Equals

Realising potential in mathematics for all

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Realising
potential in mathematics
for all

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Editors' page

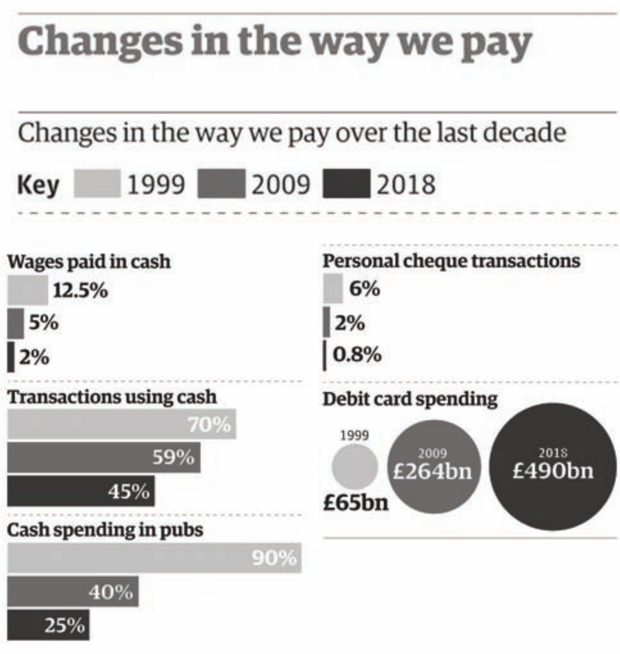
This editorial is being written before the election. Now you are reading it decisions have been made about the composition of the new parliament. It is unfortunate that, because they have spent so much time in their youth sitting in desks in classrooms themselves, most of the adult population, especially members of parliament, think they know better than teachers what should happen there. It is important, of course, not to lose sight of national initiatives but, at the same time, teachers must find their courage and creativity again after so much direction from the centre so that those pupils in the lower half of the achievement range can get the incentive they need – and that incentive will vary from pupil to pupil.

Back in 1963 the Newsom Report (*Half our Future*) commented concerning the lower achiever in school:

> 'We feel bound to record our impression that very many of these less gifted young people are socially maladroit, ill at ease in personal relationships, unduly self-regarding and insensitive; their contact even with their peers is often ineffectual; they understandably resent being organised by adults but show little gift for organising themselves'. These are serious criticisms, certainly not applicable to all our pupils, but neither are they easily to be dismissed. This matter of communication affects all aspects of social and intellectual growth for all students.

Are we still, more than 40 years later, letting down this group of young people? These skills in personal relationships and communication are after all the basics, mathematics and English only featuring in so far as they provide these communication skills. The recent stress on skills should have improved greatly what is on offer to this other 'half [of] our future' but there is still too strong a stress on testing and positions in the league tables for them to feel thoroughly comfortable in school and for schools to accept them with equanimity. In the pages of this journal we have always stressed the importance of looking at mathematics as a skill necessary for the interpretation and greater understanding of the world in which young people find themselves - the numbers are the core of the news. Without a feeling for number the coming generation is not going to be able to understand the possible cataclysmic changes forecast for the world around them.

And, not only should we be concerned with a mastery of number, it is important also to look back and remind ourselves – and our pupils – that the roots of geometry lay in the attempt to solve practical problems - a consideration of the needs of farming and the importance of land boundaries. Now, with a necessity for us all to have some understanding of the basics of the much more complex issues of climate change, 'Today we feel bound to record our impression that very many of these *less gifted young people* are socially maladroit, ill at ease in personal relationships, unduly self-regarding and insensitive; *their contact* even with their peers is often ineffectual; *they understandably resent* being organised by adults but show little gift for organising themselves'. These are serious criticisms, certainly not applicable to all our pupils, but not, either, easily to be dismissed. This matter of communication affects all aspects of social and intellectual growth. An appreciation of some basic mathematical principles is even more vital today than it was in 1963.



The Guardian 14.04.10

Integration? Yes, but Inclusion? There's the Rub

Rachel Gibbons offers a long term perspective on inclusion.

Inclusion is once more in the news with an attempt to make further education and training more inclusive. Of course the whole comprehensive school movement of the last 40 or so years has been about integration and inclusion. But, if setting is introduced, a comprehensive school can be more exclusive than any other: if you are a member of a bottom set out of 4 - or even perhaps 8 - how do you feel about your chances of achieving any success in your learning in any area of the curriculum? Jo Boaler writes of "the difficulty of identifying students correctly when children develop at different rates" (*The Elephant in the Classroom: helping children learn and love maths*, reviewed in *Equals* 16.1) Boaler also points out that teachers' views of mathematics and how they present it in the classroom can exclude the majority of children. She gives examples of children whom she met at summer school where she and her colleagues were providing a rich diet of problem solving, all calling for creativity and the sharing of ideas and insights. She describes how many of the pupils attending summer school were used to mathematics classrooms where the practice of teacher-given procedures was the order of the day – and this, not surprisingly, they found boring.

the difficulty of identifying students correctly when children develop at different rates

If as well as being procedure-driven, a classroom is test-driven it is even less inviting, particularly for the children in whom the writers and readers of this journal are most interested, the other half, the non-A-to-Cs, who are never going to push their schools up the league tables and are never going to have the satisfaction of passing out with anywhere near top marks on any test.

Just over forty years ago a group of heads of secondary mathematics departments in west London, of whom I was one, found themselves faced with groups in the first year with a very wide spread of achievement. How were we to include all the children in a class when there were no effective learning materials available for such groups? It was not easy to use talk and chalk methods with such groups and the text books we had in our cupboards were certainly not going to help. We saw a need to personalise (not that we used that term at the time) but we knew there was not enough energy and time in one mathematics department to write the classroom materials required for such a wide range of needs so the departments of 15 schools met together to share the task and SMILE (Secondary Mathematics Inclusive Learning Experience) was born. The network of mathematical tasks, each with its test and answers provided, grew steadily over the years and, with it the participating teachers grew too in their understanding of mathematics and in their pedagogical skills. Now the SMI LE materials are recognised by the mathematics education community to contain some of the most effective around.

Over the last couple of years a group of the original Smilers have been working together to bring the materials within reach of all teachers once again. By the time this piece is published we hope that STEM at the University of York will have digitised all the materials and put them on their web where they will be available to all teachers. So, if you are struggling with inclusion, this could be your salvation. But don't think of it as a resource that makes no demands. One of the most valuable characteristics of SMILE was that it was dynamic. Teachers were continually writing new activities to be added to the network and agreeing to remove any that had not proved stimulating learning vehicles. This must continue if the resource is to be kept up to date and inviting. Like earlier Smilers, who were actively involved with the development of the network of tasks, future users who are involved in the updating should find themselves gaining a deeper understanding of the mathematics involved and enlarging their pedagogical skills at the same time.

Cemetery data as a setting for real mathematics!

Alan Edmiston finds that even the first trial of an activity in a familiar setting can be fruitful and energising for a class of children. But he welcomes help with refinements.

“Was that a maths lesson?” said a Year 4 boy at the end of the first trial of a new Thinking Maths lesson which involved looking at the months people die. In this article, I will describe the lesson after outlining the steps in the process that went into planning it for pupils who do not have much formal training in mathematics.

