Equals

Realising potential in mathematics for all

for ages 3 to 18+

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MATHEMATICAL ASSOCIATION

supporting mathematics in education

How many are there?

Equals
Realising potential in mathematics for all

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Editors' page

Teachers' self-improvement vs. MoT-style regime
Yet another white paper from the Children's Secretary with yet another mix of ideas. One of these is for a Licence to Teach for new teachers made renewable every 5 years, labelled Teachers' MOT. Many such ideas come around when the Ministry's turn to be comes round in the cycle of government media events. Some ideas get worked on to be of some use, others linger on to do continuing damage before being quietly discarded, together with their fancy labels, leaving bad odours.

The Ministry itself keeps changing its name, sometimes no doubt influenced by good intentions, or need for renewals, at other times as a public relations exercise, allowing careerists to push their luck through desks to the ones nearer the Minister of the day. In their pushing, they hurriedly look for short term, memorable titles at the expense of thoughtful consideration of issues that touch upon whole generations of children and teachers.

Any proposal endorsed by the likes of Chris Woodhead alarm must cause alarm. His draconian Ofsted regime and change of culture in schooling to inspections and punishment of the labour camps, rather than advice and encouragement of the schools where human potential is to be developed. His regime drove scores of our best advisors and teachers to leave the profession, caused much damage to real standards of children, and turned many teachers into technicians who do what is required on tick sheets rather than professionals responding each time to unique human situations of learners.

There is, of course, nothing wrong with teachers being evaluated. Evaluation is always being carried out in many different ways, some formal like peer and mentor reviews, others informal, like the standing of the teachers with pupils and colleagues. A combination of the formal and informal normally promotes the best to positions where their contribution is greatest, and marginalises the weak to where they do least damage - or weeds them out if they simply cannot cope with teaching, one of the hardest jobs in the world. It is also important to recognise when a teacher has difficulties outside school - health or family problem that prevent them for doing their best - or when they are genuinely not suited to the particular post they hold. But such situations are never easy or general enough to record on a sheet with 46 items to be ticked by someone (who?) outside the place and time to decide every few years whether a teacher is fit to continue teaching or not. You could call this idea authoritarian, managerial, manufacturing, another power-seeking ploy by bureaucrats, assessment mania or any of many other common names but not teachers' professional development.

Dylan Wiliam, of the Assessment for Learning initiative, had the right polite answer to the proposal (BBC 4 Today programmme 4th July 09). He thought we should get away from the obsession with qualifications, which are weak indicators of efficiency in teaching, and look for great teachers who can motivate children. He thought that the best continuous professional development structure should be based on every teacher having a personal development plan signed off with mentors in the school. You can imagine then how teachers would strive to fulfil obligations they themselves devised, go to appropriate courses, experiment with new approaches, and improve gradually and steadily, something very similar to what they are trying to encourage with their own pupils. We can also imagine how collaboration, e.g. in peer observation, paired teaching and cooperative PD sessions, can help.

We say "Aye" to that, and "Nay" to the mechanics at their desks.

The future of *Equals*
The Mathematical Association recognises the relevance of *Equals* as a good primary and secondary journal and not just concerned with special needs. It has decided that *Equals* shall be launched as a web-based resource in the autumn of 2010. The last printed issue (Summer 2010) will be mirrored online. *Equals* is expected to evolve from a static pdf journal to possibly having monthly updates and/or having extracts published in other journals. It is not yet decided whether it will be published as a free magazine or with restricted access.

Success against the odds
(schools even a mathematician would bet on)

Denis Mongon reminds us that mathematics teachers know a thing or two about statistics and about the pressure to produce good mathematics attainment for pupils at the end of Key Stages 2 and 4.

They will not be surprised then by the fifty years of research data and narrative, which shows the persistent underachievement of pupils from relatively poor homes. My colleague, Christopher Chapman, and I were commissioned by the NUT and NCSL jointly to research the features of school leadership which are associated with good outcomes for 'white working class pupils'. Our full report with the accompanying literature review and vignettes of each school can be found at
http://www.ncsl.org.uk/publications-index/publications-display.htm?id=29091

To avoid being bogged down in a theological debate about definitions we adopted some rough and ready criteria and contacted a dozen schools, seven secondary and five primary, where Ofsted had described the leadership as good or better, where the head had been in post for a couple of years or more and where a large number of pupils described as 'White British' and entitled to free school meals were producing very good end of key stage results. Results like that ran contrary to the national trend which in broad terms correlate pupils' attainment to their parents' earnings. 'White British' boys entitled to free school meals are overall the male group with lowest attainment and 'White British' girls entitled to free school meals are overall the female group with lowest attainment[1]. Although gender is also an independent and significant factor, the social class attainment gap at Key Stage 4 is three times as wide as the gender gap[2].

Those readers of *Equals* who also subscribe to the minutes of the Parliamentary Public Accounts Committee will read its report, published in May, *Mathematics Performance in Primary Schools: getting the best results*. For those who missed it, the Chairman was quoted as saying,
"It is disgraceful that over one fifth of all primary school children reach the end of their primary education without a secure grasp of basic mathematical skills….. The social class of children at primary schools is too great a factor. There is a clear link between deprivation and underachievement in primary maths."
On this occasion, we can be confident that our parliamentarians are in line with the public mood and the regular findings of research in this specific area.

What we found were schools which had loosened and to a large degree disengaged that apparently locked in connection between attainment, including mathematics attainment, and poverty. The school leaders had created the framework and space into which the teachers and pupils could step with some confidence and expectation that they would be successful. Teachers from two of the school, one primary and one secondary, have written the short accompanying accounts of how they go about their teaching and the consequent learning in these particular circumstances. The rest of this piece summarises how the school leaders contribute to that.

They adopt strategies within the range observed in most schools which are working well in difficult circumstances. They are good at building vision and setting direction; they understand people and pay attention to their staff's development; they pay attention to the design and appearance of the organisation, which includes lines of accountability, culture and physical environment; they guarantee the quality of teaching and learning across the school. Attention to detail was a remarkable feature of these schools, not least in the compilation and use of information about what was happening. Both student progress and teaching standards were regularly, frequently and closely observed, recorded and analysed, directly and indirectly.

We concluded that it was not what they did but the alchemy of how and why they did it. These leaders had a strong rapport with the adults and young people in the schools. They had a (usually) quiet confidence. They were reluctant to blame central government, local government, communities or anyone else for any tribulations 'we don't use excuses here'. Above all they were invariably committed to working with and for the communities they served. One of them summarised that for us: *"When we're working hard ….. we know there's hard work and hard work, I don't have to go down a coal mine – and so we don't complain about things and we don't kind of just step back and say oh well our role is not to get our hands dirty..".*

University of Manchester

1. Department for Education and Skills, (2007), *Gender and education: the evidence on pupils in England.* Nottingham: DfES.
2. Department for Children, Schools and Families (2007) *National curriculum assessment, GCSE and equivalent attainment and post-16 attainment by pupil characteristics, in England 2006/07.* London: DCSF. (SFR 38/2007)

Lisa Kalache, Maths Co-ordinator and Year 6 teacher at Guildford Grove Primary School in Guildford, Surrey, describes an emphasis on mental maths, self assessment and pupil confidence with striking outcomes.

Maths has been a key priority at Guildford Grove for the past two years with a particular focus on improving the children's mental maths ability. We decided this because we believe that the skills developed in mental maths can be used by the children across all areas of maths and therefore will significantly affect the progress they make in maths as a whole.

We have worked on developing the children's mental maths skills and increasing their confidence. Highly experienced teachers, covering PPA, have implemented a program designed to target and develop the children's mental agility and knowledge of numbers. This comprises a regular extended session which is highly structured in its approach and includes four main parts:

1. Rehearsal and revision of a range of key mathematical vocabulary
2. Times table practice
3. Revision planned according to the specific needs of each class based on their previous assessments
4. Mental maths test following the same format as SATs tests

These sessions are reinforced by class teachers on a regular basis using key objectives that have been fed back following the extended mental maths session. The children are highly motivated and driven by these sessions and are keen to track their own progress and improve, resulting in outstanding achievements.

There have been particularly positive trends in maths showing that this established and focused teaching of mental maths is clearly having an impact on children's attainment. On average 83% of pupils across the school made progress in maths in the autumn term of 2008 with the mental maths score increasing the children's progress by 1 sub-level in most cases.

Year 6 - measure of progress Autumn 2008

Subject area:	Maths
Total progress	90%
1 sub-level progress	39%
2+ sub-level progress	51%

This highly successful outcome is also dependent on all adults intervening at the point of learning during whole class teaching, using differentiated activities but also working with different groups each day, which is paramount. The activities that are planned are both varied and stimulating targeting learning in a range of different ways including, formal teaching, the use of games and incorporating the outdoors.

Dave Eacott Lead Teacher of Mathematics at Park Community School in Havant, Hampshire describes a simple but powerful triangle of teaching forces - basic constructs, developmental assessment and confidence building has a remarkable impact.

