Primary Magazine

Issue 7

National Centre for Excellence in the Teaching of Mathematics

Welcome to the seventh issue of the Primary Magazine.

In *Maths to share – CPD for your school*, we focus on the effective use of interactive whiteboards. The aim behind these articles is that you, as a mathematics subject leader or coordinator, lead a whole or part of a staff meeting on key issues in the teaching and learning of mathematics. If you use these, it would be great to hear how they have been received by your staff. Please add your comments to the Primary Forum, or post them below.
This issue's Up2d8 maths focuses on the opportunities for fractions and percentages within the context of money, as the last few months have seen closures of high street stores and massive sales reductions in others. solving.

Contents

to meet in the ICT suite or a room with sufficient PCs for colleagues to work in pairs. It would be helpful if your colleagues read the article Interactive Whiteboards from the NCETM Evidence Bulletin before the staff meeting.

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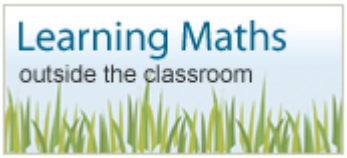
From the editor

This winter has been one of the coldest for many years, so learning mathematics outside the classroom might not be foremost in our minds. However, spring is on its way and this might be the time to consider looking at the manifesto Learning Outside the Classroom published by the DfES [now DCSF] in 2006.



The article Designing Kites Combining Maths & Art explores a 'School Grounds' project – one of the environments which the 'Learning Maths Outside the Classroom' microsite explores. It is a project for all ages involving the designing, the making and the flying of kites, which links to a wealth of exciting material. You might be interested in beginning a project such as this. If so click here to link to a professional development opportunity which includes three videos to help you:

- **Video 1:**
An Introduction to Kites: A maths lesson on constructing kites
- **Video 2:**
Looking For Symmetry: Good kite design needs maths
- **Video 3:**
Sky Full of Thoughts: Teacher reflections on constructing kites and the benefits to students

The interim report of the review of the primary curriculum was published on 8 December. It presents work in progress to put forward recommendations to create the best curriculum for primary children. Jim Rose has published an update which is worth reading.

The Advisory Committee for Mathematics Education (ACME) has produced a paper entitled Mathematics in Primary Years: A discussion paper for the Rose Review of the Primary Curriculum. Click here to read it. We would be interested in hearing your views: please add them to the Primary Forum.

You can make comments to QCA regarding the interim report, on their website: the closing date for responses is **28 February**.

Up2d8 maths

As the credit crunch continues into 2009 and we are now formally in a recession, well-known high street stores are either closing down, going into administration or struggling to keep afloat.

This issue's Up2d8 looks at Woolworths, the store that closed the doors of over 200 of its shops for the last time on 27 December 2008, and the rest in the following weeks leading to the 10 January, when the store closed for ever. It also looks at high street January sales which, in many cases, started early to try to get people spending again.

These two topics link well with fractions and percentages, within the context of money, which is the key mathematical focus of the spreads. There are also opportunities to explore currency conversion, our old monetary system and imperial and metric weight.

Click here to download the Up2d8 maths resource - in PowerPoint format.

The Interview

How mathematics has influenced my life
Interview with Dr Mark Biddiss

'Dr Mark' Biddiss is currently a science and mathematics education provider, teacher trainer and writer. He is one of the UK's leading and much sought after inspirational education providers to both teachers and pupils. He was co-founder and co-director of ProEducation Ltd, along with Dr Jasmine Pradissitto, which they started in 1996. Dr Mark was responsible for devising their highly popular 'Amazing Magical Science' and 'Amazing MatheMagical' shows and hands-on pupil workshops for 5 to 14-year-olds, as well as their INSPIREscience™ and INSPIREmaths™ teachers' CPD days.

Click here to find out more about Dr Mark, his work, and the resources he has available.