Step 1 – Open ended activities as source

As part of the Thinking Maths development group’s work in Islington we had looked at a list of the real-live activities in the Graded Assessment in Maths (GAIM) pack. I was working with some Year 6 pupils and seeking fresh inspiration. I was attracted to an activity labelled ‘Cemetery Maths’ which relies on collecting and analysing real data. I knew an interesting cemetery where my own and pupil’s relatives are buried. And so it was that in June 2009 we spent a day collecting and analysing data to answer predictions generated by the pupils. The work the pupils produced was of a very high standard and the whole activity proved to be highly memorable as an extended open-ended activity with visual outcomes.

Step 2 – Converting to a Thinking Lesson

We now move forward a year and the Thinking Maths group splits into teams to convert open activities into structured lessons keeping their real life flavour. The Cemetery Maths activity was far too open an exercise to fit the standard whole class challenge that exemplifies a good Thinking Maths activity. We focused upon data handling and based much of our thinking on a Year 5 Primary CAME activity called ‘Comparing Texts’. In this lesson the pupils are given texts from which the data is extracted and presented in a tally chart. The approach we eventually took was to present pictures of gravestones to the children from which they had to process and represent (either as a tally chart or bar graph) the information regarding the dates of death shown. This focus enabled us to manipulate the number of deaths each month to introduce the pupils to the idea of a bimodal distribution i.e. that there are more deaths in both the hottest and coldest months of the year.

Step 3 –Lesson trial

The hardest part was limiting the amount of information on each gravestone and also ensuring a ‘realistic’ spread and number of dates to work with. The lesson itself worked much better than I could have imagined and the reason for this was that the data on months of deaths presented on the gravestones’ pictures turned out to be familiar to pupils, since they collect and display the dates of birth of the peers. So giving out small cards with two bits of information on each was appropriate to all.

Most interesting were the strategies they used to sort out the piles of cards. After about 30 minutes I stopped the class and asked them to walk around the room just taking note of the different ways the groups were sorting the cards. As expected the two methods of data analysis that were the most popular were the tally chart and the line graph. During the final feedback session where they began to discuss the patterns in the data there was a real sense of the pupils being able to see meaning in the data. They were happy with the idea that ‘heatstroke’ could cause people to die in the summer as well as cold in the winter. It was at this point their teacher commented that they needed to tidy up after the maths lesson that the headline quote was uttered: “Was that a maths lesson?”

Step 4 –Refining.

The final step in the process of lesson development means that I must now pass the lesson on. I am doing this here by giving the first draft, and with the cards in small fonts so they need enlarging. I am happy that it works but the final step is where I need your help. I would appreciate any reader who wishes to try the lesson to do so using the resources included here. Please pass on your feedback and comments to me at: edmiston01@btinternet.com

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Cemetery Maths - Draft Thinking Maths Lesson for upper Primary and Lower Secondary classes

Summary
Pupils explore a range of strategies to handle data. The data is given on cards with days and months of deaths across the year of both **Male** and **Female**. The cards can be made elaborate pictures of tombstones or simple e.g.

Male
Died
2nd September

The pupils are required to sort cards prior to representing the data in some way to see if they can find any patterns. The lesson ends on two key thinking points:

1. How useful are tally and/or bar charts as ways to see patterns in data?
2. How to describe a pattern that is more complex than having a single mode, since the distribution in deaths that the data reveals is bi-modal i.e. more deaths in both the summer and winter.

Episode 1 (20-25 mins.)

Introduction
I started the lesson with a video of the trip to the cemetery and suggest you get a copy from me or do likewise with a video or use a slideshow containing a selection of photographs from a cemetery near to your school. The initial stimulus will result in them discussing the idea of carrying out some sort of survey to see if anything can be found out from all of the dates that are available.

Group Discussion
Give out the envelopes containing the cards telling the pupils that they all came from the same cemetery close to a large city from the year 1956. It is worth drawing out a few cards and getting the pupils to talk about the information they contain. The pupils are to focus here upon how best to sort their data.

Sharing
Share ideas (you may wish to encourage the pupils to wander round looking at what others have done prior to any discussion) based upon what they have done with the cards and why. I found this part worked well as the amount of data on each card is quite limited and so it linked quite well with an activity that takes place in many classrooms i.e. the collation and display of birthdays each month. This sharing should help those groups that have found the sorting part hard. At this point some of the patterns present within the data will begin to emerge i.e. that lots of people (**Male**/**Female**/both) die in August/January etc.

Episode 2 (20-25 minutes)

Intro
Encourage the pupils to decide on the best way they can show their results/patterns on paper to share with the rest of the class.

Group Discussion
Give out large paper (A3 or sugar) and felt pens and encourage the class to do something with their data to show any patterns they have noticed. There is a range of possibilities that involve the combined or separate sex data: a written list, tally charts, bar graph, table.

Sharing
Engage the class in a ‘show and tell’ that has two parts:

- Talking about what they did to handle the data – they vote on the one they like the best. The tally chart or bar chart usually emerges as the favourite. It is worth giving time to the fact that for many they actually see meaning in data for the first time and are keen to express their ideas at this point.

- A discussion of the meaning of the bimodal distribution in terms of why more people die in both the winter and summer.

Episode 3 (20-25 minutes)

There is scope to extend it to:

1. Looking in detail at the two forms of data handling i.e. back to back tally chart and bar charts.
2. Exploring how the data might look during the war if we compared **Male** and **Female** i.e. the death rates for **Males** might be steady given the number of war deaths.

Reflection

Encourage the pupils to think about how the bar graph (or tally chart) helped them to see patterns in the data and why this is a good form of data handling.

The following data is given on cards each representing 1 gravestone. Best done cut out laminated cards placed mixed in envelopes for each group of pupils.

Male Died 2nd January	**Male** Died 5th January	**Male** Died 5th January	**Male** Died 10th January	**Male** Died 15th January
Male Died 17th January	**Male** Died 20th January	**Male** Died 23rd January	**Male** Died 24th January	**Male** Died 24th January
Male Died 29th January	**Male** Died 30th January	**Male** Died 1st February	**Male** Died 1st February	**Male** Died 1st February
Male Died 2nd February	**Male** Died 5th February	**Male** Died 6th February	**Male** Died 10th February	**Male** Died 15th February
Male Died 17th February	**Male** Died 21st February	**Male** Died 25th February	**Male** Died 26th February	**Male** Died 27th February

Male Died 10th March	**Male** Died 12th March	**Male** Died 20th March	**Male** Died 23rd March	**Male** Died 29th March

Male Died 29th March	**Male** Died 1st April	**Male** Died 2nd April	**Male** Died 2nd April	**Male** Died 10th April
Male Died 21st April	**Male** Died 24th April	**Male** Died 30th April	**Male** Died 4th May	**Male** Died 20th May
Male Died 23rd May	**Male** Died 25th May	**Male** Died 7th June	**Male** Died 12th June	**Male** Died 14th June
Male Died 17th June	**Male** Died 18th June	**Male** Died 2nd July	**Male** Died 4th July	**Male** Died 4th July

Male Died 5th July	**Male** Died 10th July	**Male** Died 11th July	**Male** Died 11th July	**Male** Died 12th July
Male Died 13th July	**Male** Died 13th July	**Male** Died 4th August	**Male** Died 5th August	**Male** Died 10th August

Male Died 14th August	**Male** Died 15th August	**Male** Died 20th August	**Male** Died 23rd August	**Male** Died 29th August
Male Died 29th August	**Male** Died 1st September	**Male** Died 2nd September	**Male** Died 10th September	**Male** Died 14th September
Male Died 13th October	**Male** Died 24th October	**Male** Died 30th October	**Male** Died 10th November	**Male** Died 13th November

