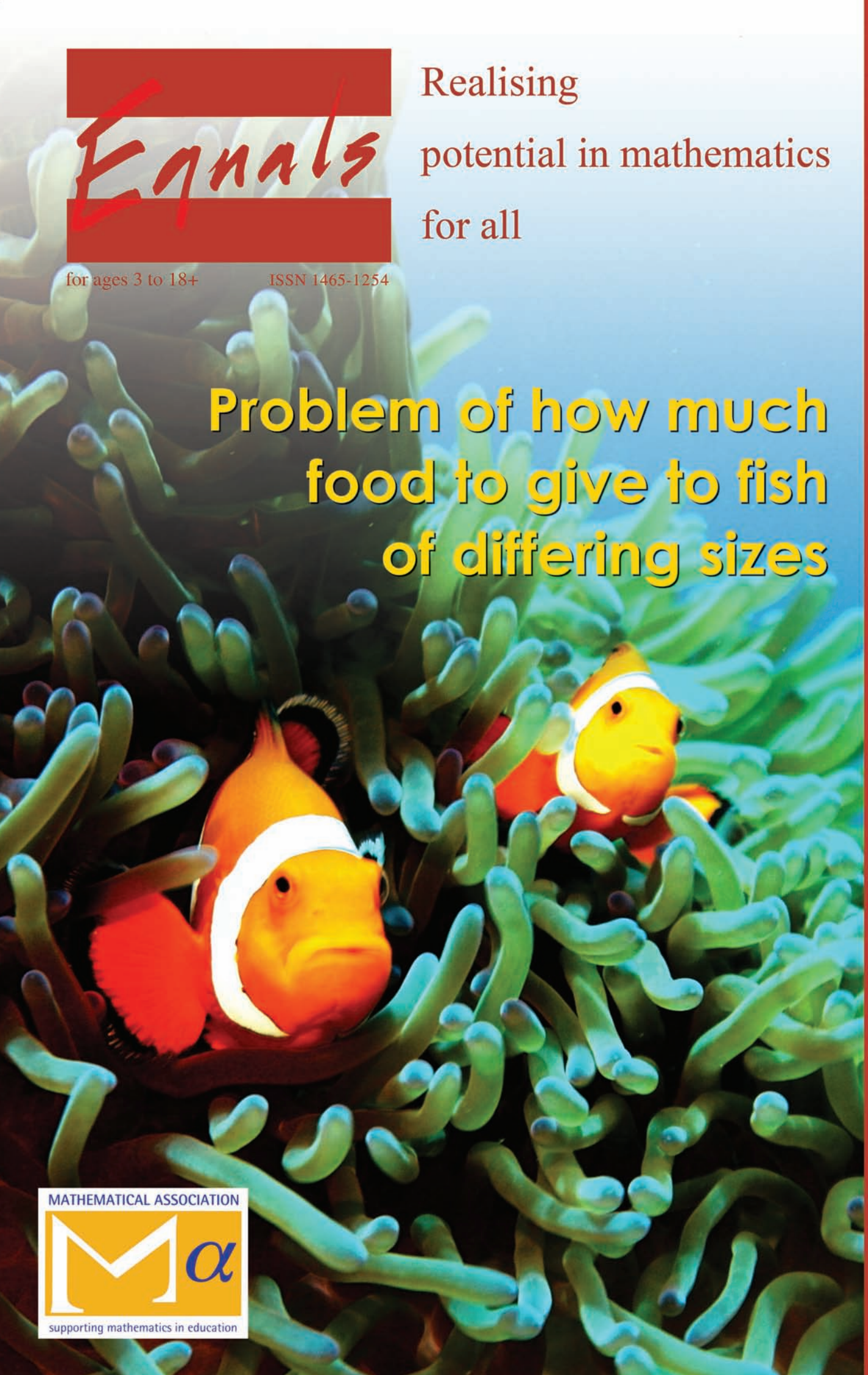
Equals

Realising potential in mathematics for all

for ages 3 to 18+ ISSN 1465-1254

Vol.16 No.1

Problem of how much food to give to fish of differing sizes



MATHEMATICAL ASSOCIATION
supporting mathematics in education

Equals

Realising potential in mathematics for all

Letters and other material for the attention of the Editorial Team to be sent to:
Rachel Gibbons, 3 Britannia Road, London SW6 2HJ

Equals e-mail address: ray.g@ukonline.co.uk

Advertising enquiries: Janet Powell
e-mail address: jcpadvertising@yahoo.co.uk Tel: 0034 952664993

Published by the Mathematical Association, 259 London Road, Leicester LE2 3BE
Tel: 0116 221 0013 Fax: 0116 212 2835 (All publishing and subscription enquiries to be addressed here.)

Designed by Nicole Lane
Printed by GPS Ltd. Unit 9, Shakespeare Industrial Estate, Watford WD2 5HD

Editors' page

Education seems, at the time of writing, to be at the forefront of many people's minds, with the idea of the importance of skills at the centre of the discussions and a great stress on life-long learning. Perhaps, at last, the pupils with whom *Equals* is particularly concerned: the other half, who fail the tests and sometimes - quite understandably - bunk off school, may be in for a little more understanding as to their needs and potential.

With the production by *The Guardian* - with the involvement of various members of the great and the good - of ***We are the people we have been waiting for***, education could be returned to pupils and their teachers rather than continuing to be dictated by politicians who do not really know what it is all about. And this would inevitably mean a recognition in the structure of education that not everyone will want to go down the academic route. Many are more interested in becoming skilled in some craft. I well remember way back in the dark ages of the early 70s telling Howard, a returned truant from my tutor group, that, although we both knew how inappropriate it was for him to be sitting at a desk for most of his day, that was what the law required so we just had to make the best of it.

The day before this conversation the rest of my tutor group had arrived back from a geography outing in the area surrounding the school armed with cans of spray that soon festooned the school with brightly clinging, coloured plastic strings. And where had they purchased these cans? From Howard, of course. He must have made a pretty profit from his day's work and had certainly showed himself to be well prepared to play his part minding his uncle's barrow in one of the town's street markets. He couldn't understand why he could not go and do that full time *now*. Although his record in mathematics classes had not been great, I was sure that any errors he made on the barrow in calculating or measuring would turn out to be in his favour.

We hope the contents of this issue of *Equals* will help our readers to offer their pupils an education acceptable to their own perceived needs and appropriate for their future lives. Some of you will have been doing this all along but others may have been put off by the over-regulation of the politicians. The testing regime has always excluded 'the other half' and there has been much discussion over recent years about what to do with truants – including fining their parents. If two generations have been thoroughly put off school such a reaction will hardly turn them back on. It is time the schools – and the politicians in their inappropriate demands of schools - started to think of ways to turn the truants on because there certainly are ways to do so.

Again I look back and remember other boys beside Howard. A group of fifteen year olds for whom the head had had the bright idea of timetabling an extra period of mathematics not linked to the rest of their mathematics lessons. As head of the maths department I thought I had to be the one to tackle this group and I got together all the maths games, puzzles and problems that I thought might appeal and spread them out along a bench down the side of the classroom and pointed them out to my class when it arrived – and then waited to see what would happen. It worked. Soon they were all occupied and by half term I called in the Head to show him the progress we had made. He was not impressed. He did not understand what was going on. But I would still recommend the method.

More old boys' networks?

Only 3% of executive directors of the UK's top firms are women – and more than 130 are without even one woman at board level.

There are 519 male MPs and 126 women.

In 2002 the British Film Institute listed 350 films in the last two years, only eight of them directed by women.

Only 32% of students studying GCSE economics and 41% of those studying GCSE business are girls.

In both the judiciary and police force, about 10% of senior roles are held by women.

Women represent 45% of the UK working population, but just 19% of the IT workforce.

The Observer 23.08.09

Multiplication tables game

Darrell Morgan writes about a way to make multiplication tables fun.

To begin the term with my new low ability year nine class I decided to recap on their multiplication tables. I started the lesson with a '3 times table song', from the Percy Parker collection. I then wrote out the three times table on the board with the corresponding division table alongside.

1 x 3 = 3	3 ÷ 3 = 1
2 x 3 = 6	6 ÷ 3 = 2
3 x 3 = 9	9 ÷ 3 = 3
4 x 3 = 12	12 ÷ 3 = 4
…….	

After some hesitation the pupils began to spot the pattern and were able to fill in the next line. We continued the table up to 12 x 3.

I got the pupils to list two multiplication facts and two division facts they knew from one number sentence. The example I gave was

If 7 x 3 = 21 then 3 x 7 = 21 and 21 ÷ 7 = 3 and 21 ÷ 3 = 7

Pupils were given some help to fill in the following table

Multiplication facts		Division facts	
6 x 3 = 18	3 x 6 =18	18 ÷ 3 = 6	18 ÷ 6 = 3
11 x 3 = 33			33 ÷ 11 = 3
	3 x 1 = 3	3 ÷ 3 = 1	
8 x 3 = 24		24 ÷ 3 = 8	
	3 x 2 = 6		6 ÷ 2 = 3
7 x 3 = 21			21 ÷ 7 = 3
	3 x 4 = 12		12 ÷ 4 = 3
12 x 3 = 36		36 ÷ 3 = 12	
10 x 3 = 30			30 ÷ 10 = 3
9 x 3 = 27		27 ÷ 3 = 9	
	3 x 3 = 9		9 ÷ 3 = 3
	3 x 5 = 15	15 ÷ 3 = 5	

The pupils were then given whiteboards and asked to devise a puzzle, game or some questions that would help other pupils to practise their 3 times table. I gave some ideas on the board and let the pupils have 15 minutes in their pairs.