How can Park Community School with an intake from the largest council estate in Britain have a CVA of 1084 and a mathematics department in the top 1% for added value results for the last 3 years? Here are just four pointers to what might be working well:

Firstly the basics: with a low level of attainment on intake we ensure that we teach the Year 7 syllabus with an emphasis on number bonds and tables. For instance, if a group is working on Area then the 'lower' groups work on the area of a rectangle 3 by 4, middle groups 7 by 8 and higher groups 13 by 15. Then you can forget the calculators! Why find the area of a rectangle 4.3 by 6.8 using a calculator when you don't know the answer to 4 by 6 using your tables?

Second: at the end of every lesson we ask the students to write down how THEY think THEY did. With lower groups this could be a simple Red, Amber and Green. With higher groups the same with an explanation. What good does this do? The answer is psychological. When you give out the books at the beginning of the next lesson and they turn to the correct page they will see Green, Amber, Amber, Green, Green; and THEY will gain confidence that THEY think that THEY can do maths!

Thirdly: we use the Assessment For Learning CYCLE. AfL is a cycle, NOT a one off lesson. Firstly, show the pupils the assessment piece which they will have at the end of the module, don't ask them to answer it but do ask them to traffic light it for each question. This will inform you of which particular points need to be the focus of your planning. At the end of the module, give a quick revision, then complete the assessment, let them mark it AND let them assess it, and then tell them to set their own goals. Make them responsible for their own learning.

Lastly: create pupil confidence. Tell them that they can do it, and 98 percent of the time they will believe it and do it. And this goes for the staff as well, our maths staff work as a team and have confidence in each other.

I just have to mention that in June we achieved an Outstanding in our OFSTED.

Starting out: some vignettes

Stewart Fowlie reminds us that the first thing a baby learns to recognise is its mother's face, in particular her eyes, not as two separate entities but as a pair.

A related ability is recognition of bilateral symmetry. Young animals also have this ability to help them notice predatory beasts making for them. It probably contributes to right/left confusion, putting shoes on the correct feet, drawing a pair of shoes or seeing which of

d b
p q are the same.

As early as 6 months old, babies distinguish any patterns containing 1, 2, 3 or 4 items. Young children can grasp these concepts, and where, for example, features should go on a drawing of a face before they have any idea of counting, and the link to numerical understanding.

If young children hear a word which they recognise it should mean an image comes into their minds. That means the image must be in the child's mind before or simultaneously to when they are told the word for it. One thing young children find difficult is to think with the sound of words. Anyone who has tried to explain a joke or the answer to a riddle to a 5 year old will know exactly what I mean! Numbers should be seen and not only heard.

Counting up to ten

By this stage I am assuming that the teacher is writing the numbers as symbols. There is no reason why the number after 9 should not be given a new sort of symbol. It represents the last of the first ten, not the first of the second. For the time being, write as □, still called 'ten'.

Next consider using fingers, not to count numbers, but to see them.

Having made clear that that we have 5 fingers on each hand one of which is called a thumb, show successively 1, 2, 3, 4 and 5 fingers with left hands palm down on the table. The right hands are free to write 1| 2|| 3||| 4|||| 5||||| . Lefthanders can use right hands palm up to show the fingers.

To show 6, show 5 and 1; write **6** 5 1.
Continuing **7** 5 2, **8** 5 3, **9** 5 4, □ 5 5.

Counting money

Children may have enjoyed learning to count their fingers but all will be keen to count money. At first think only of amounts from 1 penny to □ pence.

First learn to recognise 1p 2p 5p □p coins, both by sight and feel behind your back.
Then be able to interchange amount and coins, aiming to use the smallest number of coins:

Number	**Coins**
1	1p
2	2p
3	1p 2p
4	2p 2p
5	5p
6	5p 1p
7	5p 2p
8	5p 2p 1p
9	5p 2p 2p
□	□p

Change

If you are going to buy a small item you may not know exactly how much it will cost so you take a ten pence coin. You are asked for 7p and pay□. You are given a 2p and 1p change being told '7p and 2p is 9p and 1p is □'.

Total cost of two items, each less than □

Example 1:
6 3 5 1 2 1
5 2 2
9.

Example 2:
9 8, 5 2 2 5 2 1
□ 5 2,
□7.

These examples follow this pattern:

- First write the bigger cost first (not vital, but a good habit to get into).
- Put in coin form and using 1 1 is 2, 2 2 1 is 5, 2 2 2 is 5 1 and 5 5 is □, give amount in shortest coin form.
- Lastly put into number form.

Counting numbers up to □

When a teacher asks what 4 and 3 comes to, s/he knows the answer is 7 whatever the 4 and 3 are. A child needs to have a picture to think about. Here think of 4 and 3 as piles of these numbers of cards, side by side on the table. Take 1 card from 3 to 4 and you have 5 2, repeat to get 6 1 and again to get 7.

To find what goes with 7 to make □
write □,
9 1,
8 2,
7 3 and there's the answer.

What is 9 and 8? 9 8, □7. There in one!

It would be interesting to have the observations of others who have noted the way young children begin to familiarise themselves with the number system to help them make more sense of the world in which they find themselves.

Edinburgh

Keeping it real

Recently Alan Edmiston has noticed that his most memorable lessons are the ones where the mathematics he and his pupils have discussed has been real.

By this he means the ideas they have been working on have arisen from a real-life context that resonates with both himself and, more importantly, the pupils.

This realisation has been hastened by the fact that currently my feet are firmly on the ground as a teacher. For the past few years I have been self-employed and as a consultant you do lose touch with the 'baggage' that comes with teaching the same pupils on a regular basis. For the past couple of years I have been working part-time in a large comprehensive school and this year one particular group of Year 10 boys has been causing me to flex certain pedagogical muscles that I have not been called on to use for some time. I have been brought down to earth and the resultant struggle to reach out to them has enriched all of my other practice. They have made me question the 'relevance' of the curriculum I am supposed to be delivering to them and one consequence of this is that I apply the same focus to the lessons I teach in the other schools I visit as part of my Thinking Maths work. In this article I will describe one lesson that really caused me to reflect upon this change to my classroom practice.

The lesson in question is called '100s and 1000s' and is part of a pack of new Thinking Maths lessons that have been developed in the Cognitive Acceleration Associates base in Ambler School, Islington, London. I approached the design of this particular activity with the words of Ian Thompson in mind. In the following quote he is speaking of place value but he could equally be referring to decimals, fractions or the concept of zero.

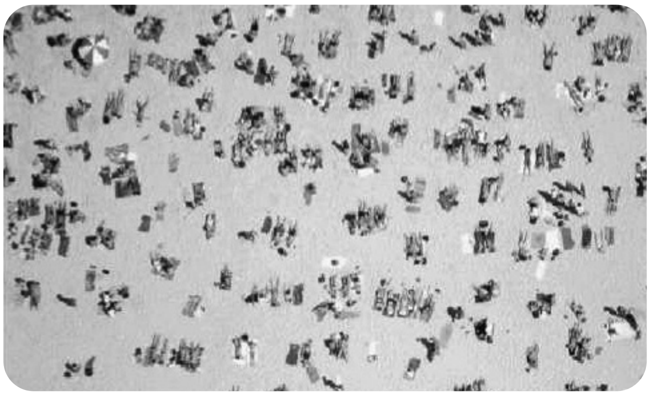
"The fact that it took such a long time for mankind to invent this important idea signals the fact this it is going to prove to be a difficult concept for children to understand".

I strongly feel that much of the maths that many pupils engage with each day has been pre-packaged and served up to them cold. By the time they come to the end of KS2 they are bored with their post-morning break diet of numeracy lessons. To my own daughter maths is something to be endured and it certainly bears no relationship to the world beyond her classroom. Primary children have lively engaging minds and love nothing more than to explore and interact with the world around them. This was something I hoped to encourage with the '100s and 1000s' lesson. Please forgive my artistic licence but for narrative purposes I will recount this lesson as a 4 act play - which should help convey both the interactive nature of the activity and the mathematical progression within the 70 minutes I had to play with.

Act 1 – Happy Feet

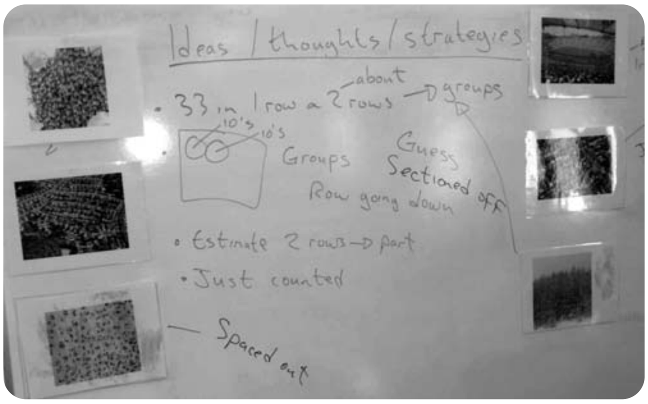
Imagine 200,000 dancing penguins looming large on the whiteboard in front of the class. The pupils watch in hushed silence, some with the feet tapping, others singing along to the tunes coming to them from the end of the 'Happy Feet' film. The camera zooms out, the scene is paused and excited chatter fills the room as they animatedly talk about what they have just witnessed. Hands go up and the dialogue begins and at some point a child states that there were 'one thousand penguins dancing with Mumble' another voice disagrees and says there must be '1 million'. The discussion now focuses upon how many penguins there are and also how we could possibly count all of them.