Male Died 23rd November	**Male** Died 23rd November	**Male** Died 26th November	**Male** Died 1st December	**Male** Died 2nd December
Male Died 5th December	**Male** Died 5th December	**Male** Died 12th December	**Male** Died 14th December	

Female Died 2nd January	**Female** Died 2nd January	**Female** Died 5th January	**Female** Died 6th January	**Female** Died 8th January
Female Died 18th January	**Female** Died 23rd January	**Female** Died 25th January	**Female** Died 25th January	**Female** Died 1st February
Female Died 1st February	**Female** Died 1st February	**Female** Died 4th February	**Female** Died 5th February	**Female** Died 23rd February
Female Died 27th February	**Female** Died 28th February	**Female** Died 28th February	**Female** Died 28th February	**Female** Died 10th March
Female Died 15th March	**Female** Died 20th March	**Female** Died 25th March	**Female** Died 30th March	**Female** Died 4th April

Female Died 5th April	**Female** Died 20th April	**Female** Died 20th April	**Female** Died 10th May	**Female** Died 10th May
Female Died 14th May	**Female** Died 18th May	**Female** Died 28th May	**Female** Died 31st May	**Female** Died 20th June

Female Died 20th June	**Female** Died 20th June	**Female** Died 25th June	**Female** Died 1st July	**Female** Died 2nd July
Female Died 3rd July	**Female** Died 3rd July	**Female** Died 10th July	**Female** Died 15th July	**Female** Died 19th July
Female Died 19th July	**Female** Died 20th July	**Female** Died 27th July	**Female** Died 30th July	**Female** Died 31st July

Female Died 5th August	**Female** Died 6th August	**Female** Died 7th August	**Female** Died 10th August	**Female** Died 12th August
Female Died 13th August	**Female** Died 19th August	**Female** Died 19th August	**Female** Died 29th August	**Female** Died 29th August
Female Died 12th September	**Female** Died 13th September	**Female** Died 13th September	**Female** Died 21st September	**Female** Died 28th September
Female Died 4th October	**Female** Died 5th October	**Female** Died 10 October	**Female** Died 20th October	**Female** Died 1st November
Female Died 1st November	**Female** Died 24th November	**Female** Died 30th November	**Female** Died 30th November	**Female** Died 3rd December

Female Died 4th December	**Female** Died 18th December	**Female** Died 18th December	**Female** Died 31st December	**Female** Died 31st December

The data from gravestone cards can be summarised in different ways including in a two-wing tally chart with the following totals:

Number of males	Month of death	Number of female
12	Jan	9
13	Feb	10
6	Mar	5
7	April	4
4	May	6
5	June	5
12	July	10
9	Aug	11
4	Sept	5
3	Oct	4
5	Nov	4
6	Dec	6

Cognitive Acceleration in Mathematics Education

Reaching the children

Extracts from E R Braithwaites's *To Sir with Love*

I tried very hard to be a successful teacher, but somehow as day followed day in painful procession, I realised I was not making the grade. I bought and read books on the psychology of teaching in an effort to discover some way of providing the children with the sort of intellectual; challenge to which they would respond, but the suggested methods somehow did not meet my particular need, and just did not work. It was as if I was trying to reach the children through a thick pane of class, so remote and uninterested they seemed.

....

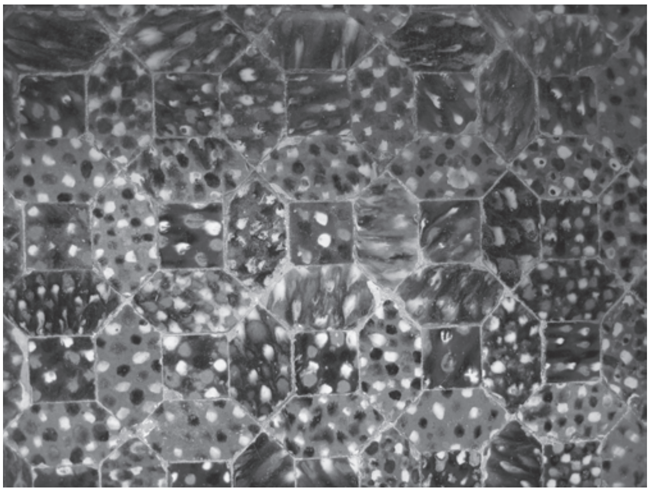
There was growing up between the children and myself a real affection which I found very pleasant and encouraging. Each day I tried to present to them new facts in a way which would excite and stimulate their interest, and gradually they were developing a readiness to comment and also a willingness to tolerate the expressed opinion of others, even when those opinions were diametrically opposed to theirs. At first these differences set tempers alight, and the children were apt to resort to the familiar expletives when they found themselves bested by more persuasive or logical colleagues. Whenever this happened I deliberately ignored it and gradually the attitude of the majority of the class to strong language proved sufficient to discourage its too liberal use. I was learning from them as well as teaching them. I learned to see them in relation to their surroundings, and in that way to understand them. At first I had been rather critical of their clothing, and thought their tight sweaters , narrow skirts and jeans unsuitable for school wear, but now that they were taking an interest in personal tidiness, I could understand that such clothes merely reflected vigorous personalities in a relentless search for self-expression

E R Braithwaite: *To Sir, with Love*, Bodley Head, London, 1959.

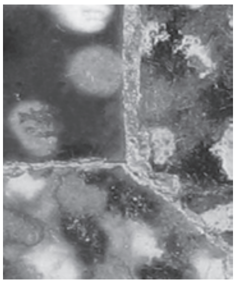
Tessellations – an approach to geometric reasoning

Tessellations are pleasing to the eye and provide some interesting challenges. Jane Gabb's pupils enjoy making and looking at them.

I started a lesson recently by looking at this tiling pattern – it is from Moorish Spain. Pupils like to see things in mathematics lessons which come from the real world and it helps to make mathematics more relevant to them.



'What can you see?' is a great open question with many answers and in this case it will encourage students to look for the shapes within the pattern. It will become apparent that people see patterns in different ways, and that none of them are wrong!



I then showed them this close up of one of the intersections and invited suggestions about how we might go about finding the angles of the shapes. This has a practical application, because the tilemaker who made the tiling pattern would first of all have needed to make the tile shapes accurately, having worked out the correct angles.

The symmetry and regularity of a tessellation means that we can assume that every similar shape is exactly the same and is symmetrical if it appears to be so. If a shape appears to be a square, then we can assume that it is. If students are allowed to talk in pairs or small groups they will soon realise that we have a 90° angle and 2 equal angles and that they all add up to 360°. A couple of calculations later we have the angle of the hexagon – 135°.

There are several ways that the lesson might proceed from this starting point. Click together shapes like clixi or polydron could be used to explore which shapes tessellate and which do not. After exploring what happens with a single shape (a particular triangle, squares, pentagons and hexagons), students could be given 2 shapes and the challenge of making a regular tessellation with them. This is much more difficult and they will find it difficult to make a regular repeating pattern, preferring to work from a middle out in a roughly circular fashion, or to begin to make 3D shapes.

An alternative would be to give them ready made tessellations (there is a wesite: http://gwydir.demon.co.uk/jo/tess/index.htm where you can download and print a good selection of tessellations.) Enlargements of the intersections can be useful in helping pupils to focus on the angles they can calculate around an intersection. They will need to know the angles of squares and equilateral triangles, and also the sum of angles at a point.

Another approach is to be explored on the cre8ate website: http://www.cre8atemaths.org.uk/ You have to register to download and use the resources, but it's free. The activity 'Tiling Patterns' asks students to find all the semi-regular tessellations using just equilateral triangles, squares and regular hexagons. There are good teacher notes for every activity and attractive resource sheets which can be printed out.