What were your memories of mathematics when you were at school?
When in infant school, I remember having no understanding of basic 'sums'. We used to get work cards from a box in the classroom, which each had about six basic sums to do. I used to just copy them into my maths book, fill in any number that came to mind in the 'equals' line, and then put the cards back in their box. I don't remember maths in junior school, though I must have done well in my last year because I got the three '1s' for reading, 'righting and 'rithmetic that you needed to get into grammar school.
In secondary school, I started well but plummeted to the bottom sets by my last year, where I eventually got a grade 1 CSE (equivalent to a 'C' grade GCSE). I stayed into the Sixth Form where I retook maths (and a few other subjects!) and got a 'C' grade 'O' Level (still a 'C' grade GCSE, but held in higher regard!). To be honest, I had little or no real interest in the subject at that time.

Although I do remember a couple of good maths teachers in my secondary school (names long forgotten though), I also remember some rubbish ones too. One in particular stands out in my memory because he reminded me of the hippy rabbit 'Dylan' in *The Magic Roundabout* children's TV show I used to watch as a child. This teacher was rather 'hippy-like' in many respects. Often in class he would get us to do work from a textbook, while he sat back in his chair with his feet up on the desk and gently strummed his guitar! He told me that I'd never be able to pass even my CSE at a good level.

Have you always been a mathematician, or is it an interest that developed during your working life?
From my school experience, you'll see that I was/am no natural mathematician! I started to enjoy and do well at maths at college, sent by my then employer, when I was studying on day-release and evening classes for my ONC in Mechanical and Production Engineering, followed by my HNC in Mechanical Engineering. I finally got a few good lecturers who taught me how maths was used, at least in the world of physical sciences and engineering. This 'applied maths' made all the difference to my appreciation and understanding of the subject.
In my first year at UCL, when studying for my Physical Sciences degree, I took an undergraduate course in pure maths just to see what it was like; I enjoyed it immensely! That said, I reckon that was only because I still had background knowledge of how to actually apply it in 'real' life.

How has mathematics impacted on your life?
Professionally it has been pivotal. In my first career in Mechanical and Structural Engineering, maths was a tool I needed to understand. When I was 26, I started lecturing and teaching about applied maths to adults at evening class, and soon after took on several primary and secondary pupils to privately tutor

maths (and science). In my PhD research on Planetary Geophysics, I needed a working knowledge of maths and statistics to help me analyse my data.
Then in 1996, I started my current profession of delivering lively and fun maths (and science) pupil shows, hands-on workshops and teachers' CPD training, in both primary and secondary schools. I have also written two teachers' maths books and the instruction notes for a 'Mad Maths' kit for an educational company.
Mathematical thinking has also aided me tremendously in successfully running three companies at the same time: two educational businesses and a small property rental business.

How did you get to where you are today?
By clear focus on goals, persistence and determination to succeed and 'make a difference', and hard, hard, hard work – no secrets there!

What is your most entertaining mathematics anecdote?
Hmmm…I think the story about one of my rubbish secondary maths teachers who reminded me of the character 'Dylan' in *The Magic Roundabout*.

If you could phone anyone from your past to say thank you for what you have learnt who would it be and what would you say?
My college maths lecturers for showing me what maths can be used for, thus getting my interest; my two university maths lecturers for stimulating my intrigue and pleasure in 'playing' with pure maths; and my *Magic Roundabout* hippy secondary teacher for showing me how NOT to teach maths and how NOT to inspire children about the subject!

What do you think could be done to help inspire more young people to enjoy mathematics today?
Personally, I would rip out much of the current content of the curriculum, I would ONLY teach 'functional' maths up to the end of secondary level (Year 11) which is useful in everyday life, along with the sort of fun and novel 'recreational' maths I use extensively in most of my maths shows, workshops and teacher CPD sessions. It is my opinion that far too much emphasis is put on number-crunching 'numeracy', and nowhere near enough on mathematics as a whole subject, including the sort of fun maths I use in my work. There should be a lot more brain-teasers and other logical-thinking puzzles too; from my experience kids of all ages enjoy this stuff!