Act 2 – How many are there?



Several pictures, similar to the ones below, are now distributed to extend and formalise the ideas just raised that are often based around the notion of taking photographs or marking each animal to ensure no re-counting.

The pictures are shared between pairs and the discussion develops focusing the pupils on the posisble strategies they could use to count large numbers of objects. The board below shows how this act draws to an end. By now the idea of counting groups or parts of the larger collection is firmly established.



Act 3 – Guess the number?

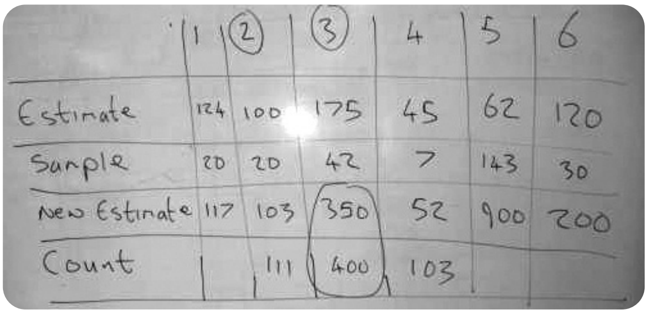
To formalise the ideas they have been using up to this point each group is now given a jar containing either pasta or a breakfast cereal such as Honey Nut Loops. They are asked to do the following:

- Estimate how many bits of food they have in their jar,
- Take out a sample using the spoon and count how many they have,
- Use this number make a new estimate for the amount of food in their jar.
- Empty their jar and count the total number of objects present.

There follows a period of discussion and sharing where groups collaborate to think about;

1. Why taking a sample out of the jar helps them to make a much better estimate?

2. The maths ideas they are using to calculate the number of objects in the jar.



This act draws to a close with some of the results being shared and discussed. At this point the pupils are challenged to think about what, in percentage error terms, actually makes a good estimate.

Act 4 – Bring back the Penguins!

As the lesson draws to a close the pupils naturally return to the initial stimulus - the DVD of Happy Feet. There is the predictable clamour to spend the rest of the morning watching the whole film but very naturally the pupils discuss the application of the multiplicative strategies that they have unknowingly been using throughout this lesson. As part of this time of reflection, and to really embed the lesson in the real world, I begin to share the large number of the strategies we have been constructing that have actually been part of my life before teaching. During this time as a zoology student and as an ornithologist for the RSPB I had the great pleasure of carrying out a large number of animal surveys.

I have one anecdote that serves to highlight how we are biologically equipped to estimate numbers and also to reinforce the point that maths is something that people do as opposed to something they learn. In 1995 I was counting Lapwings with a colleague and happened to glance at a flock of these wading birds and said, ‘I think there are about 150 in this field John’. My friend after some serious counting said, ‘No you are wrong .... there are 152!’

CAME

How exam papers can be useful

What should happen to old exam papers? Jane Gabb explains how once they have been completed and marked they can be a really useful source of mistakes!

Just as Kelly Lane, in another article in this issue, used children’s mistakes and attached them to characters in the Simpsons, your children’s exam errors could be recycled to help children to understand where they are likely to go wrong, for example, in calculations. I have taken some answers from 2008’s KS2 maths paper, scanned them and then put them 4 on a page to provide a paired activity. We have included them in this issue.

A suggestion would be to give each pair one sheet with 4 answers on and the following instructions:

For each calculation, answer the following questions:

A. Is the answer correct?

B. What strategy has been used? (Mental with jottings, repeated addition, grid method, long multiplication)

C. Is the strategy efficient?

D. If the answer is wrong, what mistake has been made?

What would you advise the pupil to do to improve?

In the plenary discussion, the answers could be projected onto an interactive white board and ideas about why pupils made those mistakes could be explored. This kind of activity could be useful at the beginning of a unit to establish prior understanding of the topic about to be explored.

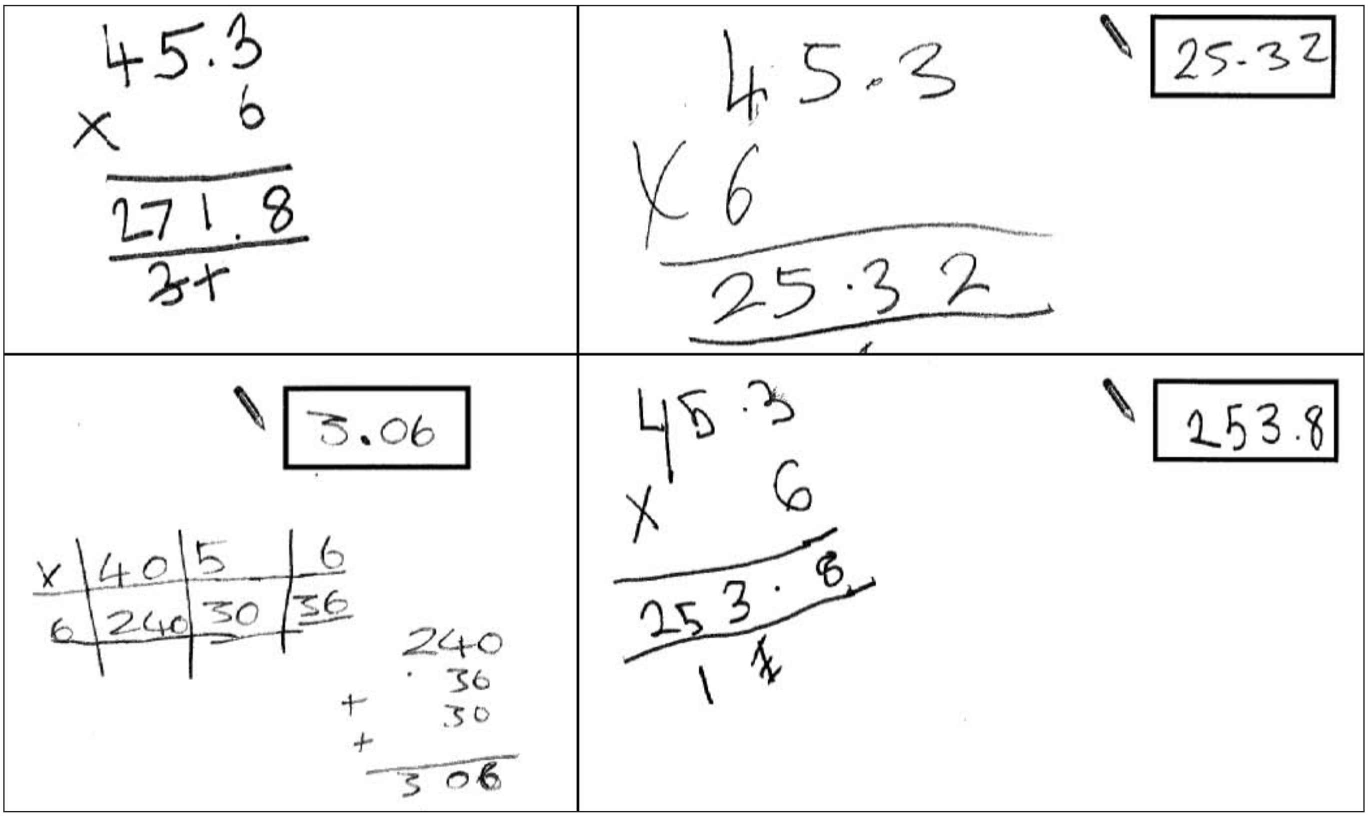
We know from a number of sources how useful it is for pupils to explore mistakes and misconceptions. For instance, from 'Understanding the score': ”Effective teachers anticipate pupils' likely misconceptions and are skilled in choosing resources and particular examples to expose misconceptions and check that their understanding is secure.” Exam papers actually provide evidence of pupils' misconceptions and this makes them a powerful tool. From the pupils' point of view, the examples they are being given are real and the mistakes have been made by real pupils, just like themselves; this increases the engagement with the task, because the context is seen to be relevant and important to them.