Other investigations on the same theme are:
Starting point: Do all triangles tessellate? Ask for pupils' predictions and then give them different triangles to experiment with. For instance on one table, one pupil might have equilateral, another isosceles, another right angled scalene, another right angled isosceles and another scalene triangles.

When they have completed their tessellations (by drawing round card shapes, or cutting out and sticking their triangles onto paper) the different patterns can be compared.

- What is the same and what is different about the patterns?
- What happens at an intersection?
- What can this tell us about the sum of the interior angles of any triangle?

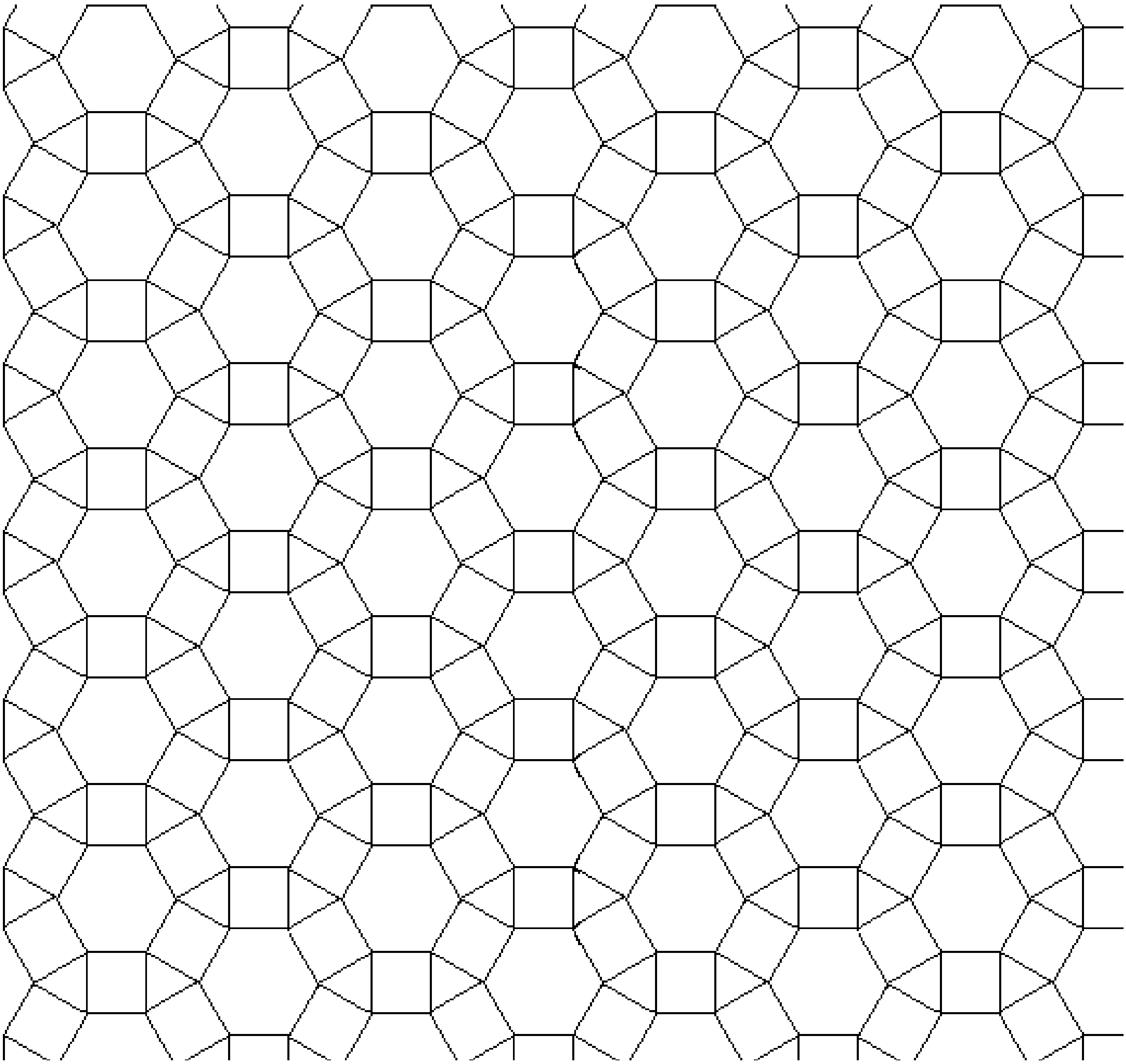
Similarly: Do all quadrilaterals tessellate? Different students experiment with kites, trapezia, both isosceles and not, parallelograms, rhombuses, irregular quadrilaterals. When they are finished the same questions as above, with the last one being:

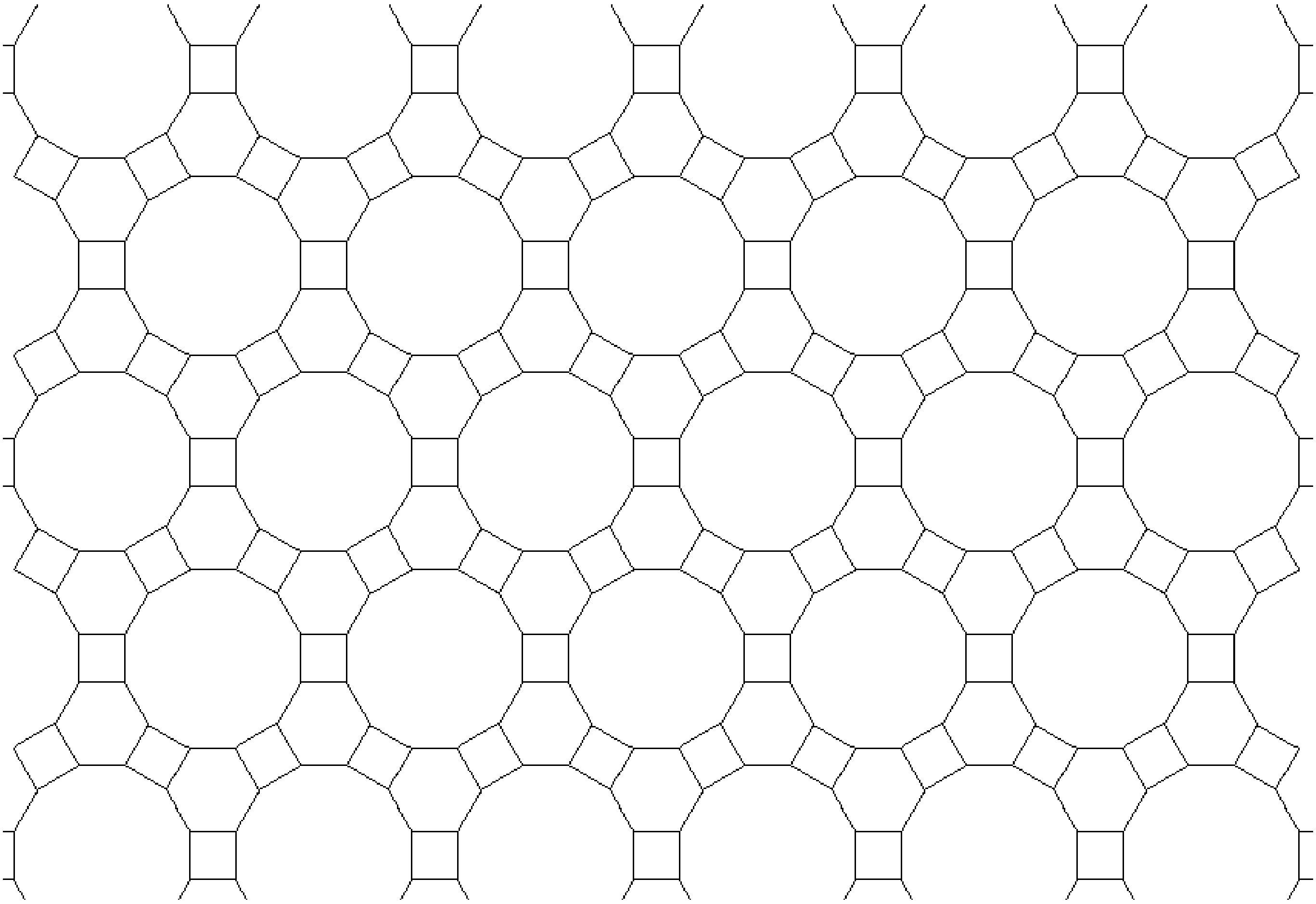
- What can this tell us about the sum of the interior angles of any quadrilateral?