When was the last time someone surprised you – mathematically speaking?
Hmmm…that's a hard one. I don't surprise easily! Certainly one of the last times was when the government's Education Secretary before the current one, Alan Johnson, made a much-publicised comment that we should make maths teaching more applicable and relevant to everyday life, or words to that effect. My surprise wasn't the content of what he said, because I fully agree with him, but more surprise that it took so long for government to realise that this was a good and useful thing to encourage! Am I being cynical here?

If you weren't working in a career that involved mathematics what would you be doing?
Science or applied psychology/personal development.

And finally, if you lived in a world of fractions and decimals, which would you rather be? Why?
Decimals, because I find them easier to understand and use.

What about if you lived in a world of cubes and spheres, which would you rather be and why?
Spheres; I just like them better. I think they're more interesting; somehow more natural, and prettier too!

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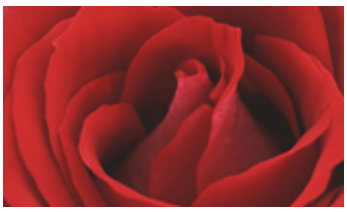


National Centre for Excellence in the Teaching of Mathematics

Focus on St Valentine's Day

As we all know, 14 February is St Valentine's Day. The first thoughts that spring to mind are likely to be hearts, flowers and Cupid.

There are several martyred Saint Valentines. It is thought that one or more of them was buried on 14 February. One Saint Valentine is said to have refused to deny Christ before the Emperor Claudius in the year 280 and as a result was beheaded. Before his demise, he restored the sight and hearing to his jailor's daughter. It wasn't until the Middle Ages, during **Geoffrey Chaucer**'s time, that 14 February became associated with romantic love. Sending Valentine's cards became fashionable in 19th Century Britain.

Today, in the 21st Century, around one billion Valentine cards are sent each year, making the day the second largest card-sending holiday of the year, beaten only by Christmas when around 6.5 billion cards are sent, 744 million of those in the UK alone. The US Greetings Card Association estimates that 85% of all Valentine cards are bought by women.

Did you know...traditionally in Norfolk, until recent times, a young man would knock on the door of his valentine and leave a small parcel wrapped in brown paper for her to find when she opened the door? The parcel would contain a love token, though no one seems to remember just what that might be. You could discuss with the children what the love tokens might have been. You might get some intriguing ideas!

Possible activities for:
Key Stage 2:
What percentage of men and women in the world send a Valentine card?
To find out:

1. Calculate 15% (men) and 85% (women) of a billion
2. Find the population of the world from a website such as the US Census Bureau
3. Assume any population is split 49.5% women and 50.5% men, though the children could search the internet for more accurate values. Find the percentages of the male and female populations which match the figures obtained in 1 above.

Explore sending Valentine cards to particular areas of the world. Find their populations and repeat the calculations from above. For example, what if cards are only sent in:

- Europe
- USA
- Canada

Key Stage 1:
Develop the tradition in Norfolk of delivering gifts in brown paper packages. You could ask the children to explore how big a rectangle of brown paper they would need to wrap a box.
You will need a selection of boxes (not too big), lots of brown paper and some large sheets of centimetre-squared paper.

Cut a rectangular piece of brown paper just big enough to wrap up a box leaving no gaps. Lay the brown paper on the centimetre paper and work out or count how many squares it covers and make the link to area. Open out the box, cut off any overlapping flaps. Draw around the flattened box on

centimetre paper and work out or count how many squares it covers. Collect everyone's results and add them to a table in order of box size. Ask the children what they notice about the difference between the two figures. This is an open-ended activity with no specific answer, but ample room for exploration and discussion!