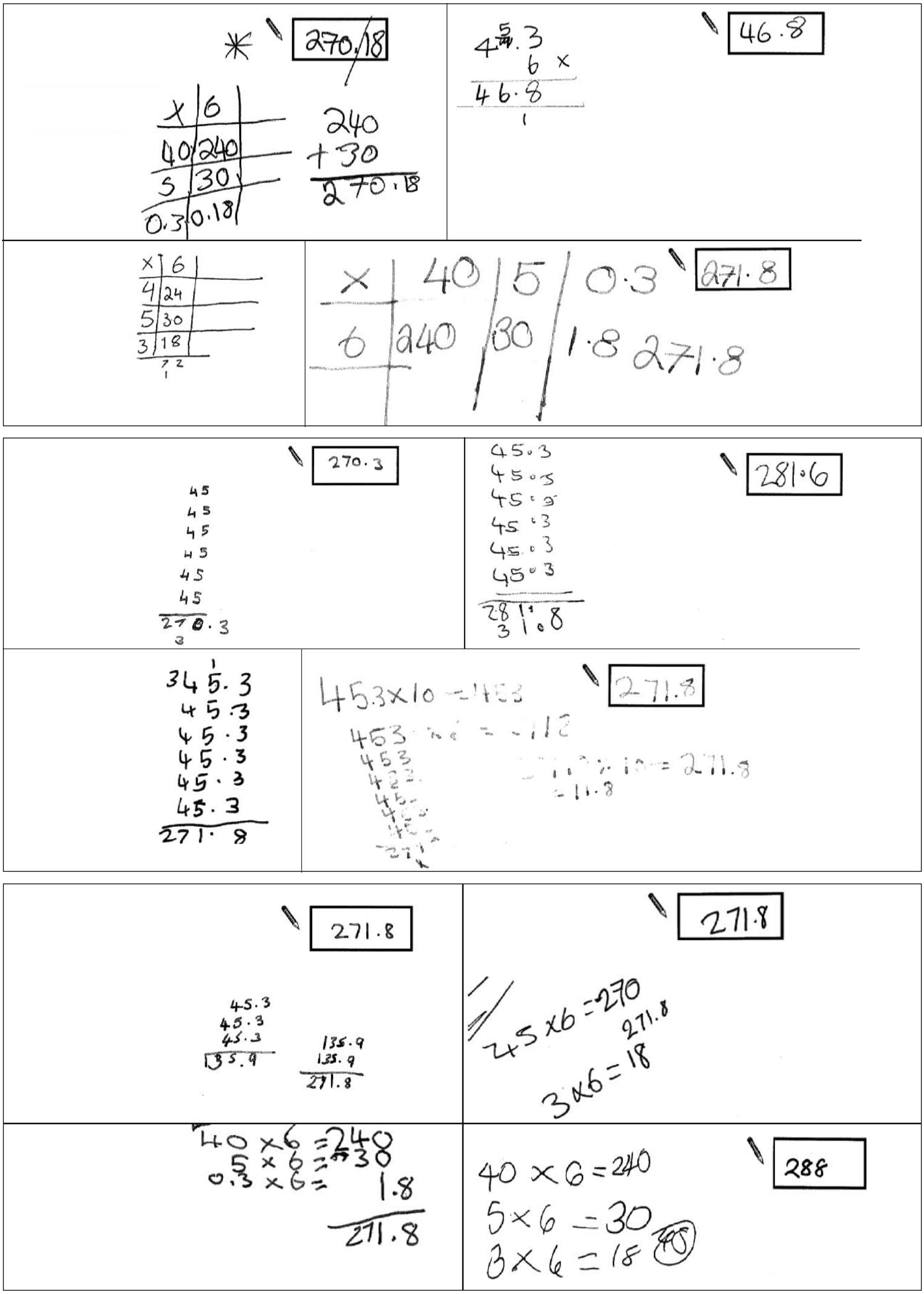
This could lead to teachers having a completely different attitude to marking exam papers and especially to finding that their pupils have made mistakes. Usually it is rather disheartening to see the mistakes that your own pupils have made, because it points out that they haven't learnt what you hoped they had. If examples of mistakes can be seen as a rich resource for future lessons, then the attitude can be one of interest rather than despondency.

In the example given I decided to pick out multiplication errors because of a current focus with a particular class, but another very rich area is that of 'Explain' questions where children have to write about how they know. Again we know that pupils are less practised at answering these questions than they are with routine problems and their answers can be used with pairs or groups working together to discuss the quality of the answers and establish what makes a good answer. If pupils are given the mark scheme as a guide, they begin to gather vital information which will help them to answer their own exam questions more clearly, using mathematical language and notation where appropriate.

So, don't throw old exam papers away, but scour them for useful teaching materials.

RB of Windsor and Maidenhead

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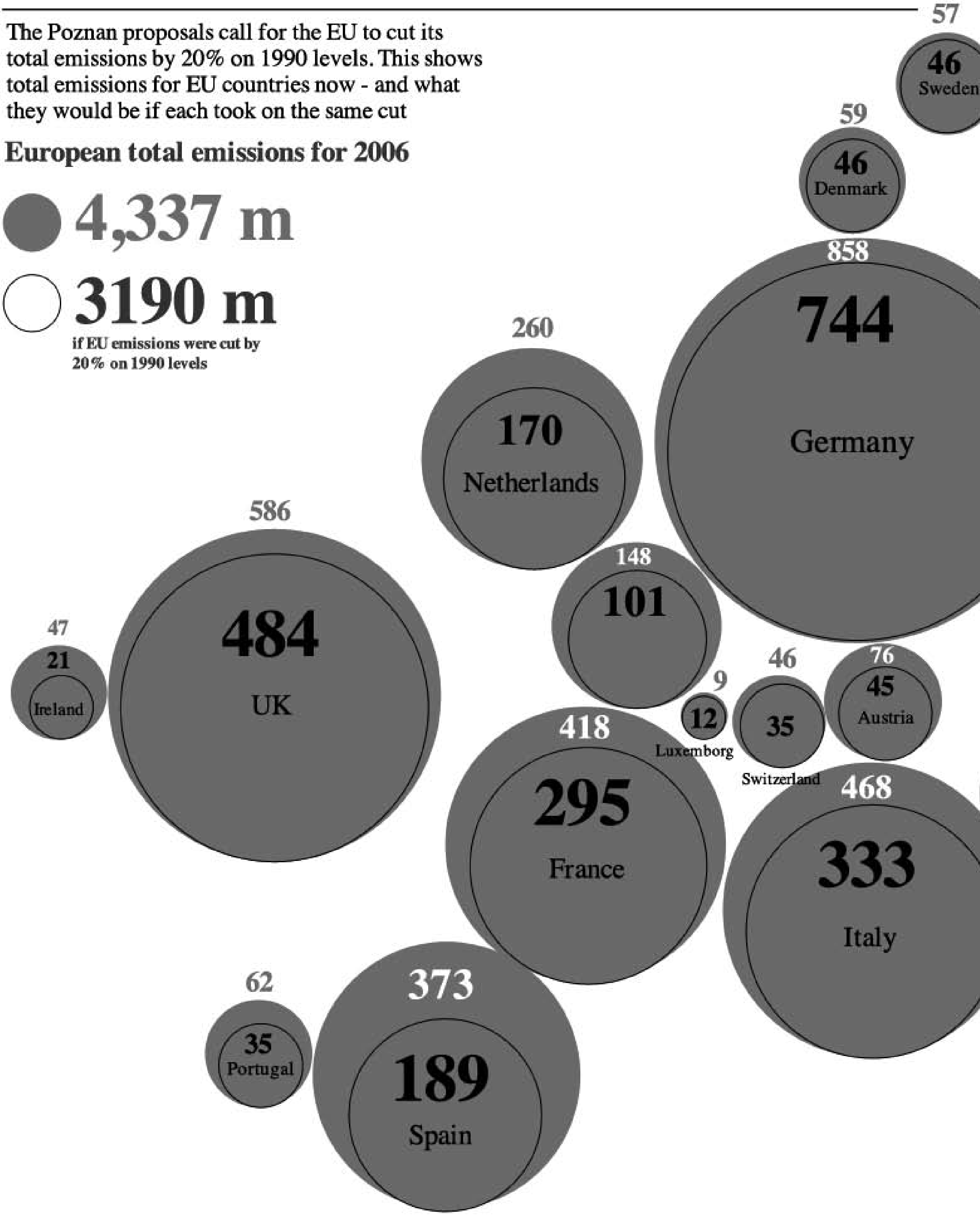
288
40×6=240
5×6=30
3×6=18

Europe's emissions Million tonnes of carbon

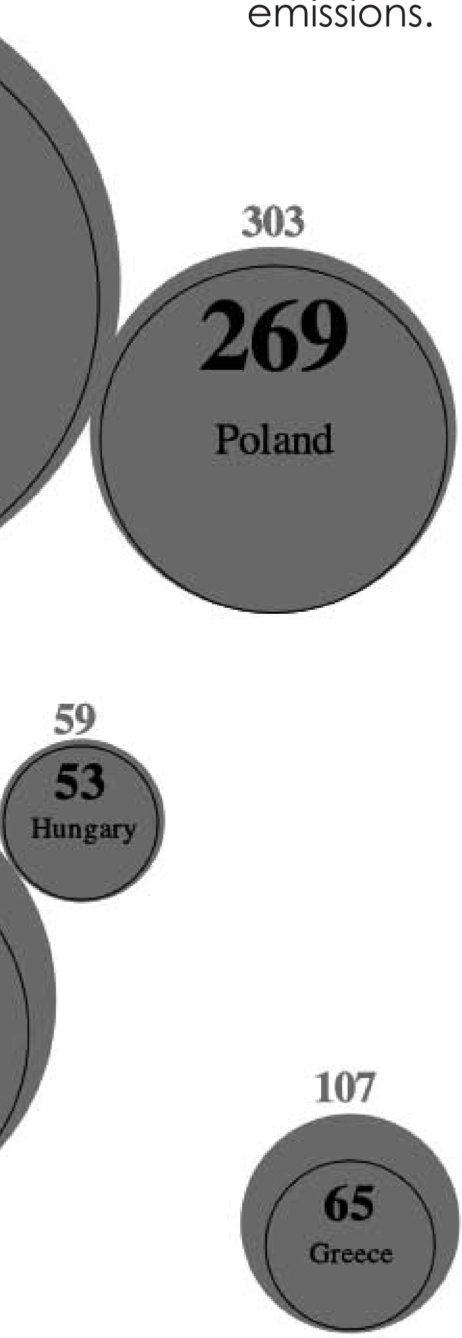
The Poznan proposals call for the EU to cut its total emissions by 20% on 1990 levels. This shows total emissions for EU countries now - and what they would be if each took on the same cut

European total emissions for 2006



Carbon and Climate Change

The diagram appeared in *the Guardian* on 13th December 2008 following a European summit of 27 countries where they all agreed, as you will see, to a 20% cut in their 1990 carbon emissions.



