Jumping on the bandwagon

Barbara Langford, the Director of Studies at Westbourne House and author of the Common Entrance workbook *Keeping up with the Joneses*, discusses the latest in the world of numbers

Few would dispute the need for basic numeracy, but what next? A command of mathematical thinking transfers into problem solving for the rest of one's life. Not just for engineers and computer buffs, but all walks of life. Despite this, many classrooms teach a mathematical method, expect pupils to replicate it and then retain the abstract method for future use.

About five years ago, I was increasingly concerned about the problem solving skills in the school where I teach. Why did pupils always preform worse on the calculator paper, which had worded problems, than on the non-calculator paper?

It was at that time I had my first sight of some of the techniques from the Singapore methods of teaching from Bernie Westacott of Newton Prep. I went to a talk about giving children the heuristics to solve mathematical problems, in particular 'bar modelling'. We were taken through worded problems from Year 1 to Eton Scholarship problems and shown how the mathematics could be unpicked. Below is an example of a Year 8 simultaneous equation question that is solved using bar modelling to reduce it to logic.

In March 1978, Jim Callaghan's Labour government informed Parliament that it would 'establish an inquiry to consider the teaching of mathematics in primary and secondary schools in England and Wales, with particular regard to its effectiveness and intelligibility and to the match between the mathematical curriculum and the skills required in further education, employment and adult life generally'.

What followed was the 1982 Cockcroft Report. Amongst the recommendations of the report came the following:

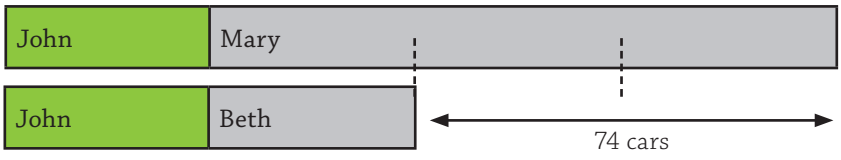
- maths requires hard work and much practice
- teachers should not expect pupils to commit things to memory without understanding them
- excessive concentration on the purely mechanical skills of arithmetic will not assist the development of understanding
- problem solving should be at the heart of all mathematics teaching

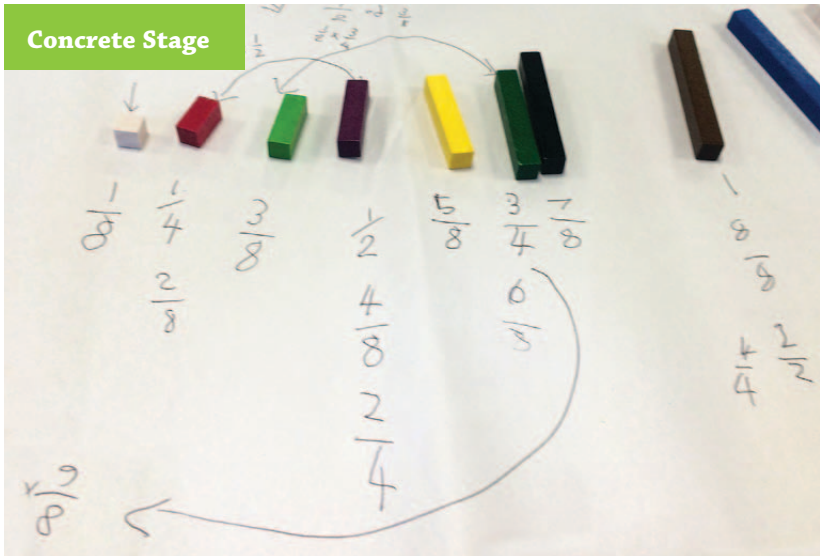
John and Beth together have 57 toy cars. John and Mary together have 131 toy cars. Mary has three times as many toy cars as Beth. How many does John have?

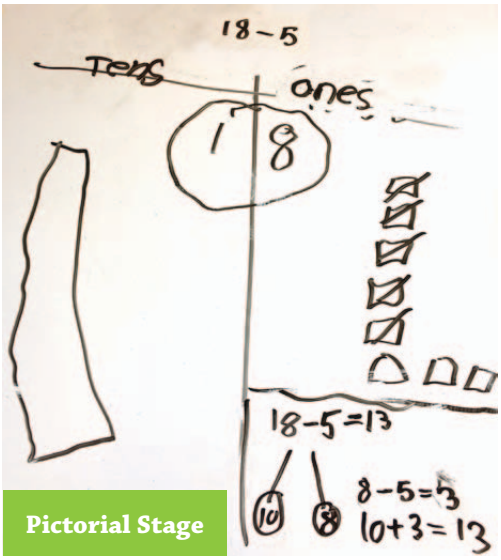
Step 1: Draw John and Beth

Step 2: Draw John and Mary

Step 3: Now we are told that Mary is three times as much as Beth. So we will compare the bars.







Sadly, in Britain, we skimmed over much of the report but the Singapore government at the time decided to use it. Now 30 years later, they are regularly in the top three countries in the world for maths whilst the UK was 23rd in the latest PISA tests. There is much coverage of 'Asian' maths and how it involves lots of rote learning and huge amounts of time spent on maths. With the Singapore scheme that we have adopted (INSPIRE Maths by OUP), this is not true.

With Singapore mathematics, the mathematics becomes a tool for solving problems and developing thinking skills rather than a means to an end. It focuses on knowledge acquisition through problem-solving, as well as creative thinking, independent learning and knowledge application. By developing critical thinking, it enables pupils to make the connections between topics right from the start of their mathematical journey. The most important aspect is that it gives pupils the tools to problem solve.

Each topic is broken into the distinct sections; concrete, pictorial and abstract and finally the much talked about 'mastery'.

The Concrete Stage:

New concepts are introduced in a problem-based setting so that young children talk about the problem first. Concrete apparatus is introduced and problems modelled practically. The language of mathematics is used and interpreted through objects.

Pic 1: *Understanding equivalent fractions at the concrete stage using Cuisenaire rods.*

The Pictorial Stage and the Bar Model Method:

Once pupils are confidently solving concrete problems, the pictorial stage is introduced. The pupils are shown how to link their practical activities with the abstract questions using pictorial models. This pictorial or visual stage is vital as it is a tool that can be used at all stages and in exams. This stage includes the introduction to the bar method for solving problems.

Pic 2: *Transferring the concrete multilink into a pictorial representation*

The Abstract Stage:

This is the actual numbers on the page.

The Mastery Stage:

Pupils who tackle each problem through a variety of approaches have reached the mastery stage. The aim is for all pupils to be able to explain why methods work and not just how to do a method. This is done in two main ways:

Mathematical variation – in this the mathematical concept stays the same but the variation is in the mathematics. For example, addition stays the same but with or without regrouping.

Perceptual variation – the mathematics stays the same but it is looked at in as many different ways as possible. For example seeing fractions of circles, of strips, viewing it as division etc.

We have now been using the full Singapore scheme for a term and the benefits are evident. The students are all talking about mathematics with enjoyment and enthusiasm. They are already tackling far harder problems than you would expect from young children, while often only using numbers to 20. There have also been hidden benefits; the classroom teachers are really enjoying their maths teaching and are becoming more confident in themselves and in the mathematics, not just the mechanics of the skills. Finally, as the pupils are reading and interpreting problems, they are practising their literacy skills.

We will not see the full effects for a number of years, but we have all been excited and encouraged by the initial results and I am optimistic that this is the way forward to produce not just numerate children, but also great thinkers and problem solvers who will become useful and fulfilled citizens.