Most pupils put questions on one side of the whiteboard and answers on the other with the task being to link the questions with the correct answer. Some gave a sequence with several terms missing e.g. 3, _, 9, _, _, 18, _, 24, _, 30, _, _.

Two girls developed a snakes and ladders type game with cards containing multiplications from the 3 times table. The board was numbered from 1 to 30 and twelve of the squares were card squares. Pupils threw a dice to move and if they landed on a card square were given a question from the 3 times table. Pupils moved on five squares if they got a question correct and stayed where they were if they got a question wrong.

One boy had drawn a 3 x 4 grid and had put the answers to the 3 times table in the grid.

3	6	9	12
15	18	21	24
27	30	33	36

He was not quite sure how to develop his game from here, so we discussed various options and decided on Noughts and Crosses. The game is for two players, each asks the other a question from the 3 times table e.g. 'What is the answer to 3 x 8?' If the opponent gets the answer correct they place a Nought on the correct square on the grid. They then have to ask you a question, if you get it correct you place a cross on the board in the correct place. The first person to get three Noughts or Crosses in a row is the winner. The game was introduced to the class and became an instant hit.

I have tried it with more able pupils and there is a quite a bit of strategy involved as well as a lot of practice (and reverse practice) of the tables. The game can be used for practising any multiplication table and the order of the numbers can be rearranged.

Cwmtawe Comprehensive School, Swansea

Outdoor teaching helps learning

Dawn King collects evidence of the value to reluctant pupils of walking through the New Forest with trundle wheels and long tape measures, and arguing about estimates of heights of trees.

Being passionate about outdoor education, I once quipped that teaching mathematics is my 'cunning disguise' to cover up for my 'playing outside'! I organised my first ski-trip in my NQT year, and became Educational Visits Co-ordinator in my fourth year of teaching. I now work in a centre for girls with emotional, behavioural and social difficulties (EBSD). Opportunities are available to us through schemes such as The Duke of Edinburgh's award. But I think learning outside of the classroom is incredibly undervalued, especially in an environment where every action of a teacher has to be justified and evidenced with numerical data.

Here I recount my exploration of the mathematical opportunities to be found in the environment and how they can be used to support students' understanding of concepts. By doing this, I hope to give validity to learning mathematics outside the classroom.

Doubly excluded girls

Historically, Pupil Referral Units (PRU) have been dominated by boys. A search of the government website edubase.gov.uk reveals that they are attended by significantly more boys than girls. For example, there are 8 PRU's in Hampshire attended by 350 students of which 256 are boys compared with 94 girls.

Sometimes, however, pupils get permanently excluded from mainstream education but also from Pupil Referral Units. The school in which this study is based caters for some of these pupils. It has been open for three years as a specialist day school catering for girls who have complex emotional, social and behavioural needs.

At the time of the research, all of the 12 girls attending the school displayed extreme behaviour, e.g. in sexual promiscuity with drug and alcohol abuse. Four had Attention Deficit and Hyperactivity disorder (ADHD) and three were on the Autistic Spectrum. The school aims to remove the barriers to learning through nurturing and fostering an ethos of mutual respect.

But how to practically show achievements in such conditions? Data is qualitative, with the danger of subjective analysis and questionable conclusions. One academic view is that becoming totally immersed in situations leads to insights coming to the researcher almost as a matter of inspiration, therefore they need complementing by systematically looking out for the occurrence of particular ideas or events.[1] So I looked out for little 'eureka' moments in an activity to identify the elements which helped learning, looked at how the environment affected their readiness and ability, and removed barriers to learning, and looked at how practical mathematics can strengthen conceptual understanding, and can give a sense of purpose and relevance.

I felt it was almost common sense to assume that taking mathematics lessons outside of the classroom would impact on students' motivation.

As a group, the girls with whom I worked, here named A, B and C, appeared to enjoy outdoor activities the most. I had formed a bond with them early on in my time at this school, and felt comfortable with taking them off-site. The activities were loosely based on readily available resources, but I had to collect evidence under a few headings, which forced me to look deeper.[2]

Impact on Motivation

I felt it was common sense to assume that taking mathematics lessons outside of the classroom would impact on students' motivation. But motivation was a much bigger concept than I first realised. For example, such work provoked greater curiosity, which lead on to sustainability. During certain tasks such as the estimating of tree heights on the local common, students seemed able to concentrate on the one task for a longer period of time than normal. Perhaps because they had a break between taking each measurement as they walked to the next tree they chose to measure. Some of the distractions which I thought to avoid in planning turned to advantage. For example, whilst working in the forest, dog walkers and such showed some interest in what we were doing. This provided the students with the opportunity to explain the activities to a 'third party'. This gave them the chance to work on their social skills, an important part of their education, particularly given the nature of their needs. It also enabled them to demonstrate their understanding of the activities that they were participating in. I also found that collecting primary data outside improved students' motivation once back in the classroom; this was evidenced by student C's response to completing her scattergraph - she simply refused to leave the room until she had completed it.

The least confident student watched her peer measure the girth of a tree and this gave her the confidence to have a go herself.

Evidence of 'removing barriers to learning'

When asked what they wanted from their school, one student responded with: 'a place where I can feel relaxed and safe'. It could be argued that mainstream schools can be quite hostile environments to a student with emotional, behavioural and social difficulties. The task of the mainstream teacher is to teach large groups of students whilst maintaining discipline, providing challenging yet accessible lessons whilst giving constructive feedback to each student. This is not the recipe for a relaxed teacher. It is almost like an educational conveyor belt. If the teacher is not relaxed, this feeling cannot be passed on to the students. This could be one explanation for why these girls in particular have not succeeded in a mainstream setting. Compared with my previous experience of mainstream schools, the environment of the school in which this study is set is a much more relaxed one. All staff are addressed by their first names and maximum group sizes are 4. Many students describe the school as their 'safe place'. Whilst taking mathematics lessons outside of the classroom brings with it certain physical hazards, it could be argued that it removes some barriers to learning. For example, whilst walking along and apparently chatting idly, students were much more disposed to ask questions. The environment we were working in coupled with the informality of the day enabled everyone to feel relaxed.

The tasks were all accessible to the students since they were presented in a non-threatening way. I found it quite remarkable that students did not appear to show any self-consciousness of the fact they were walking through the New Forest with trundle wheels and long tape measures. This enabled all students to become active participants in the tasks. Due to the different roles that needed to be fulfilled - the activities involving estimating tree heights and measuring their girth; the latter particularly required students to work cooperatively with one another. Student C who was the least confident, was the first to volunteer to write down the measurements whilst Student A took the measurements. Once student C had watched student A take a couple of measurements, she was willing to have a go at measuring herself. Watching her peer model the skill gave her the confidence to have a go herself.

She wouldn't leave the classroom before finishing her scattergraph.

Evidence of giving mathematics relevance

Students were able to make links between the fact that pine-trees grew more quickly than oaks by comparing the numerical data. They were then able to look at this on a graph comparing girth and age of tree and see how this translated i.e. that the line for pine trees was steeper which meant that they grew more quickly. We then discussed how this would impact on things such as the furniture industry and explained why so much furniture was made from pine rather than oak. It is often said that mathematics is 'a guide to the world in which we live' and I consider mathematics to be a tool to help us make sense of the world around us. The outcomes of this activity support these ideas.

Evidence of supporting understanding

The nature of the activities was such that they were a real departure from how the students were used to being taught. This made the experience more memorable for the students. This approach would also help students who are kinaesthetic learners by giving them a physical experience on which to attach the concept. Therefore, in the future, should they be required to work out the mean of a set of data, they could mentally place themselves back in the forest, which may improve their retention. This could subsequently translate into improved exam results.

Equals note: As Dawn King's piece shows, all research by teachers, even on a small scale, can offer insights which are in constant need of addressing by all. We welcome all contributions of this kind, whether originating from action research or as part of courses and certificates, especially if there is an effort at presenting it in non-bureaucratic or technical terms.

1. Martyn Denscome (2005) Doing Your Research Project, Open University press (p 271).

2. 'Pace counting' and 'Numeracy activities with trees' section of the Association of Field Studies Officers (NAFSO) publication: Numeracy through the Environment .

From the melting frontline

10% of the world's population – 600 million people – are living in areas vulnerable to a one-metre rise in sea levels. Helheim, an enormous tower of ice, used to move at 7km a year. In less than a year (2005) it speeded up to nearly 12 km a year.
Ice-sheet melting is adding 300-400 gigatonnes of water (equivalent to a billion elephants being dropped into the ocean) which could hasten a sea level rise of catastrophic proportions.

The Guardian 01.09.09

The Red Arrows

Since the Team was officially formed in 1965, the Red Arrows have completed over 4,000 displays in 53 countries.

Red Arrows Website

Let's all think maths anew!

Mundher Adhami writes about one of the best routes for developing responsive teaching skills. It is for groups of teachers to create new classroom mathematics activities starting from scratch, then try them together, and improve them. The mathematics is formally the same, but ways of teaching and learning are changing all the time!

There is much creativity in mathematics education at present. Just look at the choice of textbooks, websites and official documents. It is not only the Gifted and Talented children, or the SEN teachers who benefit from the plethora of new lesson plans, but all the mainstream teachers too.