Carbon emissions concern us all, so it is important for each of us to interpret these figures.

Do you think this agreement is fair?

To answer this question we first need to find the answers to some others –

(you may have to consult an encyclopedia, your geography teacher or the school librarian for advice on books containing the information you want.

What is the size of these countries?

Their areas?

Their populations?

List them in size order -
first according to their areas
and then according to their populations

It would be useful to discuss all of this with your geography teacher.

Ratio Easy, Fractions Hard

Something happens when mathematical ideas are approached ‘from the ground up’ rather than from the ‘from top down’. **Mundher Adhami** looks at recent realisations in the classroom.

There was a time when mathematics was taught in order: arithmetic first, then algebra, then geometry, then trigonometry etc. In my school years the coordinate grid were the last to be introduced, if at all, whether for functions or for reflection of shapes.

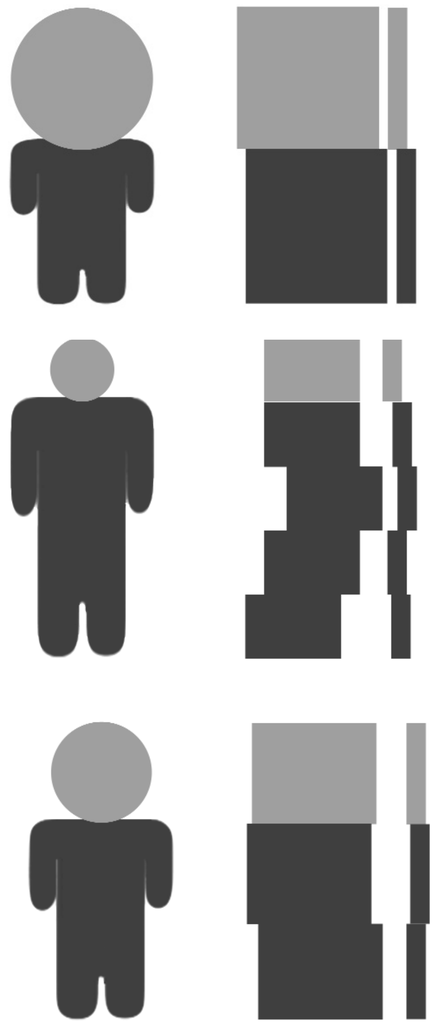
Then teachers realised that by a little bit of tinkering in presenting topics, mathematics could be made less rigid, and have a bit of life and connections. For some of us this came with the data in a large research project in the ’70s showing that some coordinates and graphs can be easier handled than algebra and many number concepts. Then everything got confused except a few fixed routes, one of which is that fractions are deemed easier than ratio.

But it is not really a matter of representation. It is a matter of recognising the essences of the formal mathematics. Seeds of the more advanced thinking in mathematics, or of mathematical language, seem to be present in certain contexts accessible to many young children in lower primary classes.

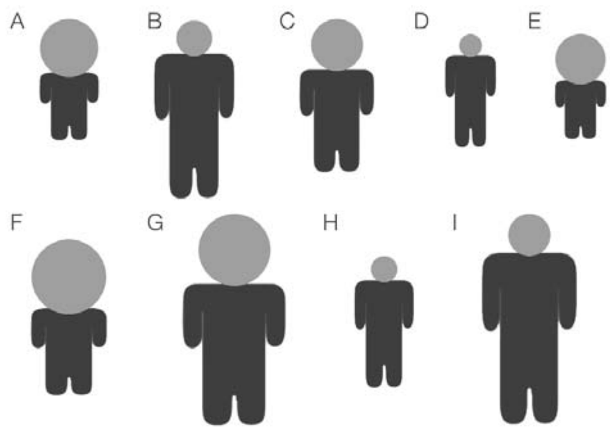
I worked with primary teachers in Islington and Bucks this year, and we proved for ourselves that ratio concepts are more accessible to children than fractions. That came up frequently in the teachers’ sessions on reflecting on the trials of a ratio lessons planned for Y2, such as the Jelly Babies activity.

The story of the local sweet shop wanting to make two flavoured jelly babies is engaging to the children from the start. They choose the two flavours then start to puzzle out the different offers by the shop in the three pictures given one a time. They name each (e.g. Jelly Baby, Jelly Man, Jelly Girl) talk about focusing on the height of each part.

The ratios of the head to the body (torso), which is either 1 to1, 1 to 2, or 1 to 4, are visible and can be talked about in everyday language, then in mathematical language.



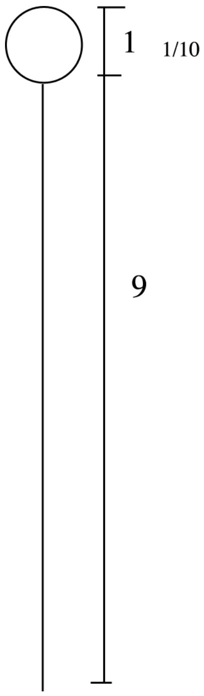
The head becomes a measure for the torso, aided by the drawn coloured blocks and by the sticks, that leads pupils towards the height aspect discounting other considerations.



Given a collections of figures of various sizes children relatively easily recognise the three types of jelly babies. They could use strips of paper to compare body and head in each and describe their thinking. They have to explain what is common between the small D figure and the large I figure. And how to show that G is not a Jelly Man.

In the third episode of the activity that length can then be used to construct a Jelly Giant of ratios such as of 1 to 8 or 1 to 9 through measured straight lines rather than as whole pictures. A ratio relates two independent quantities to each other in an accessible description. Even the notation of 1:8 instead of ‘1 to 8’ is readily understood through direct correspondence of symbol to meaning. It seems necessary to emphasise in language the distinction of the torso and the body, reserving the latter to the whole.

In trials of this activity a few pupils tried to understand how fractions fit in. This is accessible only to some children in Y2-6. It shows that the fraction idea is more demanding than the ratio idea. In addition to the two parts to compare in ratio work, fractions need the whole body, which includes the two parts then compares that with one of the parts. The whole is a construction, or an interpretation, while the ratio is just a description.



A Grafton Y6 pupil’s construction of a Jelly Giant with ration 1:9, looking only at length and converting to fractions.

So comparison of ratio and fractions seems important then. The 1:4 is visually understandable while 1/5 is an effortful interpretation in that the 5 includes the 1. Arguably this is at the same thinking level of understanding as a linear algebraic phrase such as 3n+2. The ‘generalised number’ element is implied in that the whole could be of any size, while the relationships within are the same. Empirical trials would show whether full understanding of fraction meanings, e.g. when different fractions are compared for size are near NC level 5, or early formal.

This implies that it is preferable to address ratio-fraction comparisons clearly through direct use of the two mathematical concepts in the same concrete and accessible context and setting, rather than keeping them separate and therefore conflicting systems in the mind. Pedagogically this seems similar to our approach to area and perimeter.

Why are fractions so difficult?

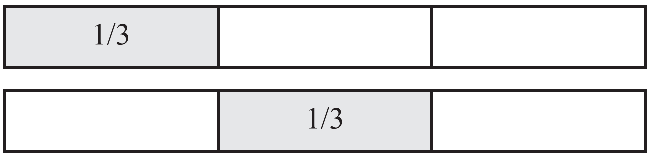
There are problems with fractions, all to do with the need for mental effort in interpreting the bits involved. When children are asked what each of the 3 elements in 1/2, there is an ambiguity or difficulty in deciding if the one is divided into 2 parts or that it is one out of 2 equal parts. You may think it is the same overall meaning, but the meaning of each bit is different. Good and scary discussions amongst teachers arise about whether 3/4 describes ‘3 out of 4 equal parts’ or ‘three wholes shared into 4 equal parts’ and why they are the same. It is a code for the part–whole relationships in terms of number of parts of equal size, but can mean different things. Such discussion may be beyond many pupils, so could be side-lined.

Any ambiguity is a source of confusion, and requires making a choice. And that is habitually avoided in intuitive thinking.

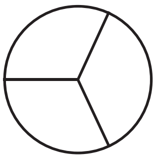
Another fraction meaning problem is evident when folding two identical paper strips, as in a Thinking Maths lessons on fractions. Children fold one strip in halves then quarters, the other in thirds then sixths. At each step the pupils talk about what a third or two thirds is, and whether 1/3 is smaller or bigger than 1/2 or 1/4 etc. Later in the episode questions on which of the several identified fraction would combine to be more than one whole and which to less.