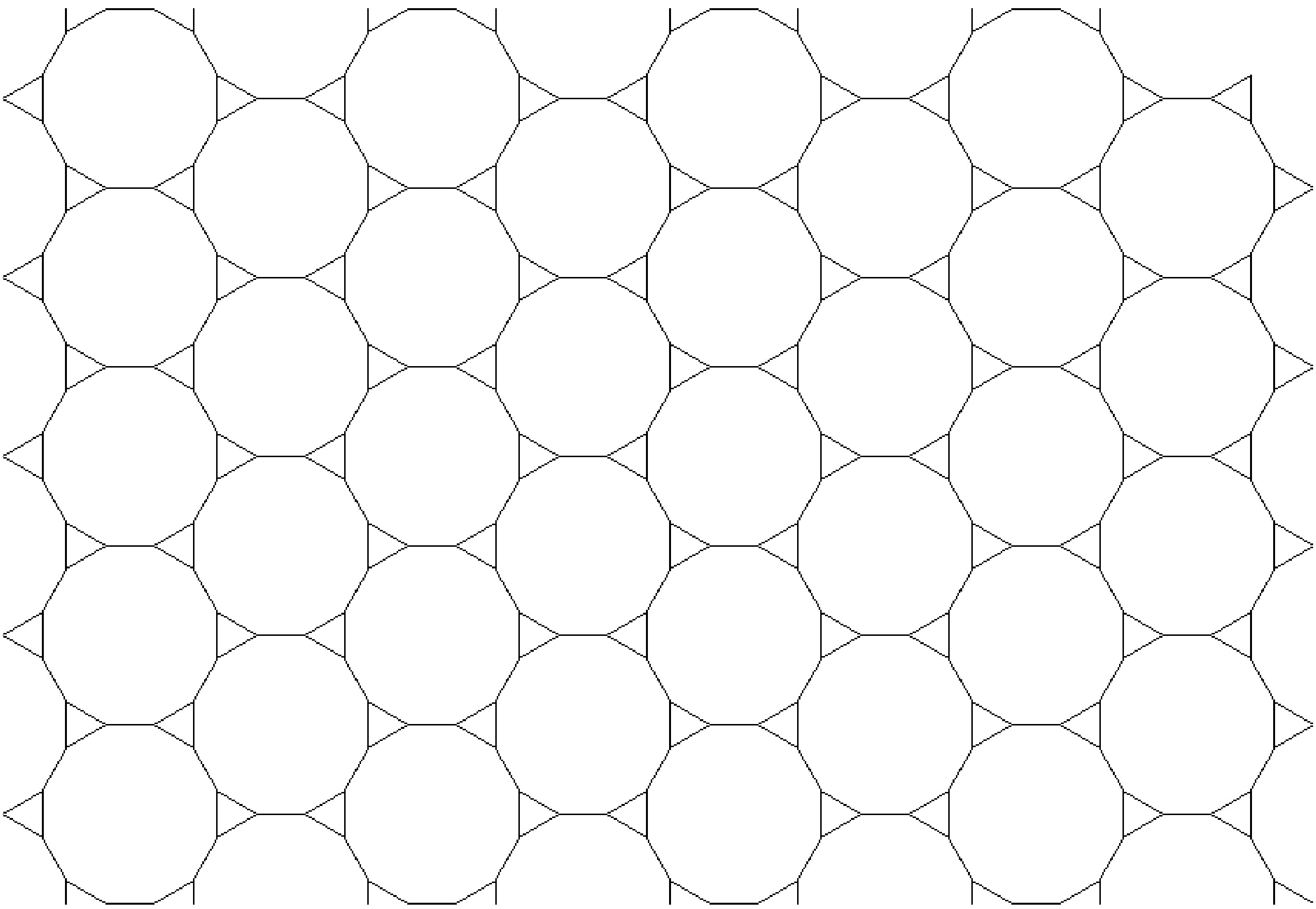
Along the way of course material is produced which can be used in a display – not just attractive but, if annotated with the angles and the reasoning behind the calculations, something which can provide a reference point for future work on angles.

I have deliberately not suggested an age or stage for this work as it can be adapted to make it appropriate for any class from age 10 to 15.

Royal Borough of Windsor and Maidenhead





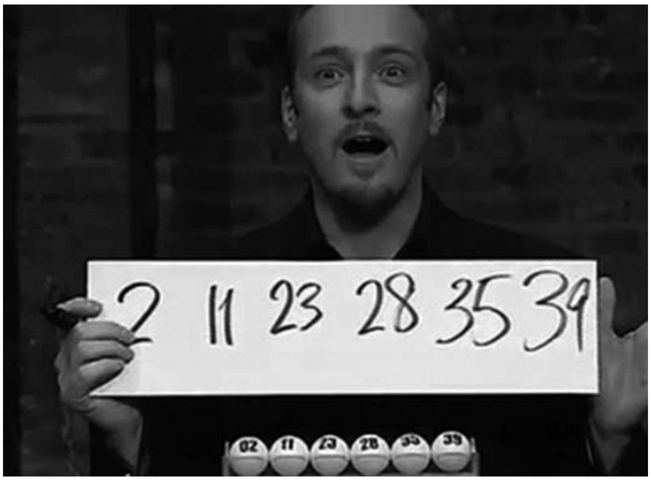


Derren Brown: Magician or Mathemagician?

Kelly Lane shows how she used a television programme to interest and motivate her lower key stage 3 pupils.

Proving a magician wrong!
'Maths is Magic' has always been one of my sayings, and using some of Derren Brown's magic tricks has opened up many mathematical avenues for my year 7 and 8 classes to investigate. The concept of proving a magician mathematically wrong inspired the children to delve into the maths behind the magic, and question whether Derren Brown is a magician or in fact a mathemagician?

Derren Brown, in his new TV series 'The Events' uses an enormous amount of language associated with probability when performing his magic tricks. This caused me to look into some of his tricks in a little more depth to see if perhaps they could be used to teach different aspects of maths. His smaller tricks are very good tools for demonstrating real life probability, with the added bonus of magic thrown in at the end.



In one of the episodes Derren claims to predict the lottery. There are two aspects of how Derren claims to predict the lottery. Firstly he shows a coin trick that he claims proves he can make correct predictions from randomness, something as random as tossing a coin. Derren claims that he can do this by using a kind of 'Deep Maths' (probability). Secondly he claims to use the 'Wisdom of Crowds' (the mean) to predict the lottery numbers. Both of these aspects lend themselves very well to the different elements of data handling such as probability, permutations and averages, despite him giving them different names.