But something is amiss. It seems that it has always been like this, but we still struggle with weak teaching and weak learning of mathematics. Just look at the real standards, not the test stats. But let's not go there!...

I think one of the main problems is that teachers themselves are 'consumers' of ready-made lessons and activities. Even when they plan lessons themselves, they do so starting from some ready-made assumption about the flow, or the order of steps in the topic. And the more creative teachers and writers produce their lessons and send them to be consumed. Multiple experiences by teachers might eventually turn into expertise, we hope. But often the role of delivering content gets in the way of the teacher really knowing what and how the children think and learn, and she just goes ahead and delivers the content.

teachers themselves are 'consumers' of ready made lessons

I suggest there are two ways out of this predicament. The first is that the lessons and classroom activities offered to teachers focus themselves not on formal mathematics, but on children's thinking and possible difficulties. Then the guidance on them should deliberately highlight classroom interactions, teacher listening and engaging with children's typical ideas on the topic. That means the lesson plans have to be trialled several times and common outcomes and misconceptions etc. noted. Some 'old' lessons and activities (e.g. in GAIM, CAME, much of SMP and SMILE) are of this type and I am sure many of the new ones are too. The guidance is variable, and I think without careful collective work in handling them, even the best are of limited value, except for teachers who are 'naturally that way inclined'.

This way of handling lessons carefully and collectively can actually be the second way out of the predicament. The lessons you use could be out there in the old texts, to be revised and looked at anew, perhaps with changed contexts and new slants to reflect the current youth culture. Or they could be fresh starts, with teachers starting from 'What do think the main problem is in teaching the X or Y topic?'

A group of us, mainly advisers who still teach in classrooms and experienced teachers in post (who often quickly end up as advisers) have been working in this vein for six years now. The work is based on the experiences of developing thinking maths lessons as part of university research based on socio-cognitive theories.[1] During the 11-year series of the publicly funded research projects we found that the best way to proceed is to be as responsive with teachers trialling the activities as we wish them to be with their pupils. That means you start with some idea of worthwhile conceptual challenges based on theory, but then are open to the teachers' own view of the difficulties. This in turn often means the teachers have to go back and reflect on their own learning trajectory, and also listen to their pupils. It seems that for many teachers, such reflection and listening have not happened before. So attending to how the children, and we ourselves, approach a concept from scratch, and talk about it in our natural daily language, seems to be a neglected aspect of teaching.

Currently we have become aware of how powerful this work is as a professional development route for both experienced and less experienced teachers. We are debating how to fund the continuing work, how to disseminate outcomes, and also how to promote the idea so that it works in the way we feel it is working for us. This article addresses this last point, and attempts to tease out the main principles of creating new *Thinking Maths* activities.

Here are some abridged quotes from the starting document on the collaborative design of new thinking maths activities.

General issues in designing Thinking Maths activities:

- The principles of design of CA (Cognitive Acceleration)-type activities need to be made explicit. These principles are not procedures but rather a combination of theoretical and practical considerations that must be coordinated. This line of activity is timely for experienced CAME teachers in the current climate in the country. Based on these principles we will be creating, testing and refining lessons for wider dissemination.
- Professional development models based on the creation and refinement of lessons need to be developed so that others can make use of them. Collaborative work on new thinking lessons has been shown to be more effective in improving pupils' learning than either generic thinking skills or narrow syllabus-focused or work-sheet based development. This may become a valid avenue for work with publishers.
- The main sources for new thinking lessons are:
  a) The detailed reasoning progression that underlies key mathematics topics. (Based on GAIM and CAME strands). This allows the topics to be explored in interactive and responsive whole-class pedagogy. This is closely related to the Assessment for Learning agenda now widely promoted by the DCSF.
  b) The fund of open mathematical investigations and practical problems, with documented or known pupils' outcomes. (Based on GAIM, ATM, BEAM and other materials). These are to be structured for challenging work in the appropriate range of attainment, to allow for creativity, enjoyment and excellence for all.
- The work will involve cycles of:
  * Whole group seminars around chosen topics and activities analysed for cognitive demand progression from the lowest to the highest levels, based on researchers' theoretical considerations and collective experience.
  * Small group planning work on appropriate pedagogy to address the challenges at the appropriate levels;
  * Team trial and observations with groups of youngsters, and
  * Reflection on practice, evaluation, and refinement of guidance for dissemination and further trials.

Cognitive match issues in selecting content

a) **Distinguishing the *reasoning agenda*** in the activity as distinct from the ***instruction or investigation*** agenda in a good lesson. In other words: distinguishing actual mental operations of generating mathematics in children's minds, mostly expressed in informal ways, from crystallised or bookish mathematics e.g in a good NNS lesson.
   - **How to avoid established or memorised knowledge and skills?** How to break through forms that create obstacles (e.g. the middle group pupils' insistence on the horizontal number line, using it as a procedure, with little attention to the position of a number on the number line in proportion to its size. They seem only secure in the procedural sense, so need extra attention to provoke independent thinking.) However, both the more - and less - able groups managed to generate ideas on the proportional placement of numbers on the number line. No such 'break-through' in the middle group,
   - **How to handle issues of context?** Sometimes context makes the maths easier; sometimes it adds to complexity. The simpler contexts e.g a simple story in familiar setting, and sensory motor activity of handling strips of paper may be preferable to using a whole set of materials, or complex stories, where diversions are possible.

b) **Distinguishing the cognitive range of children** from their mathematical knowledge and skills, as demonstrated through written tests.

Often children are graded in terms of school achievement in a way that does not match their real intelligence, i.e. the ability to process information in the mind and express themselves in informal ways. Hence the need to avoid giving too much credence to labels assigned to children, and to allow for surprise when a seemingly SEN child shines while a seemingly able child flounders because of an inability to think for themselves in a new environment.

There is **tension** between 'too-wide' a range in a group, and the need for open mindedness in assigning pupils to ability groups. We need to be careful about misestimating levels when we do not know the class. On the other hand an experienced teacher would recognise when the cognitive level differs from the achievement level of a pupil. We are having to develop a style of teaching that accepts that we do not know the levels of an individual pupil in the given context and challenge. Rather we increase the chances that the contexts and challenges are appropriate by attending to the range in a group!

how powerful this work is as a professional development route

Classroom trial issues.

These relate to the process of creating and trialing new Thinking Maths (TM) lessons or episodes in existing lessons.

- **Distinguishing near-strands in the mathematics - reasoning spectrum.** (Example of the Number lesson) While we assumed for the Number Line lesson that we were creating some access - or extension - cycles of an existing TM lesson, we found ourselves addressing a separate reasoning strand that seems to be ignored in the curriculum despite being of obvious value. In the existing TM lesson on the number line this is implicit, and now we have made it explicit. In effect we cannot beforehand, through mind exercise alone, plan a valid thinking lesson. Some aspects emerge only through open-minded trial and experiment with real classes.

  The distinction we made explicit is between:
  1. the number line as a model for quantity, which leads to recognition of equal intervals, organisation of number system e.g. in terms of 10s, 5s and 1s, proportionality, estimation

  and
  2. the number line as a procedure for calculation, either for both addition and subtraction, or at times for subtraction only, due to some misguided application of NNS practice. Here are issues of local 'cultures of teaching' leading to local cultures of learning by pupils.
- In the feedback following the trial we discussed issues of **responsive pedagogy**. The difference between **key questions** and **supportive questions**. Key questions can be pre-planned as they provide the main challenges in the range; they can be called strategic, and be included in the guidance. Supportive questions cannot be pre-planned but arise in response to pupils' ideas in the classroom. However the teacher can be alert to some typical potential responses, misconceptions and side-difficulties. (How much of that can be given in guidance? It may become unwieldy.)
- Some colleagues have **recorded children's ideas**, or collected their work. This can be very useful for analysing the lesson if time allows. Otherwise the notes and sheets can support the writing of short reports in professional magazines, or on a future CAA (Cognitive Acceleration Associates) website. We need to find ways of recording what children think. There has been some success in videoing children working and framing discussion around the clips. The more adept we are in technology the more that is useful. But the key factors are time allocation and having a frame for analysis, however flexible.
- **Readiness for a second round on the same lesson.** I think we are ready now for a second trial based on the two versions I suggest below. Colleagues may wish to do things differently, but there is value in doing the same versions and discussing both the process and content next time. I hope colleagues will jot down a few ideas on their trial.

We have talked about the trial of **other lessons** which individual colleagues may like to start developing. It makes sense to work on one extra lesson at a time, in addition to the one we are all trialling. Colleagues may even start their own journal, recording both the specifics of a trial or more general comments.

One issue we touched upon only slightly is the **relationship with the trial class teachers**. I suggest we pay attention in the future to winning them over to the approach, and at least to the trial. This may mean briefing them, asking them how best to organise, what they think we should do, eliciting their help. It may well be the case that we should trial lessons only in Y5 or Y7 and avoid year 6, so that we don't risk what may look like interfering with teaching for the test.