Area of box	Area of brown paper

In the Suffolk Primary Strategy Empty Number Line materials, there are two sections on hearts – Hearts in Love and Broken Hearts. Both are used to focus on number bonds to 10. The team recommend that you display a set of two hearts entwined, with each pair showing a number bond to 10. A second set of broken hearts, cut so that only the correct number bond to 10, will complete the two-piece jigsaw and can be laminated for frequent use.

The authors write:

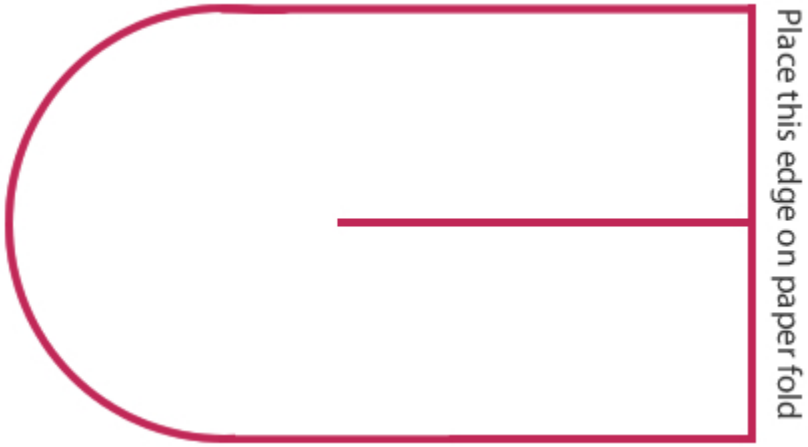
> *We know that the whole 'Hearts in Love' concept is rather silly – but that is deliberate. The children – especially some boys – may groan, but it is the silliness that helps them remember – and it also gives you a shorthand way of referring to these number facts. It's easier to say 'Remember the Hearts in Love' than 'Remember you could use your Number Pairs That Add to Ten here'. Believe us – it works – try to put aside any initial resistance or adult distaste. One teacher started the HIL off with a display of all the Hearts randomly placed, with a small envelope next to each one. When the children took out the letters in the envelopes, they said things like 'Dear 8, I think you are wonderful, signed, 2'. Of course you will have noted that 5 has no pair: 5 is in love with himself. His letter said 'Dear 5, you are THE GREATEST, signed, 5'. Now that's really silly. The children were amused by this display for a long time.'*
> © Copyright, Suffolk County Council Children and Young People 2006

Although these materials are not freely available, it is easy enough to make your own using the heart from the basic shapes in any word processing program. Alternatively, if you are a little more low tech, draw around a heart-shaped chocolate box! Draw around the heart six times, using different coloured papers if you wish. As described in the 'Starter for 10', add a number to the front and back of each heart, so that any one heart carries a number bond to 10. Laminate and use in your oral and mental starters.

Display one side and ask the children to tell you what must be on the other side. Extend for number pairs to 20, multiples of 10 to 100 and multiples of 5 to 50.

During this activity, as the children tell you the number, write it on the board and when you have a few, order them on number lines from one to 10/20/100 as appropriate and compare pairs of numbers using the symbols < and >.
You could also use these cards for generating numbers for addition, subtraction, multiplication and division calculations.

Foundation Stage (and beyond)
Use the template below to make hearts. You will need two for each heart. Fold the paper and place the template along the folded edge. Use two contrasting colours for a pleasing effect. Cut the slit up the middle and interweave the two pieces to make a small pocket. Write and cut out a number, or use a wooden or plastic one, to go inside. You could then ask children to pick a heart, find the number, read it and put the appropriate number of small items in the pocket. For a bit of fun, you could write a message or simple mathematical riddle or puzzle to go inside. Enlarge the template to make larger hearts.



To find out more about St Valentine's Day and its origins, visit these websites:

St Valentine
Valentine's Day
Valentine's traditions

Starter of the month

EYFS
Hearts in order

Use the shapes tool on the drawing part of your word processing programme to draw large hearts. Print out hearts with the numbers 1 to 9 (or 0 to 10) and laminate. Provide a washing line and pegs for the children to peg them on in order.