In the question of ‘what is a third?’ or ‘Show me a third’ some children would show

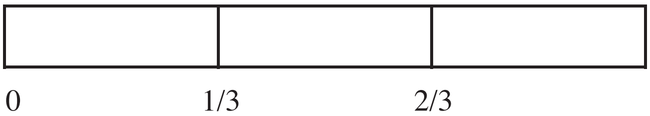
with any of the three parts, shaded or not, folded or unfolded. The fact that any of the three parts is a third is then emphasised, including when compared with 1/2 or 1/4. All of this is moving slightly ***beyond descriptive thinking***, since one needs to keep in mind that the 3 included the 1.



That is similar to the use of pie divisions, each of them is visually seen a 1/3



However, some pupils would see the line separating the left third from the middle as the 1/3. That assumes a zero starting at the left edge.



The two meanings of the fraction notation are the same two meanings as for number: one for a visible stand-alone quantity (part of the strip) and the other for measure, starting from an assumed starting point on a continuum labelled zero. The first focuses on the size of number, the second on order in equal interval scale. And the problem is greater since instead of a number we have a code of parts and wholes.

The coordination of the fraction convention and measurement convention clearly requires ***interpretative thinking***. Both conventions use number, but the fraction notation is based on the counting number system, while measurement uses the real number system, or at least the integer number system, with the zero and order of counting equal interval moves. This is way beyond descriptive thinking where the visible bits are all labelled and their relationships needs little interpretation.

In teaching, it is not clear at what National Curriculum level to put fraction notions, so that these are accessible to children in terms of understanding and manipulation. It seems taxing even for adults since it involves coordinating systems or conventions. The main thinking difficulty, however, is in the two different meanings for a number, or a phrase such as 2/3, depending on use or context.

What can we conclude from this discussion?

Perhaps pupils can answer some routine questions on fractions with practice, but we had better not assume they understand them. On the other hand we should not assume that ratio is difficult, but rather accessible to all. The difference is that in teaching fractions we start from a formal notation where the bits have ambiguous meanings, while in ratio we have more or less concrete separate bits that are compared to each other. It seems possible that in order to understand fractions you need ratio, but not the other way round.

Cognitive Acceleration Associates

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

Hadrian's Wall

Hadrian's Wall originally stretched across the 73 mile neck of England. The middle section of 20 miles remains the best preserved. It took three Roman legions – in total around 15,000 men - about six years (between AD121-AD128) to quarry the stone and build a structure on average 4.5m high (add 1.8m more for the parapet)

Brighton & Hove Newsletter, April 2008

Oh no, not rectangles again!

Mary BJ Clark applies some recent ideas from the other side of the world about effective ways to raise achievement.

An article in the Times Educational Supplement reported some education research on most effective ways to raise achievement from a Professor Hattie of Auckland University, New Zealand. This research focused on a synthesis of over 800 meta-analyses of education research, mainly relating to developed English-speaking countries, such as US, UK and Australia*. The research has enabled Professor Hattie to create a league table of the most effective ways to raise achievement. At the top of the ranking is 'student self-reporting grades' by which Hattie refers to self-assessment; also high in the ranking is feedback. Further work Hattie has done emphasises the importance of feedback; he reflects on the importance not only of feedback from teacher to child but also of children's feedback to their teachers.

Reading about the impact that children reflecting on their learning and feeding this back to their teachers can have on the children's learning made me think. It sounds seductively simple and obvious but the challenges for teachers is to find ways of doing this. As ever the devil is in the detail!

> **… it is the feedback to the teacher about what students can or cannot do that is more powerful than feedback to the student, but it necessitates a different way of interacting with and respecting students.**

In some recent work that I and a group of primary teachers (EYFS to Year 6 inclusive) have been doing we have been trying to find workable everyday strategies to enable children to reflect on their learning and articulate this or convey it in some other way to their teachers. This is still work in progress but our early findings have provided food for thought. As the children in the teachers' classes become more used to expectations of them in terms of reflecting on and discussing learning, we have been unearthing more and more about their understanding. This is not a process that children can instantly participate in but an environment that will enable this can gradually be established.

We are finding out more and more about just how much children know that it is all too easy to miss and fail to respond to as we teach - hence the title of this piece. This title refers to a recent experience of a Year 4 teacher in our group. She began some work with her class on finding the areas of rectangles by asking the children to come and show her on the interactive whiteboard what they knew about this. She drew a rectangle with the inner 'centimetre' squares displayed. Children were able to describe finding its area in a variety of ways including counting the inner squares and multiplying the dimensions. Some were also able to demonstrate how they would find the areas of compound shapes made of up to four rectangles. Had these children not been asked to talk about and demonstrate what they already know about finding rectangle areas the likelihood is that they would have worked their way through the lesson that their teacher had planned.

This would have shown them much of what they already were able to tell her. As it was she was able to respond to them in a way that took their learning forward…

In the introduction to his book, Hattie describes his research as 'An explanatory story, not a "what works" recipe'. His aim is to provide 'more than a litany of "what works", as too often such lists provide yet another set of recommendations devoid of underlying theory and messages, tending not to take into account any moderators or the "busy bustling business" of classrooms'. He comments on the need to realise that, for example, merely to provide more feedback to learners will not automatically result in improved achievement. For this to have an effect on achievement of pupils it will be necessary to make a change in the concept of the role of the teacher.

‘ … it is the feedback to the teacher about what students can or cannot do that is more powerful than feedback to the student, but it necessitates a different way of interacting with and respecting students’.

It is with these wise words in mind that I reflect on the work of the primary teachers in the group I mentioned above. During the comparatively short time we have been working together the classroom climate has been undergoing subtle changes as the teachers devise strategies for enabling their pupils to show what they do and do not understand. We have been delighted and impressed by some of the insights we have gained into children’s learning. To finish this brief reflection I am going to give some examples of the teachers’ discoveries and ideas for ways of making these happen in the ‘busy bustling business’ of their classrooms.

As the children in the teachers’ classes become more used to expectations of them in terms of reflecting on and discussing learning, we have been unearthing more and more about their understanding.

A pair of teachers from one of the schools, one with a Year 3 class and one with a Year 5 class, has been working to involve their pupils more in decisions about the groups in which they work and the way in which they access help from the teacher, and, indeed, from their peers. They have supported their pupils to decide whether they need to be in a group working with the teacher for a part of the lesson or in an independently working group (the level of which the children choose). As the lesson progresses and the teacher is available to deal with any difficulties that have emerged children are encouraged to indicate when they need help with the use of a red card. A green card indicates that the child does not want a teacher to help at present. The red card is also considered as an invitation to another child to help and is intended to discourage children from waiting with hands up, but rather to carry on trying to solve their own difficulties. The teachers observe that there are times when children are now able to make it clear that they want to get on without interruption from their teachers! This gives the teachers time to observe and learn more about their pupils’ understanding to inform their decisions on next teaching steps. Clearly an environment such as this takes time to establish.

A pair of teachers from another of the participating schools, one of the teachers with a Year 1 class and the other with a Year 2 class, has been transferring their practice of brainstorming at the beginning of a topic into their mathematics teaching. Children’s ideas have been collected on sticky notes, some with text and some with illustrative drawings. There have not only been surprises about the level of children’s understanding that is revealed but also some useful assessment information about misconceptions. The Year 2 children have been invited to comment on what they feel their next steps in learning might be. They have been enabled through this process to make some helpful suggestions that inform the teacher’s ongoing planning.

Even the very youngest learners in Foundation Stage have surprised us by their insights into their learning. With adult-led activities their teacher has been using traffic light fans to get an indication of how children feel about their understanding of the mathematics they are about to learn. When asked, for example, why one child was showing a green, he explained that this was because he had done an adding game at home with his father and so he thought he would be very good at it! The link between home and school was one that other children were also able to make without prompting.

Suffolk

*John Hattie, *Visible Learning: A synthesis of over 800 meta-analyses relating to achievement*, Routledge

Significant words

Murray has a great understanding of the geometry of the tennis court.
BBC Wimbledon Commentary 6.15 pm Friday 3rd July 2009

Bowls

108 men are chasing a first prize of £1,500 in the singles. The fours has 49 teams, the triples 61 and pairs 120.
The Argus, 2 August 2009

More for Less

This is the second article in a series where Jennifer Piggott & Liz Woodham share their ideas about how a simple piece of equipment or starting point has the potential to engage learners of all attainment levels and be flexible enough to respond to need.

One Hundred

In this article we have chosen the 100 square to help focus pupils' attention on:

- Justifying ideas
- Seeing and utilising mathematical structures
- Listening to others' ideas

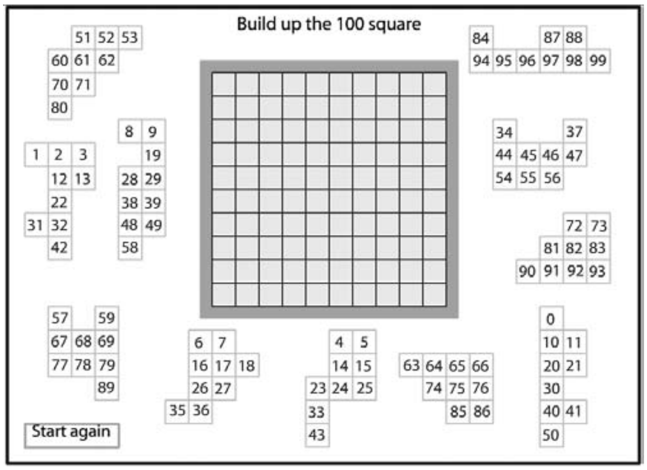
And teachers' attention on:

- Sharing ideas
- Extending ideas in familiar contexts
- Precision of arguments

You will need some hundred squares, possibly some of them printed back-to-back, some multilink cubes and you may wish to prepare some 100 square jigsaws of your own.
…

Where shall I start?