The outcomes

Over the last 6 years over 30 new Thinking Maths activities have been created in this way. 10 of these have been placed in the new edition of the Secondary Thinking Maths folder. The others are still in various forms of drafts, since they are in continuous trials. Many of the articles in *Equals*, written by Jane Gabb and myself, both members of the editorial group of Equals, and by Alan Edmiston, Sarah Seleznyov and Lynda Maple amongst others are based on these new activities. We write with the intention of showing how teachers and pupils actually responded to a lesson and so that teachers could try the activities themselves in their own classrooms. We are keen to continue this work, and would welcome feedback from all teachers.
For additional material you may look at the website www.CognitiveAcceleration.co.uk/

You can find more background on

www.kcl.ac.uk/schools/sspp/education/research/projects/cognitive

Cognitive Acceleration Associates.

1. *Thinking Maths*, published by Heinemann/Harcourt, Primary *CAME Thinking Maths* (PCAME) published by BEAM, and the two *Let's Think through Maths* packs published by NFER-Nelson (now GL Assessment). They were part of the outcomes from a series of research projects from 1993 to 2004 at King's College London, based on neo-Piagetian and neo-Vygotskian theories.

NCETM website

Jane Gabb explores what this website might have to offer readers of Equals.

I started off by searching the site. I put in 'low attainers' and found several discussions. 'Making mathematics real' contained an article about the myth that low attainers should always be taught mathematics in the context of everyday problems like tax, interest etc.

'They are just as likely to be motivated by the fantastic and mysterious as the maybe useful. We must not protect them from the fantastic and mysterious – the awe and wonder – in mathematics.' And 'An interest in the creative, investigative, puzzle-solving side of mathematics may provide them with many happy hours of entertainment.'

Someone had told me about 'The good teacher – good student deal' so I put 'good teacher' in the search engine and got straight to this good idea posted by an NQT who had observed this happen in a classroom:
'At the beginning of the class the teacher, who had this class for the first time, asked them to tell her what made a good teacher, i.e. whose classes they enjoyed and learned from. They came up with things like "has to be fair", "has to be fun", "has to be respectful" and "should not shout". She wrote all of them down on the board and then asked what made a good student.

The responses ranged from "should listen", "should pay attention" to "be respectful to the teacher". The teacher did all of this without telling the class why she wrote these on the board, and only when they had a list with a number of points she stopped the exercise and told them.

She said: "Ok class I offer you to make a deal. I will stick to my side of the list and try to be a Good Teacher as much as possible. You, however, have to stick to your list and make sure your classmates do the same."'

I had also heard about the magazines that come out every month on the site, so I looked at the Primary Magazine. Our centre spread comes from 'up2d8' maths and is about food wastage. As well as good pages to start discussion and give some facts, there are lots of lesson ideas using these pages as a stimulus. You can download the whole thing as a powerpoint presentation and put the material straight onto your IWB board.

The 'Starter of the month' in the issue I looked at (no. 15) gave related ideas for children from Early Years Foundation Stage to KS2.

I hope this has given you enough of a taster to go and explore the site for yourself.

Royal Borough of Windsor and Maidenhead

Pages from the past

Copying is better than humiliation

Our elocution lessons were held in a prefabricated hut at the back of the school. … My abiding memory is of standing at the front of the class reading from a book. Throughout the reading I had consistently pronounced words that had a long A, such as 'daft', in the same way as words with a short A, such as 'cat'. This was the way I spoke them then and how I speak today; it was the way we all pronounced such words at home, my mother being Irish and the rest of us having Black Country accents. I knew what was expected of me, but I simply couldn't bring myself to say this long A.

After the reading the teacher wrote on the blackboard a list of words that were supposed to be pronounced in this way and asked me to read them out. Something in me, even though I was frightened, still refused to say it in the way she wanted and every time I said 'bath' with a short A she walloped my hand with a ruler. I can't recall how long I stood there but there were several stinging slaps and I know that I never gave in. It felt like something of a final frontier of my self-worth. I was defending who I was. If I gave her what she wanted I should be confirming my mother's fears –that we were not good enough – and I simply couldn't do that. …

How on earth we learnt anything under this tyranny is beyond me. Long division? Forget it! Long multiplication? The same. If you didn't get it the first time, for whatever reason, it was better, at least in my book, to copy someone else's rather than suffer the humiliation that might result if you got it wrong.

Pp73-74-75

Extracts from Julie Walters, *That's Another Story:* Weidenfielld & Nicholson, London 2008

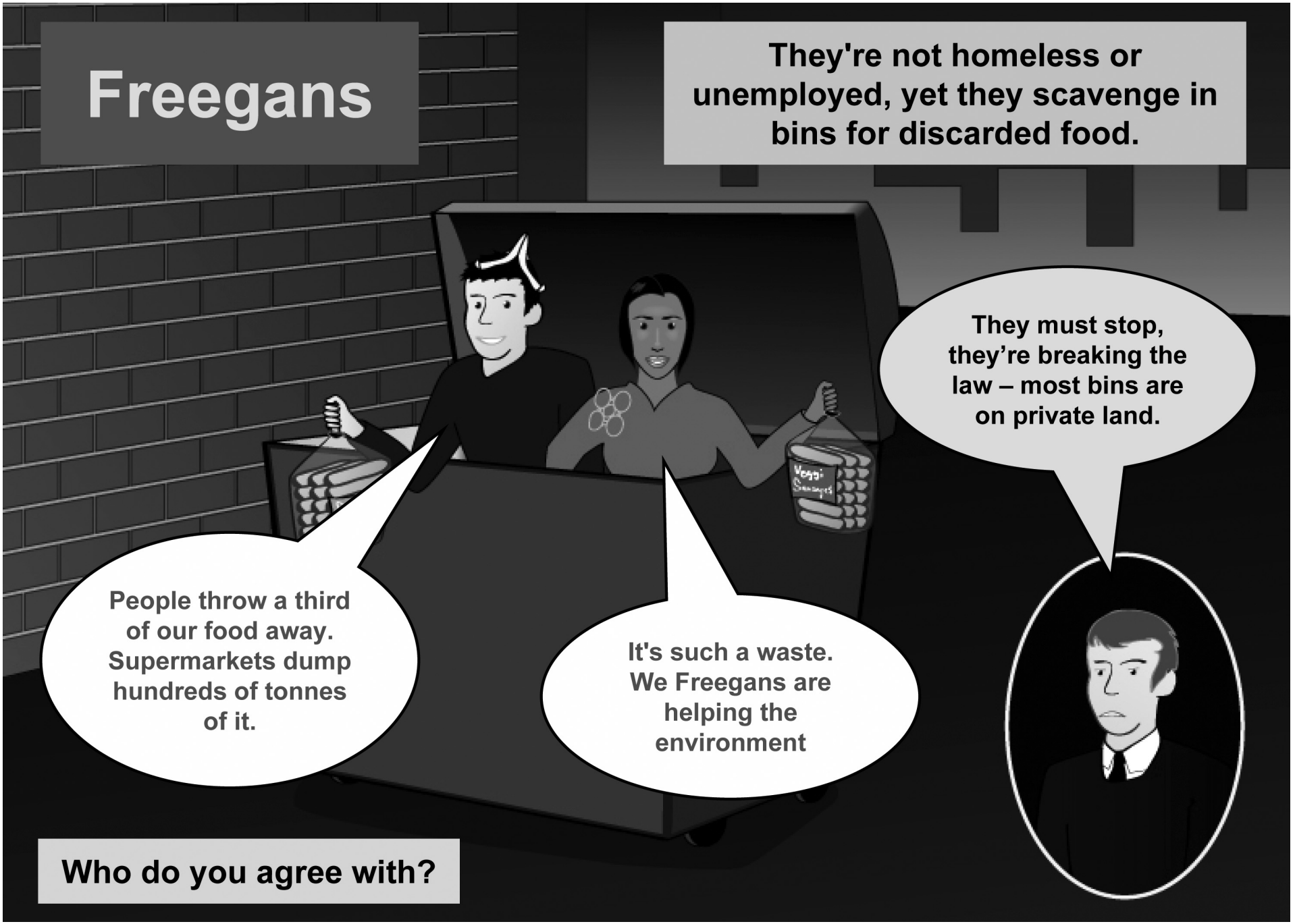
Half of the UK's annual 300,000 serious workplace injuries involve 16-24 year olds; one every 40 minutes.

TES magazine 31.07.09

The Humber

The Humber takes 1/5 of the water of England out to sea.

Griff Rhys Jones BBC August 2009


Freegans
They're not homeless or unemployed, yet they scavenge in bins for discarded food.
People throw a third of our food away. Supermarkets dump hundreds of tonnes of it.
It's such a waste. We Freegans are helping the environment
They must stop, they're breaking the law – most bins are on private land.
Who do you agree with?


Some Facts...
Every year, 17 million tonnes of food is being put into Britain's landfill sites. Around 4 million tonnes is perfectly alright to eat – fresh, tasty, and well within its sell-by date.
Wasted Food
Reasons people throw out food
Leftovers on plate 55%
Part of food not eaten 52%
Past use-by date 48%
Smelt off 46%
Looked off 35%
Past best before date 32%
Didn't like food 19%
Food overcooked 18%
Bought something I already had 2%
I am the manager of a local supermarket. I want to stop the waste of millions of tonnes of good food. But how?
Supermarkets' 'best kept advice'
Use by 20.09.09
Best by 20.09.09
Supermarkets' specials
Buy one, get second one half price!
3 for the price of 2!
BOGOF!

