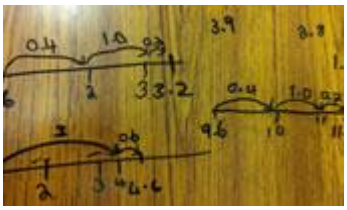
Secondary & Further Education Magazine 96



National Centre for Excellence in the Teaching of Mathematics

Welcome to Issue 96 of the Secondary Magazine (incorporating FE)

96 is the seventh number that looks the same when written upside down: can you work out the others?

This issue contains items which range from the trivial, through the interesting to some fundamental questions for us as teachers of mathematics; we hope there will be something to interest and engage you.

Contents

From the editor: writing on the table…

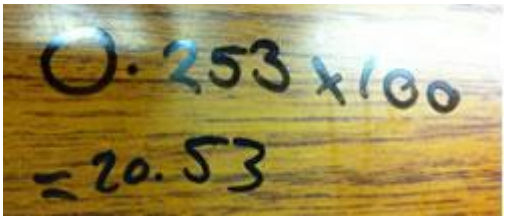
As a child I was fascinated by the story of Belshazzar and the writing on the wall – I couldn't work out how the disembodied hand wrote on the wall? Was it bloody? How did it move? The famous Rembrandt picture did not answer all my questions! Now, the drama of that moment in Walton's amazing oratorio Belshazzar's Feast makes me tingle every time I hear it: *Thou art weighted in the balance and found wanting* (28 minutes in).

One of the most dramatic changes to learning in my classroom has happened in the last year, not from writing on the wall but from writing on the table. Having spent years checking my tables for graffiti, I find I am now encouraging pupils to use the table as an extended work area. For some time, pupils have had access to a mini whiteboard and pen to respond during whole class interactive sessions and for their jottings in everyday tasks, but after watching a TV series last year I decided to experiment with the idea of table writing; the pupils loved it – how naughty they felt! After some initial opposition amongst the Senior Leadership Team, my Deputy is now converted after some positive lesson observations.

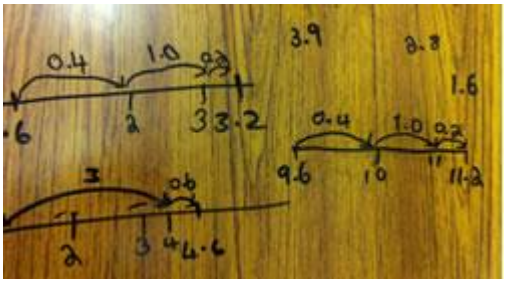
A note of caution here: there are some dry-wipe pens that do exactly that and wipe off tables leaving hardly a trace; others are more problematic, so do test out on a small area first. I also had some early conversations with my cleaner to ensure that we could negotiate a way to keep the classroom as a clean, tidy, stimulating learning environment.

So why am I making a feature of this? So what?

There are comparisons with pupils working on small and big pieces of paper but I think this is slightly different: pupils now have access to huge scribbling area to record their thoughts; they are not restricted to the confines of a white board which seems to liberate them. This results in more examples, more ideas and deeper thinking. They are more willing to commit themselves to the table as they know they can rub things out and leave no permanent record if they are unsure about something; the example below gave me a good indication of how to plan my next lesson on multiplying and dividing by powers of ten.



As you can see there are times when pupils are so proud of their jottings that they want a more permanent record which can easily be provided by a photograph (a colleague recently showed me how to annotate photographs using Skitch):



Writing on the table could be the focus of a small scale action research project to examine and develop the impact of this small pedagogical change. You can read about some action research projects that other people have undertaken.

So what will your writing on the wall say?

> You have been weighed in the balance and…
> …been proactive in investigating the impact of changes to pedagogy in the mathematics classroom?