Finding out what your learners understand about a very familiar setting, and how easily they can make and justify connections, is our starting point.



Show the class the 100 square jigsaw activity found at http://nrich.maths.org/public/viewer.php?obj_id=5572. Or, download and use the pieces so that pupils can work in small groups. Working together, complete the jigsaw, asking for justifications for positioning pieces before moving each one. Starting from 0 rather than 1 helps learners to focus on the structure and sequences contained within the 100 square, sharing their observations with others as they justify the locations they choose. Ideas for additional support and extension can be found in the teachers' notes on the website. Why not develop a class set of different jigsaws that can be reused and circulated?

What next?

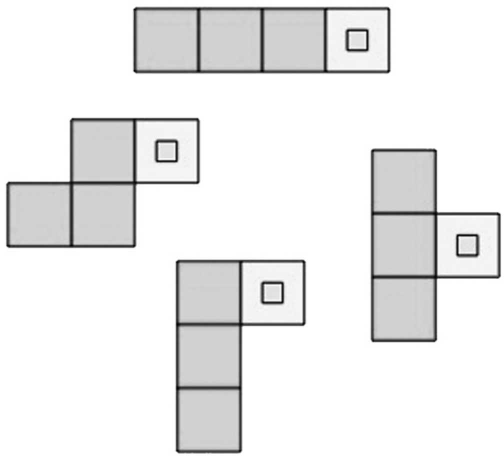
The problem "Hundred Square"(http://nrich.maths.org/public/viewer.php?obj_id=2397) is one of our favourites. Learners are asked to visualise what is behind each number if a similar number square is printed on the back. What is exciting is all the associated talk about how you worked it out and what we particularly love is the way learners often change strategy after they hear how others do it. We also use double-sided print-outs to help establish a focus on the strategy rather than the answer.

Why not?

How about working on some problems where learners might wish to use the 100 square as a tool for their solutions? Flashing Lights (http://nrich.maths.org/public/viewer.php?obj_id=1014) or Lots of Lollies (http://nrich.maths.org/public/viewer.php?obj_id=2360) are good examples. Of course learners might wish to use strategies of their own that do not involve the 100 square, however, translating their findings onto the 100 square may help to encourage discussion and generalisation.

Leading on to:

Worms (http://nrich.maths.org/public/viewer.php?obj_id=40) is an absorbing investigation using a 100 square. What is the sum of the numbers on the 100 square that the worm covers? What sorts of things do you notice and can you explain why?



Going a little further:

You might want to try this great extension, which exploits the structure of the 100 square: Diagonal Sums (http://nrich.maths.org/public/viewer.php?obj_id=2791).

The NRICH team at Cambridge University.

Pages from the past

'I don't care for children.'

Eglantyne Jebb 1900

In spite of this dislike Eglantyne Jebb founded the Save The Children Fund, stating that 'the only international language in the world is a child's cry'.

In earlier years she had trained as a teacher at Stockwell Teacher Training College and then taught in a village school as Clare Mulley describes in her biography *The Woman Who Saved the Children*:

Eglantyne had no personal experience of going to school, and no knowledge of many of the subjects like household management, sewing and nutrition that she was expected to teach. … Worst of all she discovered that she had no natural talent for teaching and described her own lessons as 'execrable'. She determined to pull herself together and 'do better' at the 'job in hand by finding creative ways to catch her students' imagination. She soon brought history to life with stories and visits to the Tower of London, and, told to give a lesson on a rabbit, she bought a dead one and taught herself how to skin and dissect it. Slowly she was beginning to learn what made children tick inside and they began to respond to her unconventional approach. At the end of the year she had won over many hearts if fewer minds among both fellow students and pupils, and she later confessed that she only passed her exams when these allies 'brightly gave the right answers in a way that concealed the wrong questions'.

Later [at Marlborough] conditions were miserable. There were not enough books, chalks, needles or fuel. Even in the spring Eglantyne had to make the freezing children clap their hands and stamp their feet every few minutes to keep warm. ..

Eglantyne considerd her school-class with humane concern but little sentimentality. Early on she described them with rather cool detachment as having 'pathetic faces with expressions of dull stupidity or animal cuteness'. She cultivated their interests and talents, and often visited them in their homes, where she was outraged by their appalling living conditions. But if anything she was bemused by their affection. … 'They beam up at me all the way to school just as though they didn't know that I was going to bully them all day.' Her reservation was quite deliberate. Worried about the poor quality of her lessons, she took comfort from reading somewhere that 'no real lasting harm is done to children by any teacher, however clumsy, if they have integrity of character.' … Miss Pullen, the headmistress reported that although her pupils were not particularly distinguished in their exams they did develop 'more than ordinary initiative and resourcefulness'.

Extract from Clare Mulley. *The Woman Who Saved The Children: a biography of Eglantyne Jebb Founder of Save the Children*. Oxford: Oneworld Publications, . 2009.

Engaging mathematics for all learners

This is a new resource from QCA, and as, Jane Gabb points out, with a title like that, it's clearly meant for the eyes of *Equals* readers.

The aim of the booklet is to show how the new curriculum can be made real in the mathematics classroom.

It is arranged under the questions which underpin the new curriculum:

- What are you trying to achieve?
- How will you organise learning?
- How will you know that you are achieving your aims?

The foreword, written by Mick Waters begins:
'If we want young people to do well in mathematics, it helps if they enjoy the subject. They need to see that the subject is fascinating and exhilarating, to see the way it affects everyday life and helps to change the world in which we live.'

I can't imagine that any of our readers could argue with those sentiments.

He goes on say that 'all children should have a rich experience.'

There are practical suggestions on devising rich tasks and the booklet is punctuated with snippets of wisdom from learners and teachers, making it very readable and placing it in real contexts. Throughout there are references to sources of good ideas, including nrich, Bowland maths, Teachers' TV and NCETM.

One of the best features is the section of case studies. There are 17, covering a wide variety of real settings with differing populations, and a range of mathematical topics. Two may be good starting points:
Case Study 1 shows how recreational activities have been used in a residential special school to engage learners. There is a video to support this on: http://curriculum.qca.org.uk/key-stages-3-and-4/case_studies/casestudieslibrary/

Follow the mathematics link and then find 'Playing at mathematics' from Baliol School, Sedbergh. The teacher used the recreational games that pupils played during their non-school time as learning contexts for mathematics. Snooker, darts and Connect four were used for different mathematical purposes.

It should be stressed that the case studies are ideas; they are not fully detailed lesson plans, and for all of them there will be a need to plan in detail how the idea might be translated into your context.

Case study 11 links mathematics to healthy lifestyles by looking at nutritional data from a fast food chain and comparing different constituents with the recommended daily amount. This is a great way to link the Every Child Matters outcomes 'Enjoy and achieve' and 'Be healthy' through the mathematics of a real context.

Further video clips are planned, and will be put onto Teachers' TV.

The page on Resources at the end lists lots of useful websites and some sources for statistics.

You can download or order this booklet (free) from: https://orderline.qca.org.uk/bookstore.asp?FO=1169415&ProductID=9781847219428&Action=Book

The reference number is QCA/09/4157.

I can thoroughly recommend this publication as useful to any teacher or department who wishes for some support in making the new curriculum a reality in their classroom or school.

We would be very interested to hear your ideas of what makes mathematics engaging for all, either using resources from this booklet or your own ideas.

RB of Windsor and Maidenhead

Investigating Misconceptions with the Simpsons - part 1

Capturing what the children say about their misconceptions is very important to Kelly Lane. Some mistakes were taken from what the children had said and done at the start of the year and of the topic, some from what children said in different classes. The children could all empathise and understand why the mistakes had happened, probably because they had made them themselves at some point.

Lesson 1 - ordering decimal numbers.
Year 5 and 6
A good way of getting children to work collaboratively is by giving them scenarios or misconceptions that they can investigate. This works best if other children or 'volunteers' have made the mistakes. The specific mistakes chosen were linked to the misconceptions seen in childrens' understanding at the beginning of the topic. This is also a great way of developing and training children's skills in peer assessment.

Starter

Can you put these numbers in descending order?

2.889 26.88

2.841 3.14

2.88

1.99999

Using number cards with a mixture of decimal numbers the children were asked to put them into order as quickly as possible. I asked the children to show their partner what they had done, and to explain why they had done it. This showed the children the variety of different ways there are to do this. We discussed that some ordered them in ascending order, some descending, some vertical and some horizontal. We made suggestions about the best method.

Can you put these numbers in ascending order?

8.836 8.863

8.386

8.638

8.368 8.8

The children were then asked to order the cards in ascending order and asked the children to explain how they knew which number to start with and so on. The children came to the conclusion that ordering the numbers vertically would be the best as this allowed them to check down each column to make sure there were no mistakes.

Can you put these numbers in descending order?