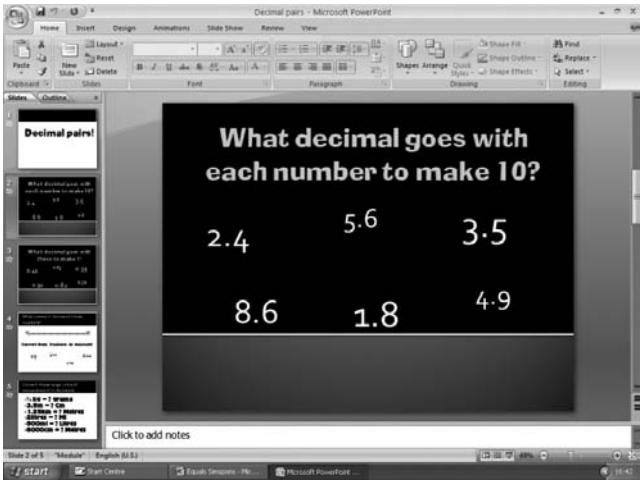
Investigating Misconceptions with the Simpsons - part 2

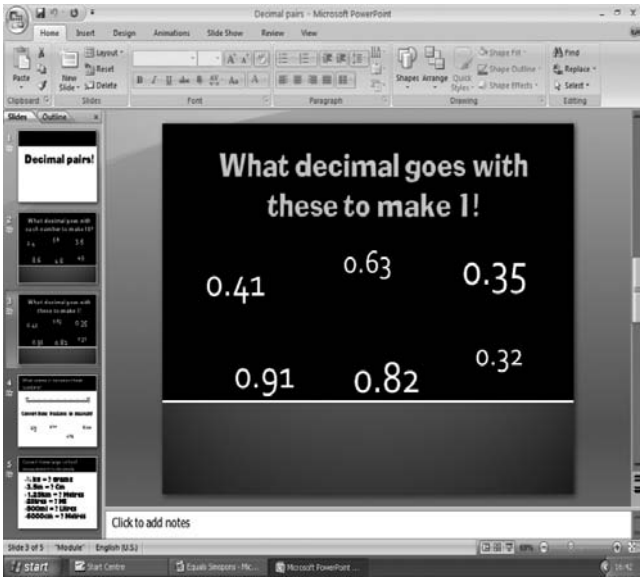
Kelly Lane follows up the work on ordering decimal numbers with this lesson on addition of decimals.

Lesson 2 – Addition of decimal numbers.
Year 5 and 6

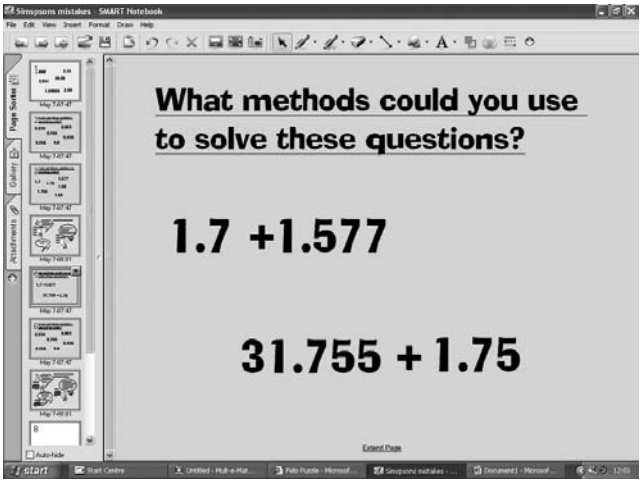
Starter - 5 mins

I used a power point slide show for this starter. The children were given 5-10 seconds to answer by holding up their mini white boards all at the same time. This allowed me to use quick fire questions to gain a quick insight into who might need extra support during the lesson, and who might need a challenge with their adding.



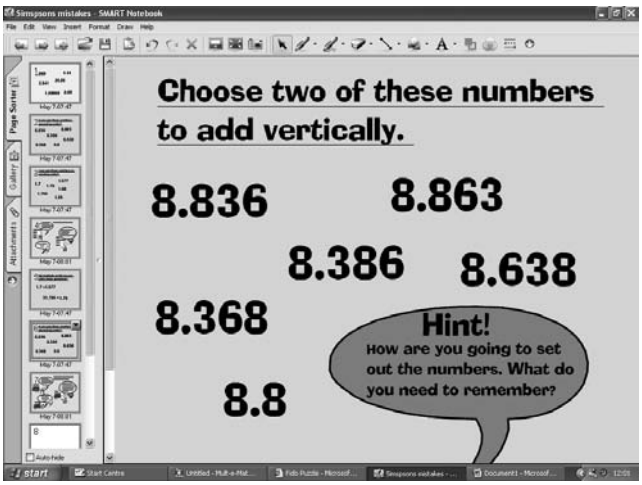


Main



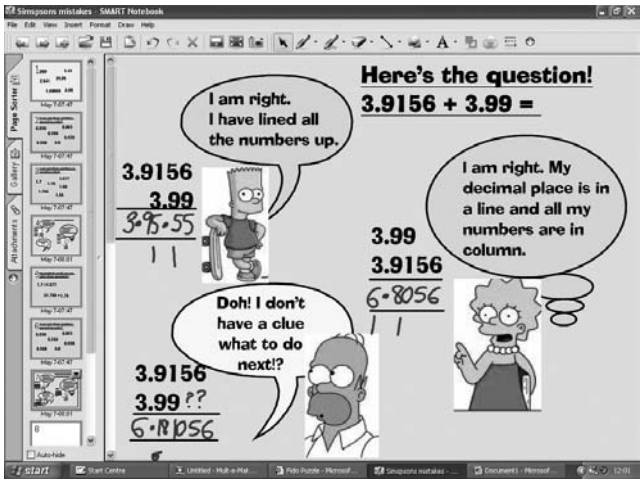
The children were shown the first slide on the smart board which asked them to think of as many different ways to add two decimal numbers as they could. Children worked in pairs on their white boards, and the pairs were then asked to come up to the board to show one of their methods. After watching a few ideas the children came to the conclusion that you should always make an estimate first and then if the numbers are tricky a vertical pencil and paper method could be used.

The next slide asked the children to choose two random numbers and to add them using the vertical method.



Children were asked to check their answers with their partner and explain how they did it, step by step. Volunteers came up to the board to demonstrate using a vertical method. The children then worked independently for a few minutes choosing two numbers from the slide and were encouraged to make estimates and check answers.

I told the children I had asked for some volunteers to take part. The children were suspicious due to my grin and were curious to see who had actually taken part. It was great to hear the giggles when the Simpsons were revealed. Each character believed they had answered correctly and gave a reason as to why they thought so.



The children were then set the task to find out who was correct and who wasn't, and why certain mistakes had been made. I was amazed by the depth of answers from the children. The children were able to understand why and how the mistakes occurred, and were able to speculate about the characters' understanding. Some were even able to say that Homer had started from left to right rather than right to left. When the children were giving their opinions I posed some questions:

- What do the mistakes tell you about the characters' understanding?
- What do they understand really well?
- What do they need to learn next?
- What is the next step?
- Have you ever made a mistake like Bart did?
- What helps you to remember how to do it?

The children were then asked to think about the advice they could give to the characters to help them learn and remember strategies, and to put the mistakes right. This caused the children to focus on why the mistake happened and to come up with strategies to ensure this didn't happen again.

Plenary

Finally the children are asked to work in pairs and decide a way to teach the Simpsons how to do it. All of the characters had clearly made some big errors, but for different reasons. This caused the children to think about what the character knew really well, and what they needed to learn next. Children took it in turns to teach their partner and then some volunteers came to the front to demonstrate their ideas.

Trevelyan Middle School, Windsor

Watermills

There were once five and a half thousand watermills in England – one for every 3,000 people.

Griff Rhys Jones BBC August 2009

On average

(Jotted down by Lewis Carroll for future use)
Dr Piaget was conducting a school examination, and in the course of his questions he happened to ask a small child the meaning of "Average". He was utterly bewildered by the reply, "The thing that hens lay on," until the child explained that he had read in a book that hens lay on average so many eggs a year.

The life and letters of Lewis Carroll by Stewart Dodgson: Collingwood 1898

A binary joke

There are 10 types of people in the world:
Those who understand binary and those who don't.

Graham Tyler, Cardinal Newman School, Hove

Bingo

Nearly 4 million people in the UK, the majority of them older women, play bingo at least once a week. But last year 25 clubs out of 464 in England closed due to financial pressure. … Nearly 80% of over 70s have gone to the same club for more than 10 years.

The Guardian, 03.10.07

Tables are not the only way!

Alan Edmiston challenges the assumption that ratio is too difficult a concept for young children. Using a context of feeding fish, he explores how children can think about ratio when it is presented in a problem-solving context.

The following quote stood out from a book I was looking through as I decided whether or not it was time to assign it to that big box in the loft: *'Before children meet the arithmetic operations formally, it is crucial that they appreciate the nature of situations in which multiplication and division are inherent …'*[1]

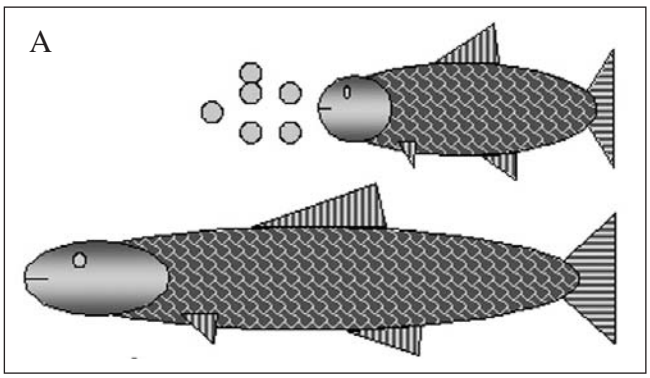
I happened to have multiplication on my mind because of a conversation with Sandy's mum at the school gate. Now that our children are in Year 3 they are expected to make progress with their tables. The problem was that he was not and some three weeks into this work he was still stuck with his threes. Many of the others had moved on leaving this boy to fall behind his friends – I cannot imagine the impact this was having upon the mind of such a keen little learner.