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A resource for the classroom – working with quadratic equations

Even within mathematics – a logical and factual subject? - individual teachers have their own preferred ways of explaining concepts to pupils. This particularly hit home to me recently when I saw the following written on a board at the end of the school day:

$$\begin{aligned} 6y^2+26y+20 &= 0 \\ 6y^2+20y+6y+20 &= 0 \\ 2y(3y+10)+2(3y+10) &= 0 \\ (3y+10)(2y+2) &= 0 \end{aligned}$$

I must admit that this is a path I haven't followed recently when working with quadratics. The next day we had quite a conversation about this way of factorising a quadratic which does make perfect sense.

A quadratic like	x^2+3x+2
could also be written	$x(x+1)+2(x+1)$
and factorised to	$(x+2)(x+1)$

This could also be demonstrated by a number pattern:

$$\begin{aligned} 1x2 + 2x2 &= 3x2 \\ 2x3 + 2x3 &= 4x3 \\ 3x4 + 2x4 &= 5x4 \quad \text{etc} \end{aligned}$$

For me, the most important thing is that pupils can see how this method works and that they are flexible in their approach to working with algebra so I used this card sort to try and explore further. Some pupils who had been struggling to factorise 'difficult' quadratics appreciated a change of tack whilst others preferred their original way. This then led me nicely into using 'the formula' to solve quadratic equations. How do your pupils work with quadratic equations?

Image credit
Page header: Furiously factoring by CarbonNYC some rights reserved

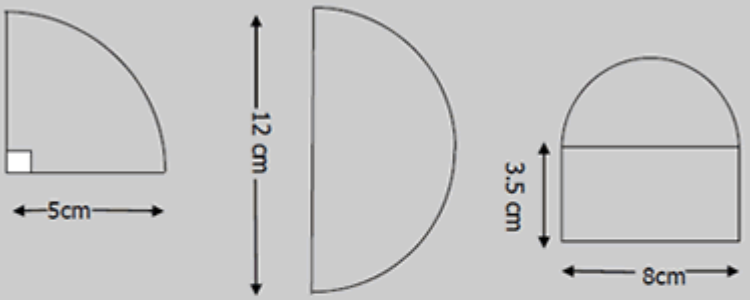
Focus on…assessment

Assessment in lessons is fundamental to measuring the progress and understanding of pupils. As a profession, we no longer limit our assessments to a termly test and are now able to be more responsive to the needs of individuals and groups within our classes. How do you use assessment to influence your teaching?

Mathematics: Made to Measure (Paragraph 79 onwards) talks about assessment in lessons and gives an example of prime practice:

Prime practice: good assessment through an interesting introductory activity

The teacher asked the pupils to calculate the area of these three shapes:



The teacher stopped the lesson after a few minutes having circulated to observe the pupils at work. She had recognised that their prior knowledge was insecure. Her questioning tackled errors such as use of incorrect formulae. She then modelled the solution for the semi-circle clearly, leaving the answer in terms of π (pi), before allowing the pupils time to complete the other two shapes.

Although the pupils had initial difficulty with this task, the three shapes selected by the teacher gave suitable variety and made pupils think more than a routine exercise on calculating the area of circles would have done. Her effective monitoring of their progress with the task meant that her intervention was timely.

The NCETM microsite Excellence in Mathematics Leadership identifies assessment as one of the key elements for a mathematics department. A sample assessment policy can be viewed as part of this key element.

A Professional Learning module that is offered by Education Services Australia considers the formative use of summative assessment and states:

Making formative use of summative assessment means using information derived from summative assessment to improve future student performance. For the teacher it involves:

- providing a range of assessment tasks and opportunities to make certain that a range of student learning styles are catered for
- teaching students to prepare more efficiently for summative assessment by making use of knowledge about themselves as learners
- making use of the results of summative assessment so that learning is emphasised.

For the student it involves:

- developing the ability to identify 'where I am now' and 'where I need to be'… and to prepare for summative assessment accordingly
- recognising that summative assessment experiences are an opportunity for further learning and a chance to improve future achievement.

The OECD Working/Policy Paper Integrating Formative and Summative Assessment: Progress Towards a Seamless System? by Janet W Looney suggests that

> *the assessment is formative if and inly if it shapes subsequent learning*
> (Black and Wiliam, 1998; Wiliam, 2006)

Kangaroo Maths has a range of resources to support assessment at Key Stages 3, 4 and 5.

