachers, give pupils the confidence to solve problems and how we develop our pedagogy to allow that confidence to grow. I was in the classroom of a colleague this week as part of a learning walk in the school and was delighted to find pupils sitting in groups with a large piece of sugar paper and sets of cards, trying to solve a problem (it was the Zin Obelisk task from NRICH). The teacher was incredibly apologetic because she said she wasn't doing any teaching – I had to highlight the great learning going on in the room and hoped that she had had an impact on that!

In order to build up the skills needed to solve the Zin Obelisk problem, you need to start small so here is a simple mystery using basic properties of numbers and shapes to encourage pupils to work systematically and make deductions.

The grid at the top of the page is a possible support for pupils who really find it hard to organize themselves but for most pupils, deciding how to record their findings is part of the problem solving skill.

For pupils who find this easy I usually ask them:

- do you need all the clue cards? Are there any that could be left out?
- which was the most important card?
- could you write two more clues to help other pupils through the puzzle?

If pupils are finding this activity hard then I might stop them after a few minutes and ask them to share how they are getting started, or organising themselves.

I know that I have one class that need to focus on communicating their findings so I will ask them to make a poster with the answer on but also explaining how some key cards were useful – for example if we know that the sum of the numbers is 17 and that all the numbers are different and prime what deductions could they make from those two pieces of information.

When you use this task – try to think about what you are doing in the classroom. Will you be doing *'no teaching'* or perhaps will you be noticing how your carefully targeted questions enable pupils to make progress, or think about how your classroom layout and organisation has enabled pupils to improve their problem solving abilities perhaps? Do tell us about it.

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Focus on…the use of ICT to enhance learning in the mathematics classroom

The recent Ofsted report Mathematics: Made to Measure talks about 'the underdeveloped use of information and communication technology (ICT) to enhance learning' (paragraph 44). Pupils are using aspects of ICT in their personal lives to play games, communicate with their friends and access a wealth of information; using ICT in mathematics lessons is a great way of exploiting pupil interest and making mathematics relevant to the world in which we live. Here are some suggestions for integrating the use of ICT into your practice.

Mathematics: Made to Measure has examples of prime practice in using ICT in paragraphs 64 and 65, with other examples of the use of ICT in mathematics in paragraphs 66 and 67.

The Key Stage 3 strategy document Integrating ICT into mathematics at Key Stage 3 lists the opportunities for exploiting the power of ICT as:

- **Learning from feedback**
  The computer often provides fast and reliable feedback which is non-judgemental and impartial. This can encourage students to make their own conjectures and to test out and modify their ideas
- **Observing patterns**
  The speed of computers and calculators enables students to produce many examples when exploring mathematical problems. This supports their observation of patterns and the making and justifying of generalisations
- **Seeing connections**
  The computer enables formulae, tables of numbers and graphs to be linked readily. Changing one representation and seeing changes in the others helps students to understand the connections between them
- **Working with dynamic images**
  Students can use computers to manipulate diagrams dynamically. This encourages them to visualise the geometry as they generate their own mental images
- **Exploring data**
  Computers enable students to work with real data which can be represented in a variety of ways. This supports interpretation and analysis
- **'Teaching' the computer**
  When students design an algorithm (a set of instructions) to achieve a particular result, they are compelled to express their commands unambiguously and in the correct order; they make their thinking explicit as they refine their ideas.

How many of these opportunities do your pupils get?

The Bowland Case Study Crash Test enables pupils to use computer technology to explore the impact of car crashes under varying conditions. The Case Study includes lesson plans and worksheets needed for the series of lessons.

The NCETM microsite ICT and Digital Technology used in mathematics teaching includes self-evaluation materials, lesson reports and case studies, and links to numerous other useful resources.

The Mathemapedia entry Board Desk Head gives information about using an Interactive Whiteboard to enhance teaching in mathematics linking to research reports and some IWB files.

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5 things to do

If the idea of Mathematics and the Battle of Trafalgar interests you - read Peter Ransom's article on the Guardian Teacher Network.

Have a look at the online resource A maths dictionary for kids, which contains readable and well-illustrated definitions of mathematical terms. Another part of the website has examples of mathematical charts which may be particularly useful if you are working on mathematics across the curriculum.

Create a Twitter account. There are some mathematical tweeters that you may find interesting. These include @mrbartonmaths, @geogebra, @KennyCounts and @NCETM of course! Do recommend some more.

Download some of the FREE resources from the ATM website. You could look at the samples from the publication Reaching the Core of AS Mathematics.

Prepare to watch the Royal Institution Christmas Lectures 2012, The Modern Alchemist, or watch the 2011 lectures, Meet Your Brain.

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Tales from the classroom

Algebra is difficult isn't it?! How many times have you been talking at a parents evening only to have a mum or dad tell you that they don't really see the point and that it's just too hard?

I've been thinking about algebra quite a bit recently. I have a year 9 class who are fairly able (they're entering for the higher tier of GCSE) at most of the curriculum but whose algebra is way below par. It's not one or two students, it's the whole class! I've had to do some serious soul searching about what their experience of algebra has been up to now and this reflecting has also got me thinking about what algebra is to me.

I did some assessment activities and found that I was getting very fundamental errors ($x + x^2 = x$ is a classic but I don't expect it from a higher GCSE group!) so decided to start from the beginning – collecting like terms.

I gave the class a challenge – to see who could be the first to calculate the answers to ten questions mentally.

The first problem I posed was 3x4 + 2x4 + 5x4

The first person with the answer was the one I expected: he's very good at his tables and fairly accurate with mental arithmetic. He gave the answer and looked at me strangely when I asked him to explain his method. "Well Sir, I did three times four then two times four then five times four and then added them together" he said, slightly puzzled by me asking such a simple question!

I then wrote on the board 2x9 + 6x9 + 5x9 – 2x9. Again, the same student was first with the answer and with the same explanation, he'd calculated each of the multiplications and then added and subtracted as appropriate.

Before I started to write the third calculation on the board I heard a gasp of realisation from somewhere else in the classroom, it was the sound of a light bulb going on!

I changed my mind about what I was going to write and went for a calculation that would be hard to work out without spotting the structure. 3x19 + 5x19 + 4x19 – 2x19 and almost instantly was given the answer 190 from a new part of the room. On asking for an explanation the response (from a usually quiet girl) was very different to the previous. She said something like "I spotted that there are three nineteens, five nineteens and four nineteens so I added them together to get twelve nineteens, then took away two nineteens which left me with ten nineteens which is one hundred and ninety." There was the sound of agreement and understanding around the room. I gave them a fourth calculation with multiples of 261 to tackle and, almost as soon as I'd finished writing, was met with a sea of hands offering the answer.

Having gone from some relatively simple cases through some using 'more difficult' numbers, I felt that now was the time to generalise and so I put on the board $5a + 3a + 7a - 2a$ and was met quickly with the correct answer. I then asked the class to write me four more similar questions which also gave the answer $13a$.

Now I know that this is a fairly able group but I was struck by how quickly they went from not being able to simplify something as simple as $3x + 5x + x$ to being able to write their own questions, and all without me having to offer any instruction.

I also know that there are loads of ways of teaching this topic which would be just as quick (if I've got 3 apples and 5 apples and another apple how many apples have I got?) but, for me, the strategy that I used fitted in with my understanding of what algebra is (I don't think that a is a quick way of writing apple because mathematicians are lazy, I think that a is a variable that can represent any number). For me it's about looking at the structure behind the relationships and writing those in a general way. I'm delighted to have found a way of starting this topic which is as efficient as any other I know but which also offer an insight into the structure of the maths that we're working on.