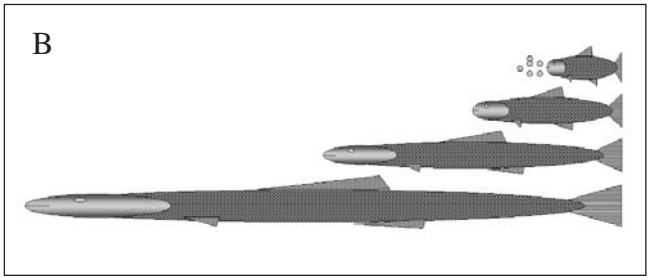
Many of the early Thinking Maths lessons tackle the idea of multiplicative thinking head on. The concepts are presented in a way that builds upon the work of Piaget who found that many 5-7 year olds are able to handle this concept i.e. the multiplicative links between numbers (3 sweets for every one party bag). The activities present the pupils with situations that require this type of reasoning and do so to lay down good thinking foundations for fractions, measurement and multiplication. All of these areas of mathematics are dependant upon multiplicative relations rather than simple additive ones. They seek to integrate the idea of ratio at an early age so that the pupils have a rich source of formative experiences to draw upon when they are required to grapple with proportions, ratios, fractions and decimals towards the end of their primary school experiences.

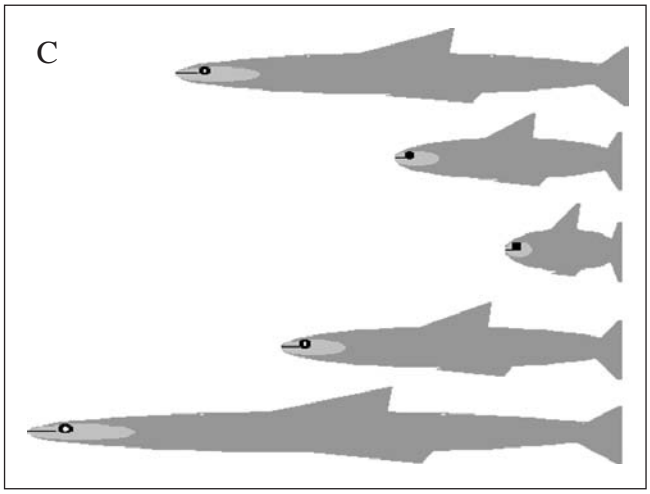
This is of particular interest to me as on courses in both Wales and Northern Ireland I have been told by Mathematics Consultants that ratio has been moved out of their primary curriculum because it is too hard. I just wonder if by doing this, with the learners' best interests at heart, they are failing to build upon the very skills that young children bring with them to the classroom and as a consequence are storing up even more trouble ahead?

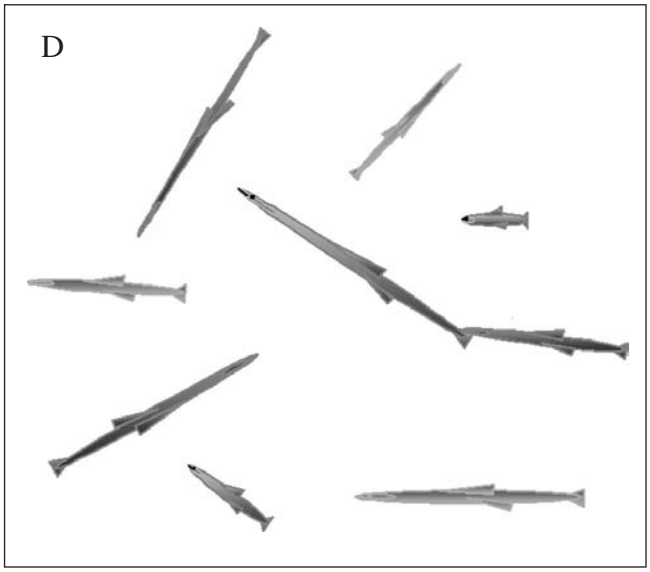
Feeding the fish

I will describe another new Thinking Maths activity developed during a CAME Extension Course at Ambler School, London. The aim of this particular lesson can be found in the words of T Nunes[2] who states that *'The need to discover a relation from the meaning of the situation (instead of being told what the relation is) can lead the children to expand their understanding of one-to-many correspondence'*. The situation that prompts the discovery in this activity is the problem of how much food to give to fish of differing sizes. The lesson is built around 3 thinking episodes that culminate in the use of explicit multiplicative relations to calculate the amount of food that should be given. The pictures show the four sets of fish in question:









Episode 1 – I have a problem.

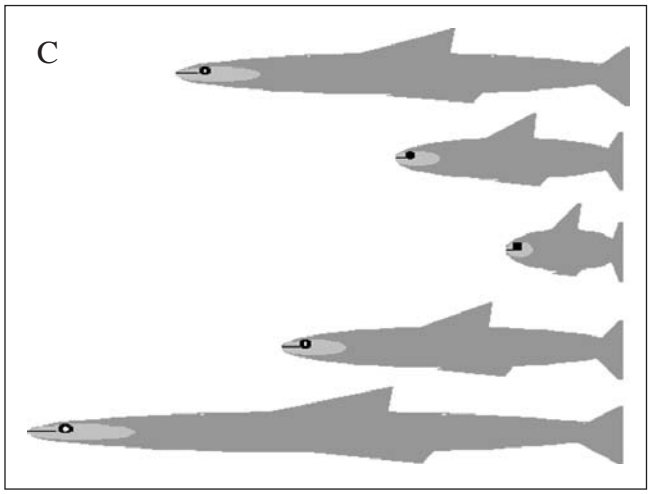
This particular lesson was taught in October 2009 and at the start many of the pupils shared their experiences of looking after other people's pets. This led to one boy relating his experiences of helping his aunt feed a particularly valuable group of tropical fish, and in his words 'she just did not know how much to give them!' A better start I could not have wished for!

With the children sitting in tables of four, but working in pairs, two fish families are given out, A and B, one set per table. The idea was that after a few minutes they could swap families before reaching a consensus.

The discussion at this point is very animated; some are using unifix blocks, some rulers and others fingers to formulate the patterns that they can see before them. Episode 1 works because the pupils are using their maths knowledge to verbalise the intuitive patterns that are present in the fish lengths. A quick survey would reveal that 95% of pupils have grasped the proportional nature of Family A. They give this family a range of names to describe this which are all based around the idea of 'times tables' i.e. up in 3's, 4's or 5's. Family B on the other hand presents them with more of a challenge. That particular Tuesday the breakthrough came when the group who were using a ruler volunteered the fact that their numbers went '24, 12, 6 and 3 – that is halving'. This led to them being called the 'Double family'.

Episode 2 – Fish family C

At this point the pupils realise the importance of quantifying the fish with rulers as a way of spotting the multiplicative relations between the fish in each family. The challenge in this part of the lesson requires the pupils to both round and order the fish lengths to see the x 4 link.



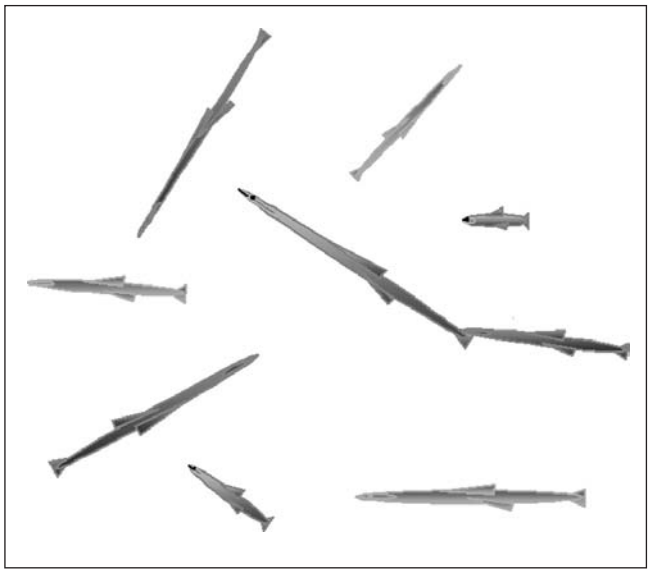
Even though they were easily able to measure the fish they found the ordering and rounding aspect much more difficult. Only 2 out of the 5 tables were able to see beyond the numbers (4, 7.5, 12, 15.5, 21.5) and grasp the pattern. To me this is a key aspect of the Thinking Maths approach for the numbers used are not presented in any tidy order – the pupils themselves need to decide what to do to best make sense of the situation.

The feedback was quite interesting as 2 of the tables quickly shifted position and agreed with the others, leaving one group who had a most interesting strategy!