5 things to do

View these Animated Factorisation diagrams. You could leave this animation playing as pupils enter the room - it might give them another image for prime numbers.

Download the Nuffield Foundation post-16 report, which talks about participation in upper secondary (post-16) mathematics education in seven countries, and aims to identify the factors that drive participation in mathematics post-16.

Become more fluent with GeoGebra? This link will take you to a variety of CPD opportunities provided by MEI, focussing on using GeoGebra.

Read about the mathematics behind the proposed changes to the lottery system in the UK as reported recently.

Did you know that...on a Google search page, if you type in the name of a commonly used numeral system, say, binary, hexadecimal or octal, Google will display the number of results it found for that query in the system you typed in.

Image credits
Page header Day 237 – Losing Ticket by daGoaty some rights reserved

Tales from the classroom

Why do we teach circle theorems? What's the point of them? It's one of the topics I have found it very hard to justify in any sort of practical terms. As one of my students wrote in a recent practice paper, 'Argh! This is Child Catcher maths! There's no need for it!'

This time round I was determined to look deeper into them. To teach them in a more interesting way than 'here's some things you need to remember'. Our scheme of work now includes a 'big picture' suggestion for each unit of work, a reason why we cover this and an idea of where it fits in the whole map of maths. In this it is suggested that the reason for circle theorems was as an introduction to the idea of mathematical proof and so I thought I'd better try to reflect this in my teaching.

I thought quite a bit about what the important points are in circle theorems and what I ended up telling students most of the time. I decided to start with an activity to help them understand what to look for, a sort of 'what's the same and what's different?' question but with a dynamic image. I made an interactive geometry file using GeoGebra (downloadable for free), and a set of always, sometimes, never cards to go with it.

I started the lesson by moving the point on the circle and asking the class to think about what stays the same and what changes as the point moves around the circumference of the circle. It was all fairly low level observation (there are two triangles, it's inside a circle…) and certainly nothing of the mathematical observation that is important for proof.

I left the image up on the whiteboard and gave out the cards (I say 'cards', I didn't cut them out but gave them the choice if they wanted to), and asked them to decide which of them were always true, which were sometimes true and which were never true. I was very impressed with the way that the conversation shifted and the pairs started looking at the 'important' things. I suddenly started to hear phrases like 'Ah! That's the radius isn't it? So it's going to be the same as that one there'. It felt that the class had started to look at the image with mathematical eyes having been given a little scaffold. It seemed to be the case that it wasn't that they couldn't follow the proof - simply that they didn't know what to look for.

The next part of the lesson was to use all of the 'always' statements to construct a proof that the angle was always a right angle and this proved too much for all but the most able in the group. I ended up working through it on the board in a traditional chalk and talk way although I was aware that the class were much more with me than they ever have been before on this topic. My conjecture is that they understood the image that I was working with and were only having to follow the logic of the argument rather than having to also understand the image

The part of the lesson that convinced me that I was on to something and that this was a path worth exploring further was when I put up a different animation and asked the class to prove that the angle at the centre was always double the angle on the circumference and, to my delight and amazement, almost everyone in the class drew out a diagram, labelled up the radii and marked them as being equal, identified some isosceles triangles and had a decent go at a proof. This was just 30 or so minutes after they'd been making statements about 'it's inside a circle'!

I can't help thinking that I didn't do much 'teaching' that day, despite the chalk and talk episode. The key principle was focussing the class' attention on the important things, in this case the radius and isosceles triangles, and letting them work the rest out (once I'd modelled the sort of argument they needed to construct). I'm going to try to keep looking at that part at the top of the scheme of work that tries to answer the 'why are we doing this?' question and think about the skills needed. I'm much happier

justifying covering circle theorems because they help us to construct a reasoned mathematical argument than I am in trying to come up with a practical reason!

You could also look at the NCETM Departmental Workshop, Circle Theorems - Editor