KS1
Hearts in love

Draw or print out six large hearts, big enough for everyone to see (see Focus on). Add a number to the front and back of each heart, so that the total of the two numbers is 10. Display the hearts one at a time but quickly, asking the children to tell you which number must be on the reverse of the heart. Shuffle and repeat. Extend this idea to number pairs to 20 and then multiples of ten to 100. Then put the hearts to one side and ask the children to answer quick fire number bonds to 10 or 100 questions...

KS2
Heart delivery

You have three cards to deliver. The first one is for A, who lives 5km away. The second one is for B who lives 7km away and the third is for C who lives 9km away. You must start and finish at home.

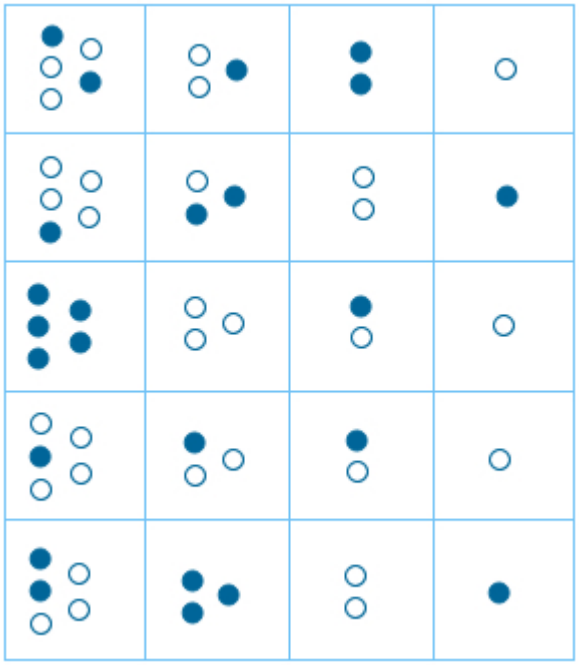
Everyone is out so you'll have to use your bike. Can you find the shortest route? Dad arrives home and offers to drive you in the car. Since he is in no hurry, what is the longest route?

Click here to download this activity sheet as a PDF.

A little bit of history – Inca number system

The Incas were an ancient people who lived between around 1200AD and 1533AD. Their empire consisted of about 12 million people, spanning a territory stretching from Ecuador to northern Chile. This people of this empire built vast cities, developed extensive road systems and treated their citizens fairly...and all without a written language.

The Incas might not have had a written language, but according to research they did invent a number system that might have been used to make complex calculations. The main evidence for this was the discovery of mysterious objects, in the form of geometrical tablets, which might have been used to store units of information. These are known as *yupana* and appear to be a type of abacus.



A Spanish priest called José de Acosta, who lived among the Inca from1571 to 1586, described the way they counted using their *yupanas*:

> *To see them use another kind of calculator, with maize kernels, is a perfect joy. In order to carry out a very difficult computation for which an able computer would require pen and paper, these Indians make use of their kernels. They place one here, three somewhere else and eight, I know not where. They move one kernel here and there and the fact is that they are able to complete their computation without making the smallest mistake. As a matter of fact, they are better at practical arithmetic than we are with pen and ink. Whether this is not ingenious and whether these people are wild animals let those judge who will! What I consider as certain is that in what they undertake to do they are superior to us.*
> José de Acosta in his book *Historia Natural Moral de las Indias*.

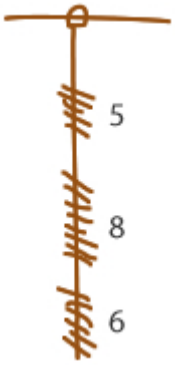
For more information about *yupanas* click here.

You could ask your children to make a *yupana* and investigate how to make numbers based on our number system of base 10.