They had been using unifix to measure each fish and then doubled the answer to give a value to each. What eventually caused them to agree was that one child was overheard talking in a most animated fashion as he changed his mind with the realisation that all he needed to do was to order the numbers rather than look for patterns between individual numbers (16, 8, 4, 12, 20)

Episode 3 – Feeding the fish from the pet shop

As an extension activity the pupils are presented with a more complex scenario. A school of fish of many different sizes need feeding but here the ratio is not fixed but dependant upon the relation of the smallest to each of the larger. In addition to this one of the ratios involves a x 1.5 relation.



This activity requires the pupils to measure, order and tabulate the fish so that the ratios can be explored. Seeing the need for and then creating a table adds quite considerably to the task and with only ten minutes to go I felt it best to consolidate the gains that had been made by the class thus far. In discussion with the teacher she agreed with this, feeling that Episode 3 would need at least 30 minutes to tackle in a meaningful way.

What I remember most from this lesson is the joy that arose from the class as they realised that they could see the 'times tables' patterns in familiar objects and that a knowledge of this helped them to calculate the quantity of food required by each fish. On a more sober note it also makes me see just how important is the work of people such as T Nunes is to children in school today. She notes that *'Mathematics teaching has often overlooked young children's understanding of multiplicative relations. It is possible that, if children were to explore their early understanding of multiplicative relations, the progress from understanding relations to solving quantification problems might be different.'*

I just hope it is not too late for Sandy but maybe I could help; I wonder if he would like to feed our fish next time we go away!

Cognitive Acceleration Associates

1. *Language in Mathematical Education*, Ed Durkin and Shire, 1991, p. 95
2. *Children doing maths*, Nunes and Bryant, p 168

On 6th August 1945 the USA dropped an atomic bomb on Hiroshima

The firestorm destroyed 13 square kilometres (5 square miles) of the city.
Over 60% of buildings in Hiroshima were completely destroyed and over 90% of structures were destroyed or damaged.
Up to 180.000 people were killed - out of a population of 350,000.

Three days later, on 9th August, a second atomic bomb was detonated over Nagasaki.
Nearly a quarter of Nagasaki's buildings were consumed by flames.
Up to 100,000 people were killed out of a population of 240,000.
In total around 250,000 people died in the first few days.

Today we live in a world where there are around 30,000 nuclear weapons.
These weapons are capable of destroying all life on earth many times over.

CND leaflet, April 2008

Save the children

I can count further than I will probably live….
Kroo Bay, Sierra Leone, is the worst place in the world to be born.
In Kroo Bay 1 child in 4 won't make it to five.

Save the children leaflet, November 2008
(020 7013 6400)

Which is the odd one out?

Inspired by an article on the *nrich* website **Matthew Reames** reflects on a versatile "odd one out" activity.

A recent article on the *nrich* website suggests that mathematics talk can be a very effective way of helping pupils to communicate their developing mathematical understanding. I have found 'Which is the odd one out?' to be one useful activity to prompt both mathematical thought and reasoning. It is an open-ended activity where there is no single correct answer and thus promotes opportunities for reasoning and discussion.

The activity begins by presenting a set of numbers and asking which one does not belong with the others. Pupils can decide that any one of the numbers does not belong as long as they are able to justify their response. When given the numbers 4, 16, 1, and 8 (it is not necessary to present the numbers in numerical order), my pupils came up with the following responses:

'1 doesn't belong because it's the only odd number.'
'16 is the odd one out because it is the only two-digit number.'
'I think 1 doesn't belong but it's because it's not a multiple of 4.'
'8 doesn't go with the others because it's not a square number.'

These are just four of the statements my pupils discussed for this set of numbers. It is important to have each pupil justify their choice and to have the rest of the class consider the statement and decide if the reasoning is correct. It is always interesting when one pupil agrees with another that a certain number does not belong but gives a different, equally valid reason for this.

Depending on the set of numbers, the discussion can include investigation of factors, multiples, primes, squares and other types of numbers. The set of numbers 2, 7, 17 and 77 might produce the following responses:

'2 is the odd one out because it is the only even number.'
'77 doesn't belong because it is the only number that isn't prime.'
'2 doesn't go with the rest because it is the only one without a 7.'

It is always interesting when one pupil agrees with another that a certain number does not belong but gives a different, equally valid reason for this.

After giving my pupils a few sets of numbers, I then asked them to come up with their own sets of numbers for which there were at least two ways of identifying odd ones out. They then shared their own sets with the class who tried to figure out which numbers were the odd ones out. Some of their sets of numbers are listed below. Can you find the odd ones out?

1, 5, 10, 15
49, 13, 121, 12
4, 10, 13, 12
4, 24, 20, 14

St Edmund's Junior School, Canterbury

Unrepresentative?

The 2005 House of Commons is one-third privately educated against 7% in the wider population. There are 79 lawyers, while only eight MPs describe themselves as semi-skilled or unskilled workers.

The Guardian, 17.11.08

Everest

Hundreds of climbers flock to the world's tallest peak at 8,850 metres (29,035 ft) every year… an expedition in May collected 965 kg (2,100lb) of rubbish dumped by previous climbers

The Guardian, 17.11.08

A paradise that ends at age 11?

Ray Gibbons finds a kindred spirit writing in the *Education Guardian*.

Peter Mortimore, writing in the *Education Guardian* recently[1], described a Grandparents' Day at the primary school where his twin grandsons are being educated:

> We sampled only a fraction of the school's life. We were not inspecting it in any formal sense and, anyway, we were far from objective judges. That said, our impression was of excellence: a happy, well-ordered community in which the rules for civilised behaviour were being deeply embedded and in which learning was given the highest priority.

He ends the article with the comment that
'The local authority - working within the government's national policies of choice, league tables and selection – has, so far, been unable to make an equivalent success of the local community secondary school.'

As I am sure I have written in these pages before, I am convinced that league tables, tests and all that present day jazz have caused us to forget what Mortimore reminds us are the basics of a good lesson and what effective teaching is all about – developing 'a happy, well ordered community in which the rules for civilised behaviour are deeply embedded'.
If you have not learned to

- take responsibility for your own work,
- respect the work and space of others,
- continue to develop your understanding of the world in which you find yourself,

then your education has not even begun.

Although the *TES* seems to have lost its way in recent years, it still has two good sources of advice for those who wish to become more effective teachers – the voice of the pupil in 'My Best Teacher' and, in the newly introduced obituaries section, the stories of effective teachers who have recently died. Almost without exception the ex-pupils remember the teachers who took them seriously, believed in them and encouraged them to develop their interests and their talents. The obituaries tell us of the work of teachers who were passionately involved with their pupils' development – personalised teaching I suppose you might call it. Perhaps primary teachers are better at this than secondary because their pupils are not yet fully socialised and each expects to be addressed individually. In my many years in the classroom it always seemed that 'the other half', those who found learning most difficult, needed throughout their schooldays what I suppose you might call personalised teaching. When teaching what was known as a lower set I found that any instruction I had given to the class as a whole each member of the class then wanted (needed) to have it explained to them personally.

1. Opinion: The local community school: a paradise that ends at age 11, *Education Guardian* 01.09.09

Water

Water is the most common molecule on the surface of the earth. It covers 75% of the planet.
With a population of 6.6 billion people on the planet, fresh clean water is under pressure.

Leaking water from mains, industry and private housing accounts for up to a fifth of the UK's water.

The average person in the UK uses about 150 litres of water in a day in the home – but taking into account the water that goes into making products we consume, gets through a staggering 3,400 litres a day.

On average a shower takes 45 litres of water, a quick shower 80 litres and a bath 90 litres.

'A dripping tap wastes up to 140 litres a week.

Ecover promotional materials

The Elephant and Castle Station of the Chatham and Dover Railway

Nearby is … Mr Spurgeon's tabernacle, capable of holding 5000 persons, which was built in 1860-1 at a cost of £31,000

A very old riddle

"A pilgrim came to a fork in the road. One road led to safety, and the other to death. In each fork stood a guardian. They were twins One twin always spoke the truth and the other always lied. The pilgrim was allowed only one question. Only one. And to save his life he had to find out which road led to safety. So what did he ask?"
"He asked which way was safe."
"Which twin did he ask?"
"The one who spoke the truth."
"But how did he know which spoke the truth? They both looked the same. They were twins. What question did the pilgrim ask?"
"Haven't the foggiest."
"*That's* not what the pilgrim said."
"The pilgrim could only ask one question, so he went to one of the twins and he asked, "If I ask your brother which way leads to safety, which way will he tell me to go?"
"Is that all he asked?"
"That's all. So what did the pilgrim do?"
"Well . . . he . . . I give in. What did he do?"
"One of the twins was a devil," said Edward, "and the other was an angel."
"What did the pilgrim do then?"
"Whichever road either twin told him was safe, he went down the other one. Both twins would point to the road to death."
"How come?"
"If the pilgrim asked the truthful twin which way his brother would send him to safety, the truthful twin, knowing his brother would lie, would point to the road to death."
"You've lost me."
I explained over again. "And if the pilgrim happened to ask the lying twin which way his brother would send someone to safety, the truthful twin knowing his brother would lie, would point to the road to death, the lying twin though knowing his brother would speak the truth, lied about what he would say. So the lying twin also would point to the road to death."