1.577

1.7 1.75

1.58

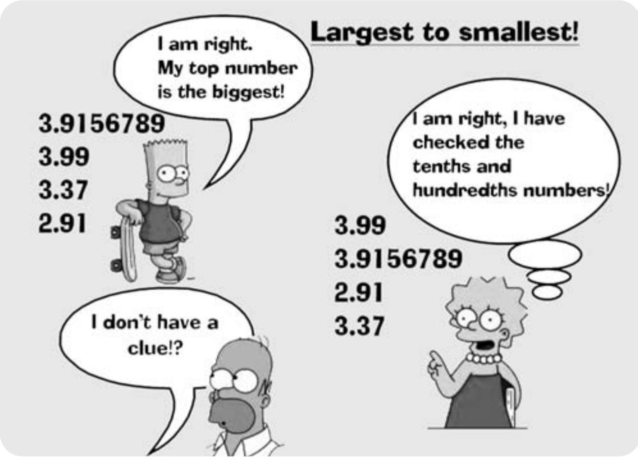
1.755

1.55

The children were then invited up to use the white board, moving a variety of decimal numbers into either ascending or descending order.

Main

With this particular lesson 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.



For this activity 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.

When the children were giving their opinions I posed certain 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 were asked to work in pairs and decide a way to teach Homer how to do it. Homer clearly claimed that he didn't have a clue how to even begin, which caused the children to start from scratch sharing and demonstrating all of their knowledge and understanding clearly. The statement from Homer also made those that felt the same way at the beginning of the topic more confident. Children took it in turns to teach their partners and then came to the front to demonstrate their ideas.

To finish off I asked if they felt they had achieved their objective. I then asked how they *knew* they had achieved their objective. The children revealed that they knew they had achieved their learning objective because they felt confident they could explain and show somebody else at another time.

Review by Mundher Adhami

Lifelong learning:
a worthwhile outlook in teaching at any age?

Educational initiatives are not confined to government agencies, where they often have the short-term horizon of political calendars and media schedules. Educational trusts and most universities usually have another outlook. They have largely continued their patient, thoughtful work and experiments through the rocky years of heavy political intervention in education. One area of their current public-interest work is the long term nature of learning and how that influences our approach to teaching. One recent initiative in this area is the **Inquiry into the Future for Lifelong Learning** (IFLL).

The Inquiry was established in September 2007 and is producing its main report in mid-2009. It is sponsored by the National Institute for Adult and Continuing Education (NIACE), with an independent Board of Commissioners under the chairmanship of Sir David Watson, a professor of higher education management at the Institute of Education, University of London, and a Nuffield Trustee.
(Full details of the Inquiry can be found at www.niace.org.uk/lifelonglearninginquiry.)

The IFLL project started with commissioning Sector Papers that discuss the implications of lifelong learning for each of the 7 sectors involved in providing learning opportunities: pre-school, school, FE, HE, private trainers, third sector organizations and local authorities. The goal here is to encourage innovative thinking on how these parts do or do not fit together, as part of a systemic approach to lifelong learning.

The first Sector Paper was published in 2009 and is available on the web, despite a strangely retained standard paragraph on copyright. The paper is under the title :

School as a foundation for lifelong learning: the implications of a lifelong learning perspective for the re-imagining of school-age education, Professor Guy Claxton and Professor Bill Lucas, *Centre for Real-World Learning, University of Winchester*

Colleagues in London have used one section of the Claxton and Lucas paper with teachers on a Thinking Maths course and found the ideas fitting with the ethos of the course. The section is on the characteristics of the lifelong learner, which are worth summarizing. (In places the wordiness gets in the way more than the over rich phrasing!)

The authors suggest eight attributes for long term and continuous development of people or core qualities of the confident learner. They suggest these as in need of encouragement by school teachers at any age -. 'The Magnificent Eight' attributes of powerful learners:

• Curiosity
Children are born curious, they like to wonder how things come to be; how they work. They like to get below the surface of things, to ask pertinent questions. Curious people can be challenging and healthily sceptical about what they see and are told.

• Courage
They are not afraid of uncertainty and complexity. They have the confidence to say 'I don't know' and try something they are not yet sure how to do. Courageous learners can stick with things that are difficult. Mistakes are for learning from, not for getting upset about. They are good at exploration and investigation. They are always ready to learn by imitation of those who appear to have tactics and strategies that work. They are opportunistic, alive to new possibilities and resources that crop up along the way.

• Experimentation
They like to try things out, sometimes to see if they work, sometimes just to see what happens. They say 'Let's try…' and 'What if?' They like messing about with interesting material – mud, footballs, PhotoShop, friends – to uncover the 'affordances' of materials, situations and people. They know how to 'prod' things, to get them to reveal themselves.

• Imagination
They value 'mental simulations' of tricky situations to see how they might behave; they know to let ideas 'come to them', and have a mixture of respect and scepticism toward their own intuitions. They like making connections inside their own minds, and they use a lot of imagery, analogy and metaphor in their thinking. They know when and how to put themselves in other people's shoes.

• Reason and discipline
They are good at 'hard thinking': they follow rigorous trains of thought to lead to fresh ideas or predictions. They spot holes in their own and others' arguments. They know the value of goals and deadlines.

• Sociability
They know how to make good use of the social space of learning. They are happy sharing ideas and resources. They hold their own views in debate, but stay open-minded. Effective learners seem to know who to talk to (and who not to), and when to talk (and when to keep silent) about their own learning.

• Reflection
They are able to step back and take stock of the process but don't get in the trap of being too analytical or self-critical. They are self-aware, interested in their strengths and weaknesses. They can apply expertise acquired in one situation to another possibly unfamiliar one. They see themselves as continually growing.

The authors see these core qualities as a foundation of a rich epistemic (knowledge building) curriculum. They invite us to ask new kinds of questions about the design of schools to cultivate of eight qualities thorough syllabuses, timetables, assessments, environments, resources and teaching styles.

I am weary myself of long and numbered lists but see in presenting these ideas to teachers a valid opening for some active engagement. This in fact is a feature of teaching that the same paper advocates in a different section.

Teachers themselves would:

- **judge** which of the eight attributes are more or less crucial, or easier to promote in children
- **reconstruct or rephrase** the ideas in their own ways and as relevant to their own conditions
- **order or classify** the attributes in some way, getting away from lists and numbers.

Perhaps one of the questions for teachers is:

- If you were to sort these attributes into two sets, what would they be?

This is a question that proved very fruitful in other reflection slots, some of which I have reported in *Equals*, with rich variations in interpreting the labels. As for the eight attributes, I wonder how colleagues would place these, despite the overlaps, into intuitive and contemplative attitudes (curiosity, exploration, imagination and sociability) on the one hand, and more deliberate and effortful attitudes (courage, experimentation, reasoning and reflection) on the other. The labels may not fit exactly, but that is one of the functions of active learning: create your own labels.

Cognitive Acceleration Associates

Review by Rachel Gibbons

***Circa Maths Magazine* &**
Buzz for young mathematicians
published by Juliet and Charles Snape Limited, London NW6 1TH

It must be obvious from how frequently we use material from the Circa Maths team in *Equals* how much the editors value Juliet and Charles Snape's productions.
They present mathematics in a colourful and exciting way which must appeal to even the most turned-off-mathematics youngster. *Circa* is aimed at key stages 2 and 3 pupils, encouraging them to search for patterns, play games, find the way through mazes and generally do mathematics. *Buzz* will appeal to younger pupils. I have just been looking at a copy with a lively rising-four who has been delighted with all the brightly coloured cats, was ready to find the hidden ones and quickly spotted the objects that did not belong in a picture of a room.

The magazines contain many interesting facts – rather like *Equals*' 'significant figures' - such as:

> The whale is the world's largest animal. The blue whale grows to about 30 metres. That is as long as three buses.

as well as fascinating historical events linked to mathematics and examples of mathematical patterns taken from different cultures where mathematics is seen by readers as a means of interpreting the world in which they live. The magazines are surely musts to enliven every mathematics classroom.

There is also a Circa bookshelf containing special selections of *Circa* and other discounted books containing answers to such questions as *Why Do Buses Come in Threes?* and *How Long is a Piece of String?*

Ring for a catalogue today (020 7433 1231).

What's the point? motivation and the mathematics crisis
David Wells
Rain Press, 27 Cedar Road, London NW2 3UL

Another book with a rich collection of mathematical treasures is David Wells's latest, this time worth digging into by the teacher. I would not suggest that it should be read from cover to cover but it would be a useful source in a secondary mathematics department or in a primary school to be dipped into for tips on classroom approaches – the chapter headings are a useful guide in which you should find your areas of interest. He starts by going back a century and quotes J.W.A. Young:

> Where are the mathematical laboratories in our schools, lumbered as they are with targets and exams and more exams and more targets?

Wells has much to say about demotivated pupils, and the aesthetics of mathematics that will motivate them. He tackles the topic of proof in the classroom stating that

> proof is a central concept in mathematics: indeed it is the feature that distinguishes mathematics (and abstract games) from science.

In all, it is a useful book to have in a secondary mathematics department or in a primary school, a book through which teachers can profitably browse during odd moments and find motivating ideas for use in the classroom.

Hove