The Coin Trick – Part 1
Derren demonstrates all the permutations possible for flipping a coin three times. He explains that there are 8 different permutations and if two people were to pick one combination each then each person would have an equally likely chance, which would be one eighth of a chance as there are 8 different permutations. In doing this the children are learning about permutations, listing outcomes and probability. To perform the trick, ask the person to choose one of the combinations first. From their combination you do the 'deep maths', this means you take the middle coin letter and switch it to the opposite, place it at the front and remove the last coin letter. Therefore if they were to choose Heads, Heads, Heads, the combination that you would change it to is Tails, Heads, Heads. In doing this the second combination will always win. According to Derren each combination has an equal chance of winning, but is this really true? The children investigate why the trick works and why the second combination always wins.

Introduction
First I showed the children a clip from the Derren Brown episode of the coin trick with a small part of his explanation. Derren explains that the magic trick is done by using a kind of 'deep maths'. We then copied the coin trick as a class with me claiming that I could predict the outcome by using 'deep maths', predicting who will win out of the two people flipping the coin. I set up the trick in the same way as Derren Brown does and as they have just watched. I explained that the two combinations are equally likely to pop up, wrote my prediction down of who would win and gave it to one of the children in the class to hold.

The two volunteers flipped the coins and their results were written down on the board for the class to see. This consisted of a continuous list of all the sides the coins have landed on, with a tally to show when the two different combinations come up. The trick ended, I revealed my original prediction, and their mouths dropped open when the prediction was correct. We then talked about why this happened and got different suggestions. I asked if they had noticed anything and what they thought this 'deep maths' actually is. At this point they really did believe I had used magic to make my prediction. I have found that when a magic trick has the wow factor it can make maths far more engaging, especially if they believe what they are doing is a magical kind of 'deep maths'. I then asked who wanted to have a go at this 'deep maths' and the hands of the whole class went up!

Main activity
I then showed the children the rest of the video with Derren explaining this 'deep maths' and set the children off to repeat the trick in pairs. They were to record their results and investigate their findings.
The main focus is the question: "What is this 'deep maths', and can they work out why it works?" Is it deep maths/magic or is it something else (logical probability)? What does the 'trick' do to make the second combination win?
The children may need a couple of lessons on this to gather as much information as they can, but to understand the children need to verbalise their findings and explain what they have learnt.

The Prediction of the lottery numbers – Part 2
Derren claims to use a theory called the Wisdom of Crowds that was originally found by a scientist at a fairground. The visitors at the fairground were asked to guess the weight of the ox and when they had gathered all the guesses up they decided to add them up and divide it by the number of visitors, *finding the mean*; they found a curious result. The mean from the visitors equaled the exact amount the ox weighed and this became known as the Wisdom of Crowds. Derren claims to use the guesses of 26 random people added up and divided by the number of people to predict the lottery numbers. The children called this into question by testing it themselves and used and applied their knowledge of the mean to ask, 'Could this actually work?' They watched one of the episodes to see the trick in action and see what Derren was doing. After they has watched this I asked the children to investigate whether this could actually work. If they were to repeat what they had seen in the classroom, could they prove that it might be possible, or could they prove him wrong?

The lottery prediction – Introduction
There were a couple of lessons leading up to this where the children investigated the different averages of plant growth in a science experiment. The children learnt that low and high numbers have a very influential role when finding different averages and began to look at the average first and to make predictions of what the starting amounts could have been.

The children watched part of an episode where Derren explains how he predicted the lottery. We recreated the method that he used to gather the numbers (explained above) and displayed this on the board. The children worked in pairs to investigate the numbers that had been generated. This works well with a class of 30, as the example shown in the episode works with 26 people. After the children had properly investigated the numbers they then questioned whether using the 'Wisdom of Crowds' (mean) could actually work. The children then repeated this to gather more examples and analysed the types of numbers which were most likely to be chosen.

This then allowed them to analyse the final mean average numbers. They found the mean numbers to be middle range numbers like 20 and most were decimals. The children noticed that decimal numbers were not mentioned or shown by Derren and the numbers that he showed as his results leading up to the prediction were wildly apart (mixture of high and low numbers). The children noticed the differences between their results and that of Derren Brown and continued to investigate. After watching the final prediction that Derren gave, the children noticed a very obvious reason as to why this could not possibly have been the method used, and reached the conclusion that Derren Brown could not have predicted the numbers in the way that he claimed. The give away is that in the final prediction the number 2 came up. The children investigated these numbers further and found that to get the number 2 as the mean average from 26 people, each person would have to have chosen low numbers that total 63 or lower, or 1, 2 or 3 in order for the number 2 to have been the average. They concluded that this would be highly unlikely with a group of 26 people all choosing random numbers from 1 to 49. Bingo! The children, to their dismay then realized that trying this at home was not an option!

It was very important to me that the children noticed this for themselves and came to this conclusion on their own. This clearly shows their level of understanding and use of investigational skills. After the initial investigation of numbers and analysis of what they found, they were able to apply their knowledge to generate a judgment and conclusion from their work.

The children were able to mathematically prove Derren Brown wrong, with evidence that it would be highly unlikely that his method could work based on how the mean average is calculated.

For the children to be able to prove a magician wrong using maths was extremely inspiring, and engaged the children in using maths practically to investigate in a range of different ways.

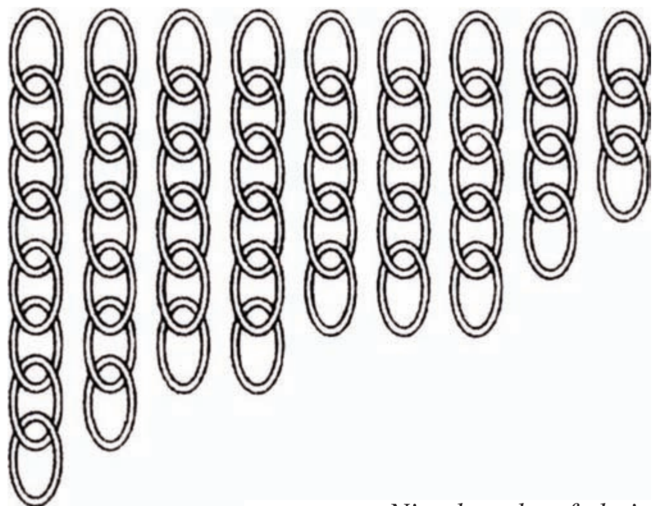
My goal in using these ideas is to make maths a more enjoyable and exciting subject to learn, and I feel making magic part of it helps to engage children in the subject. In addition, when a well known magician claims to be using a magical, deep kind of maths it helps to raise the importance of how maths can be used in a variety of different ways that can be fun and exciting.

Trevelyan Middle School
Royal Borough of Windsor and Maidenhead

The Jeweller's Dilemma

Ian Stewart has kindly given us permission to present a second teaser from his collection *Professor Stewart's Hoard of Mathematical Treasures*[1]

Rattler's Jewellers had promised Mrs Jones that they would fit her nine pieces of gold chain together to make a necklace - an endless loop of chain. it would cost them £1 to cut each link and £2 to rejoin it – a total of £3 per link. If they cut one link at the end of each separate piece, linking the pieces one at a time, the total cost would be £27. However they had promised to do this for less than the cost of a new chain, which was £26. Help Rattlers avoid losing money – and, more importantly make the cost to Mrs Jones as small as possible – by finding a better way to fit the pieces of chain together.