In addition to the *yupana*, they were able to track all important facts required to rule such a vast empire by using a memory tool made of knotted strings called a *quipu* or *khipu*. Very few of these *quipu* are left today, but there are modern versions so people can learn about the old ones from these.

Quipu were basically thin strings looped around a larger cord. Knots of coloured thread or string were then tied around the thinner strings. The positioning of the knots indicated the value. The closer to the large cord a knot was placed, the greater its value.

It appears that the Incas worked in a system that was base ten, although some argue it was base seven, and others base forty! The example below shows the number 586 made on one thread. There are five touching knots tied close to the main cord representing the hundreds, a space then eight touching knots tied below for the tens, another space and then six touching knots tied near the free end of the string to represent the units/ones.



For larger numbers more knot groups were used, one for each power of ten, in the same way as the digits of the number system we use. To distinguish between different things that were being counted coloured threads or strings would be used for example numbers of cattle might be recorded on green strings while numbers of sheep might be recorded on white strings.

There are many drawings and descriptions of *quipus* made by the Spanish invaders. Here is what Garcilaso de la Vega, a man living at the time, said about them:

> *According to their position, the knots signified units, tens, hundreds, thousands, ten thousands and, exceptionally, hundred thousands, and they are all well aligned on their different cords as the figures that an accountant sets down, column by column, in his ledger.*

The information for this article was found on these sites:

MacTutor History of Mathematics
Wichita State University
Australian Broadcasting Corporation (ABC)
Washington State University

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Maths to share – CPD for your school

Effective use of interactive whiteboards

You will need to meet in the ICT suite or a room with sufficient PCs for colleagues to work in pairs. Ask colleagues to read the article Interactive Whiteboards from the NCETM Evidence Bulletin *before the staff meeting.*

Discussion of the paper

- Consider how you use the interactive whiteboard (IWB) in your classroom. Do you use it mostly as a presentation tool or do you use it interactively with your pupils?
- Can you share with your colleagues an example where you have used the IWB interactively with success? What made it successful? How did the IWB enhance learning?

The interactive whiteboard can be used as a tool to:

- promote discussion
- develop problem solving skills
- embed using and applying skills.

However, as discussed in the above article, it is often used only as a tool by teachers for modelling, demonstration or presentation. There is wide scope to involve children in its use to enhance learning in mathematics.

Work through these examples of the effective use of an Interactive teaching Programme (ITP) and spreadsheet during your staff meeting, with one person taking the lead as the class teacher and colleagues acting as pupils. Encourage teachers to do one of these activities with their own classes adapting as necessary.

Area
You will need to display the ITP Area: click here for access.

Year 4 learning objectives:

- *Calculate the perimeters and area of rectilinear shapes drawn on a square grid by counting squares*
- *Solve problems and investigate shape, and measures.*

You might find it helpful to look at the PowerPoint presentation (click here to view or download) for further guidance.

After clarifying the meaning of area, the person taking on the role of 'teacher' should ask a 'pupil' to make a rectangle on the ITP that has an area of 12 cm by clicking squares on the grid. Ask other 'pupils' in pairs to discuss different options. Invite some to show their ideas on the grid. Discuss the whole number options: 4 x 3, 2 x 6 and 1 x 12. Model questioning by asking such questions as: Are there any more options? How do we know?

Focus on 3 x 4 grid. Ask them to work out the perimeter and invite 'pupils' to model finding it on the ITP. Agree methods: counting squares around the outside or adding the length of the sides. Establish that the perimeter is 14cm.

Ask the following questions:

- Can we remove any squares from the edges of the shape and keep the perimeter the same?
- What will be the area of the shape now?

Investigate what happens when one squares is removed.
Agree that the area is now 11cm^2.
Invite 'pupils' to choose a square to remove, remembering to replace the previous missing ones each time. Through their efforts they should realise that the perimeter changes depending which square they remove. Record examples (CTRL+Print screen) and save in word document or IWB to display and record for future discussion.