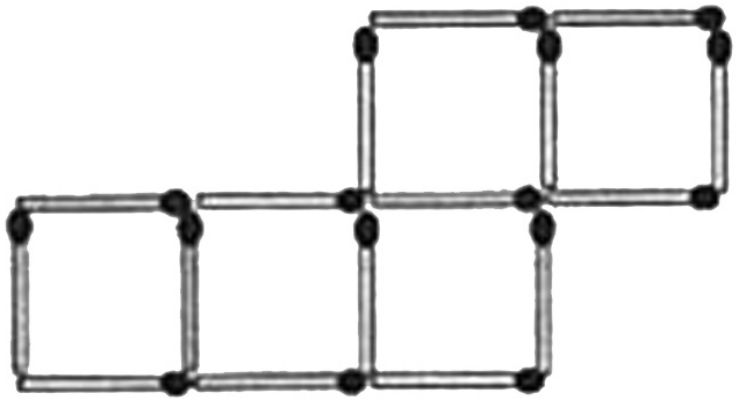
Dick Francis: *Decider, BCA 1993*

Sixteen Matches

This puzzle is taken from *Professor Stewart's Hoard of Mathematical Treasures* (Ian Stewart, Profile Books 2009) Beside the huge hoard of puzzles the book has very valuable hints, comments and answers for all of them. Professor Stewart has given us permission to reproduce three of them - one in this *Equals* and one each in the next two issues.

Sixteen Matches are arranged to form five identical squares.

By moving exactly two matches, reduce the number of squares to four. All matches must be used, and every match should be part of one of the squares.



Sixteen Matches arranged to form five squares.

What is *good enough* progress?

Jane Gabb gives an account of a methodology which can support schools in helping those children who are not making 'good enough' progress. She is indebted to Will Connolly, Regional Adviser for mathematics in the South East, who introduced her to this process through collaborative work in one of Windsor and Maidenhead's schools.

Why do some children 'make good progress' in mathematics, while others don't? What is *good enough* progress? We could have a long philosophical discussion about these terms and argue about whether there should be a measure of progress which is applied to all children. In the current climate, progress measures are gaining prominence alongside raw percentage results. This at least gives hope for those schools whose pupils start at much lower attainment levels than the average, but get judged just the same over their percentage of level 4s at the end of KS2 or GCSE grades A*-C at the end of KS4.

However, in some schools this emphasis on progress has lead to tracking systems which require an input of a sublevel every half term in order to measure progress to targets. Again in some schools this means that a week of every half term is dedicated to testing as this is felt to be the only way of establishing an objective sublevel. I sometimes wonder whether those who make government policy ever consider the likely consequences in schools and classrooms of ideas which sound eminently sensible (or even desirable) to those sitting around a table in Whitehall.

Putting all of that on the back burner for a moment, let us consider how such data might be used by a school to improve what happens in the classroom. In other words, given that the system is flawed, what good can come out of it? ('Look on the bright side….')

'These children could be of any ability and so those who did very well at the end of KS1 came under the spotlight'

During the making good progress pilot, [For free publications go to: http://publications.teachernet.gov.uk/default.aspx?PageFunction=productdetails&PageMode=publications&ProductId=DCSF-00105-2008 (KS2) and http://publications.teachernet.gov.uk/default.aspx?PageFunction=productdetails&PageMode=publications&ProductId=DCSF-00152-2008& (KS3)] a methodology was used which focussed attention on those in classrooms who were not making good enough progress. These children could be of any ability and so those who did very well at the end of KS1 came under the spotlight, as well as the more usual children 'at risk of not getting the expected level' at the end of a key stage. Pupils (called 'focus pupils') are identified through the use of data and 3 or 4 who warrant investigation are selected from each class. In a small primary school this might cover all KS2 classes; in a larger school, one or more year groups might be chosen to look at more closely. Pupils are selected about whom little is known; they are the hidden or, more likely, hiding members of the classroom. They are not those who are recognised to have challenging behaviour or a known special need.

'Pupils are selected about which little is known; they are the hidden or, more likely, hiding members of the classroom. '

Observations are carried out in pairs. The observers might be senior managers of the school or subject leaders; local authority advisers or consultants might support this process.

Teachers are not told which pupils will be observed, but it is emphasised that it is their learning and non-learning behaviours which are the object of scrutiny, not the teachers' teaching. Typically half lessons are visited, rather than the whole lesson.

During the observation period, which might be a day in a small school, the observers meet together during the day, sharing their findings. The questions they are asking themselves are:

- Why are these focus pupils not learning as much as they could?
- How engaged are they in the lesson?
- Are they given opportunities to express their mathematical ideas/thinking? Do they have the language to do so?
- How do they escape the notice of the teacher?
- What are they doing instead of learning?

'During the observation period, which might be a day in a small school, the observers meet together during the day, sharing their findings.'

Some recent visits to schools have yielded the following:

- a passive copier, who did no work of their own;
- children who were focussed on task completion, rather than learning;
- intermittent texting all through a lesson;
- misconceptions from a much lower level of mathematics;
- lack of mathematical vocabulary;
- a pupil who apparently paid no attention to the lesson or the teacher, did not put his hand up when a question was asked, but could answer every question and give reasons for his answer;
- and, very commonly, pupils who never answer a question or give voice to mathematical language;

After the observations, the focus pupils' books are subjected to a 'quick book look' to see whether that supports the conjectures which are being made about the pupils and their learning. The observers look for the following:

- curriculum coverage and level of work;
- quality of presentation and quantity of work being done;
- marking and feedback.

A selection of pupils are interviewed as a group and invited to talk about lessons they like and learn from, and lessons they don't. This can be revealing and gives weight to their viewpoint.

The sorts of questions that might be asked during the group interview are:

- Tell me something that you really enjoyed learning about this week. Why did you like it?
- Tell me some things that your teacher does that really help you to learn.
- What do you do when you are stuck?
- What stops you learning in class?
- Is there anything else that you think I should know in order to help the teachers improve teaching and learning in your school?

From this process, general strategies appear, which can show the way forward to improving the learning of the focus pupils. For instance, in a predominantly 'hands up' culture, pupils say things like 'The smart kids get all the questions'.

'At the end of the day, the findings are shared with the rest of the staff, and ways forward are discussed. '

At the end of the day, the findings are shared with the rest of the staff, and ways forward are discussed. This leads to an action plan for the school to follow so that the focus pupils are supported in their learning. It could also lead to some action research in the classroom, perhaps a lesson study approach (for more on this see: http://nationalstrategies.standards.dcsf.gov.uk/node/126431?uc=force_uj)

Royal Borough of Windsor and Maidenhead

Review by Jane Gabb

Book Review: The Elephant in the classroom
Helping children learn and love maths
Jo Boaler
Souvenir Press
ISBN 978-0-285-63847-1

In recent editions of *Equals* (14.3 and 15.1) we published articles by Jo Boaler which were based on her research in the US. She has recently brought out this book which draws on that experience as well as work in the UK.

This is a vitally important book. I want to send it to every primary headteacher and everyone involved in mathematics education, and I want to stand over them and make them read it!

On the first page she says: 'There is a huge gap between what we know works for children and what happens in most classrooms.' On the second page ' If you have the knowledge of good teaching methods and important maths learning principles, you can be very powerful in helping children, or yourself, to have a much brighter mathematical future.' This seems to echo what Equals writers (and hopefully readers) believe about teaching maths and Jo Boaler illustrates the above with very practical ideas and examples all through the book.

'There is a huge gap between what we know works for children and what happens in most classrooms.'

Her theme is that problem-solving, not rote learning and drilling children with methods, is the way to help them learn and love mathematics.

Chapter 2 'What's going wrong in classrooms?' examines in detail what happens when pupils are taught 'the rules' but not taught to make sense of them, or to use mathematics in reasoning, or indeed to think at all about the mathematics that they are doing.

In Chapter 5, starkly entitled 'Making low ability children', she examines the results of setting children from an early age. She looks at the effect on self-esteem and the resulting low expectations of teachers, leading to a belief in the children that they have low ability. 'We tell children, from a very young age, that they are no good at maths.' She quotes research in England which found that 88% of children placed in ability groups at age 4 remain in the same groupings until they leave school, making a nonsense of the fact that children develop at different rates and stages. She gives 5 reasons why mixed ability grouping is associated with higher achievement. She then underlines that in order for this to work the students must be given open work which can be accessed at different levels and must be taught to work respectfully with each other.

There is a focus on girls and mathematics in Chapter 6. Her research has shown that girls are more interested than boys in the connectedness of mathematics and therefore respond badly to being in a learning situation which is about learning rules and procedures without understanding how the different pieces of mathematics fit together.

All of this book is good and there are some really useful ideas about the way forward. There are lots of examples of activities which can be accessed at different levels, and some guidance for parents.

I cannot recommend this book too highly; it will provide anyone who reads it with some important ammunition to challenge some widely held beliefs about children, mathematics and learning.

Jane Gabb
Royal Borough of Windsor and Maidenhead

How do we deliver EQUALITY in the 21st century?

The wealthiest 1% of the population owns 21% of the nation's wealth; the bottom 50% own 7%; recently it has been shown that health inequalities have grown; the government faces controversy over abolition of the 10p tax rate; this year's budget pledged an extra £1.7BN in the fight against child poverty: whilst a recent report warned that child poverty could double over the next 2 decades; 67% of ethnic minority communities live in the 88 most deprived wards; the median gender pay gap has reduced from 17.4% in 1997 to 12.6% in 2007. Make EQUALITY matter.

Compass e-mail April 2008