Nine lengths of chain

1. Stewart, Ian. *Professor Stewart's Hoard of Mathematical Treasures*. London:Profile Books, 2009

Using Photographs as a Starting Point for Discussions of Mathematics

Getting children to talk, observes **Matthew Reames**, is not a problem but getting them to talk about mathematics is more difficult.

Getting children to engage in a discussion of mathematical concepts may sometimes seem more of a fantasy than a reality! One thing I have found useful to help children of all ages and abilities to engage in mathematical discussion is to use photographs. In fact, a photo can provide a concrete, visual reference that is necessary for a child who may have trouble visualising certain concepts.

A way of using photographs as a starting point at the beginning of a lesson. Project a photo onto the screen and ask the question, 'Where is the maths in this photo?' or 'What maths terms are shown in this photo?' I often ask the children to spend two or three minutes writing down their thoughts and ideas before discussing them as a group. This allows everyone to have at least one or two responses ready and helps reduce the fear or panic caused by not knowing the answer. Another benefit is that it allows a child to say something as simple as, 'I see an angle,' or 'There is a triangle.' These are both valid responses to the question 'What maths can you see in this photo?' that can then lead to further discussion: 'What type of angle is this?' or 'What do we call a triangle with three identical sides?'

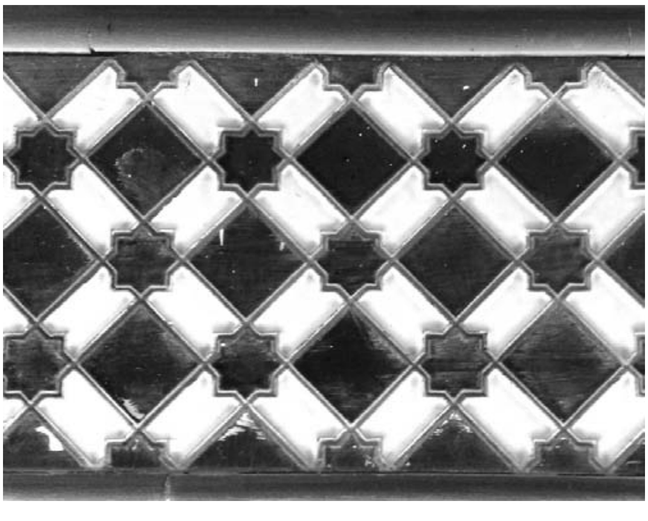


figure 1

The two photos (figure 1 and 2) are examples of what many would consider quite obviously 'mathematical photos'.

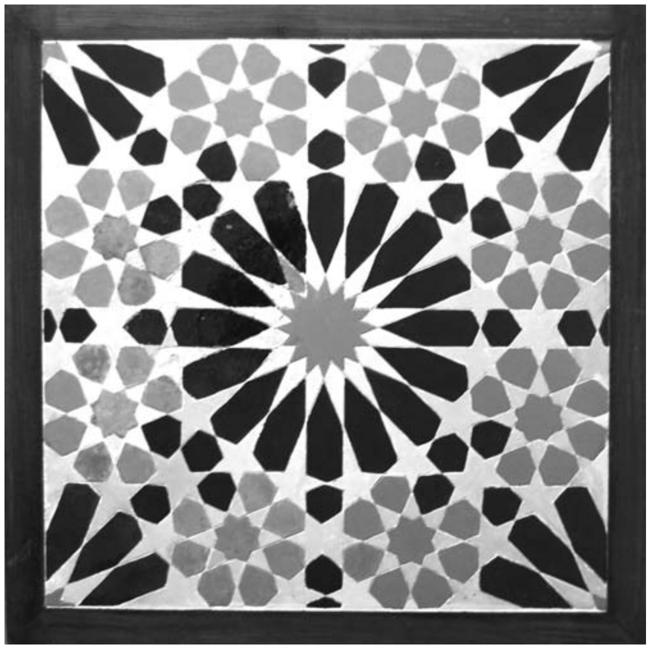


figure 2

These examples of Islamic wall tiles are full of polygons, angles, parallel lines, and symmetry.

Other photos are somewhat less obviously 'mathematical photos' and therefore require deeper thought and understanding of maths concepts. At first glance, the photo of the beach in Cadiz, Spain (figure 3) shows only a reflection but when children look deeper, they begin to consider ideas such as the height of the tower, the rate of the waves, and how the size of the closer buildings compares with the size of those further away.

One benefit of using a photo as a stand-alone starter is that it opens up the range of acceptable maths topics for discussion and gives a chance to talk about a number of different ideas.

figure 3

Another time to use photographs is when starting a new topic or when summarizing a nearly-completed one. You can show a photo and ask, for example, ‘What examples does this photo give of angles?’ or ‘We have been learning about transformations; can you find any in this photo?’ You might even say, ‘We have been learning about ratios. Write three ratios that describe something in this photo.’

figure 4

Using photos in a mathematics lesson is an excellent way of discussing how mathematical topics apply to real life. When shown the photo of the Eurostar train (figure 4), a class of year 7 children who were known for asking, ‘When will we ever use any of this?’ made quite a large list of topics, including:

The number on the side
How fast the train goes
How long it is
How much tickets cost
The symmetry of the train as you look straight on from the front or top
The angle of the sloped front and why it needs to be sloped
The measuring involved in placing the Eurostar logo on properly
How the height of the train must be less than the height of the tunnels through which it travels

Each of these statements can be the starting point of an excellent, mathematics-rich discussion, and importantly, each phrase shows how mathematics is connected to other areas, including business, science, design and architecture.

One way of using photos is to project a photo on the screen as mentioned above. I used a different method, however, when I introduced a series of cross-curricular lessons on Islamic art. I printed a number of different photos four to a page, laminated them and passed one page to each pair of children. The instructions were to ‘discuss with your partner what mathematical things you see and make a list’. After several minutes, each pair swapped photos with another pair and added to their list with a different set of photos. After a class discussion in which groups shared their lists and talked about some of the photos they found interesting, the class was well prepared to spot these themes in the art they later created and in the actual artefacts they saw during a trip to the British Museum.

Once children start to see mathematics in photos that initially seem ‘maths-less,’ you can challenge them to take their own photos of mathematical topics. You could provide a list of topics (particularly good for a shape and space unit) or ask each child to find a mathematical ‘situation,’ photograph it and then write a short description of the mathematics. This provides an excellent link to a number of ICT topics.

Using photographs in these ways can provide an excellent starting point for mathematical discussions. Particularly with children who are less maths-inclined, seeing a photo and having two or three minutes to write some ideas, even if it is only, ‘I see an angle,’ is a way to involve everyone right from the start. It is also a very good way to illustrate mathematical concepts as they appear in real life.

Looking for some photos to start with? I have placed some in a set here: http://tinyurl.com/mathsphotos - please feel free to use them with your classes! (Note, this url leads to the flickr website which is blocked in some schools. You are welcome to save photos to travel between home and school.)

Another good source of large photos is the Guardian newspaper. Several days each week, the newspaper's centre page spread is devoted to a single photo (or occasionally several smaller ones) that might be used to spark a discussion.

St Edmund's Junior School in Canterbury.

Is Poverty a Learning Difficulty?

Rachel Gibbons considers the report, *An Anatomy of Economic Inequality in the UK*, funded by the Joseph Rowntree Foundation which has revealed a Britain where the "richest 10% are now 100 times better off than the poorest".

The Guardian's report (27.01.10.) continue:

"A central theme of the report is the profound, lifelong negative impact that being born poor, and into a disadvantaged social class, has on a child. These inequalities accumulate over the life cycle, the report concludes. Social class has a big impact on children's school readiness at the age of three, but continues to drag children back through school and beyond."