Using 'pupil' examples, establish that corners can be removed and the perimeter will still be 14cm but other squares will increase the perimeter to 16cm. Discuss why this is.
From this, one can conclude that shapes with the same areas can have different perimeters.
This type of activity can be extended, for example, into symmetry: which shapes have a line of symmetry/more than one line of symmetry?
The IWB can also be used interactively to facilitate discussion and reasoning about perimeter and area, pentomino investigations and other shape activities.

This example uses an Excel spreadsheet; the decreasing number grid which illustrates an example not so much of an interactive session but a good example of an activity using ICT that promotes discussion.

You will need to display the Excel spreadsheet: decreasing number grid.

Year 2 learning objectives:

- *Count on/back in steps of 1, 2, 5 and 10 from various start numbers;*
- *predict whether the sequence will contain all even numbers, all odd numbers or alternate then check by counting;*
- *record sequences and describe patterns within the numbers;*
- *find missing numbers from sequences and explain reasoning*.

Set the grid up as follows:
Choose 5 columns, set the step size to 2 and the start number to 128. Reveal the first, third and fifth numbers. Ask 'pupils' to identify the second and fourth numbers. Demonstrate capturing this part of the sequence on the IWB. Use it to annotate on as you get feedback from 'pupils'.

Next ask what the sixth number will be, and follow up by asking how they know this is the case.
Repeat asking for the 10th number and the reasons for making this choice.
At this point demonstrate adding annotations to the whiteboard file.
Reveal the sixth and 10th numbers on the grid.
Say that instead of asking what a number in a given position is, now you want to know the position of a given number in the sequence. Ask 'pupils' where in the sequence the numbers 76, 68 and 94 are positioned. At this point, invite individuals to come to the board and highlight where the number is.
Again, follow up by asking how they know this to be so.
Finally, say you are looking at the last three rows on the grid. Ask 'pupils' to suggest any numbers that are in these rows and would be revealed. Again, allow time for them to work together, make jottings and explain their thinking.

Independent task/extension. Grids can be printed off and you can ask children to generate sequences which start with 8 and have the number 58 in the sequence.

Questions to ask yourself:

- Do I use the IWB as an interactive tool or do I use it mostly for presentation, demonstration or modelling?
- Do I use the renewed framework to help plan in ICT opportunities?
- Do I give clear feedback or do I leave answers dangling in uncertainty?

Next steps
Some of the ITPs have very specific titles which lead people to think they can only be used to support teaching of that aspect of maths – don't be fooled by the title. Adapt them to support other concepts. Think about more generic uses.
Choose five ICT resources from the Primary Framework and think about how you could use these more efficiently. For example, the author of this article likes to use 'Measuring Cylinder' to discuss estimation, rounding, and addition of multiples of 10 and 100. Can you see how this could be used?

The above examples show how the IWB can be used in a more interactive way to promote children's understanding of mathematics. Could you work with a colleague to plan IWB-based activities aimed at increasing pupils' involvement in discussion? Could you observe each other use IWBs and discussing effective approaches? Bring examples and feedback to the next session for a brief discussion.

Interested in this fascinating subject and keen to find out more...?

NCETM Teacher Enquiry Bulletin How can we use interactive whiteboards effectively for mathematics learning?

Davison, I. (2003) Using an interactive whiteboard to facilitate pupil understanding of quadrilateral definitions. In Pope, S. (Ed). Proceedings of the British Society for Research into learning Mathematics (23) 1 pp. 13-18

Drews, D. & Hansen, A (2007) Using Resources to Support Mathematical Thinking: Primary and Early Years. Exeter, Learning Matters

Gage, J. (2005) How to use an interactive whiteboard really effectively in your primary classroom. London, David Fulton

Knight, P., Pennant, J. and Piggott, J (2004) What does it mean to 'Use the interactive whiteboard' in the daily mathematics lesson? Micromath, 20 (2)