The *TES* (19 February 1010) reports that a £250 million Government scheme to transform education in England's most deprived areas has failed to improve results for most pupils and has even had a negative effect on some. Any serious search for the reasons why this is so I have not as yet been able to discover. We can at least be sure that parents who have not apparently benefitted from their own educational experiences to any obvious degree are unlikely to prize that kind of experience for their children.

The findings of both of these reports suggest that poverty can certainly inhibit children's learning but maybe it is more difficult to devise strategies to overcome this learning difficulty than some others we have featured in *Equals*. Certainly, whatever the difficulty children have with learning, the teacher's aim must be to make the subject exciting and relevant – relevant to the child that is. A national curriculum may well have inhibited any concentration on relevance and a testing regime has without doubt done damage to the education of those children who have not achieved highly in the tests.

How can we get back the interest of children who have switched off and are not achieving? In *To Sir with Love*, E R Braithwaite describes how he tackled this problem back in the 50s. See page 10 of this issue of *Equals*. Games and puzzles are always a good way in, especially where the children are inventing their own: such activities as inventing "Think of a number" journeys, whereby they get back to the number they started with so that they can mystify their friends or families. If you can persuade some of your pupils to invent some of these journeys we would have great pleasure in printing them and I am sure they would be thrilled to see their own creations in print. Another sure area of interest for nearly all is sport and the available statistics about all sports are endless, to be found on TV and in the newspapers. And you don't have to get these yourself – you should be able to persuade the members of your class to collect them and bring them into class for you, to be discussed and, where appropriate, analysed and tabulated.

Come on! Send us the results for publication.

Fulham, SW6

Folding

Stewart Fowlie reminds us that geometry is a part of school mathematics where children should be given opportunities to *see* (that is, perceive) and words suited to their age to say what they can see.

Here is a way to give experience of seeing.

Give each child an A4 sheet of paper.

You can see it is flat, sometimes called a 2D shape. It has 4 edges so let's call it a 4-edger.

It has 4 corners that look like the corners of a square so let's call them square corners.

Write A, B, C, D in black inside the corners.

Turn the sheet over and write the same letter on the back of each corner as on the front, but in red.

Notice that the black letters go clockwise, the red ones anticlockwise.

Ask each child to mark a second sheet it in the same way.

Take the top sheet and fit it on top of the first.

Turn it over like turning over in bed and you see that
edges AD and BC are the same length.
edge AB, BA are the same length, so A is as far from B as B is from A.
corner A is the same as corner B and
corner D is the same as corner C.

You can over-turn it over like turning head over heels.
edges AB, DC are the same length.
edges AD, DA are the same length.
A is as far from D as D is from A.
Corner A matches corner D and
Corner B matches corner C.

You can turn it half round.
edges AB, CD match.
edges AD, CB match.
corner A matches corner C and
corner D matches corner B.

You can turn it right round.

This restores the original position. Indeed if any of the 4 turns listed is repeated, the original position is restored (the 4th is of course the 3rd repeated). If any 2 of the first 3 turns is made in either order, the effect is the remaining turn, and if all 3 are made one after another in any order, the original position is restored.

To a 5 year old the only way to find the effect of making 2 particular turns is to make them. Teachers may be able to devise a logical explanation but young minds don't work like that.

2 or 4?

Take 1 of your 2 marked sheets and put it in front of you, with (black) A B at the top. Bend the sheet so edge BC fits exactly on edge AD and crease the fold. Mark the corners where the crease meets the edge AB with (red) Ps and edge DC with (red) Qs. Unfold the sheet and in black mark each of the 2 corners at P and at Q.

In the same way bend the sheet so DC fits on AB leading to a crease RS, R on AD and S on BC the 2 creases crossing at O.

A PP B

R OO S
R OO S

D QQ C

Notice that the 4 shapes are all the same.

Making a Square

Take the last marked sheet. To make it into a square its longer pair of edges must be reduced to the length of the other pair. Bend the sheet so edge BA lies on BC. Crease the fold.

Fold the lower part of the sheet up over the 3-edger and crease making sure the crease fits exactly under the edge of the 3-edger. It is then a simple matter to cut or tear off this portion leaving a square or regular 4-edger. Mark the new corners C and D on the front and in red on the back of the sheet. A B B A (underlining represents red)

D C C D

It is easy to make an uncreased marked copy of the square. Place it black face up and put the other square corners matching on top. Find all the ways it can be turned and still fit on the other. Just making all 4 edges the same doubles the number of different turns. While doing any 2 turns one after the other is always the same as a single turn, but doing them in reverse is the same as a different single turn.

Look back to 2 or 4? Carry out the instructions on your un-creased marked sheet to get :

A PP B
R ?? S
R ?? S
D ?? C

Draw lines from P to S to Q to R to P to Q and from R to S.

Notice that the square ABCD is made of 8 3-edgers, PSQR is a square made of 4 3-edgers and each of the 4 small squares is made of 2 3-edgers.

Notice that 2 of these 3-edgers can be put together to make the same shape as 1.

There is only 1 other shape 2 of which can be put together to make 1 which is the same shape. Take a sheet of (A4) paper and mark its corners A, B, C, D as above. Bend the sheet so edge DC fits exactly on AB. Crease the fold, unfold and mark the ends of the crease, R on AD and S on BC. Cut along RS and fit corner B of ABSR on corner A of a further copy of ABCD. Notice corner R lies on AC. This means that ABSR is the same shape as ABCD.

Using structured imagery to develop language and foster systematic thinking.

Margaret Haseler gives examples of how structured apparatus (in this case Numicon – see http://www.numicon.com/ for more details) can be used to encourage children to use mathematical language and to develop systematic working.

Moriarty: How are you at mathematics?
Harry Secombe: I speak it like a native
The Goon Show

Language underpins all learning but it is of crucial importance in helping children understand more abstract subjects such as mathematics. Language helps us to make sense of difficult ideas. It also helps us to solve problems by describing the steps we need to take when reasoning our way through a problem.

Children learn language by actually using it. This can only be achieved if:

- they hear language being used by adults and engage in conversations with adults;
- they are encouraged to describe the mathematics they are carrying out; this helps them to develop and use the correct mathematical vocabulary;
- they have opportunities to hold mathematical conversations with their peers.

Mathematical conversations occur when we are sharing ideas about mathematics with others. They also occur when we need to solve a problem.

Able mathematicians can hold these 'conversations' in their heads. Many children (and some adults!) find these 'internal' conversations hard, if not impossible, to do without the opportunity to practise this with another person. Verbalising out loud can help us to clarify our thoughts more effectively than just 'thinking' in our heads. Many of us, when solving a problem, will 'talk our way' through the steps needed and we often find it more useful to do this out loud even when we are solving the problem alone. Before 'internal' conversations can take place, a child needs to have opportunities to 'talk through' the steps needed to solve a problem and this can only really take place with another child (or adult) or with a group of children.

Developing systematic thinking in mathematics

Being able to use mathematical language accurately to describe the maths you are doing is an important factor when children are using and applying their mathematical understanding to solve problems. Another crucial factor is the ability to think systematically and this in turn depends on being able to see patterns and then to describe them.

The explicit patterns afforded by structured apparatus (e.g. Numicon) help children to develop systematic thinking. By noticing the regular pattern of each Numicon Shape and how it relates to the Numicon Shapes on either side, children are able to see how our number system works and to appreciate that the 'pattern' is repeated again and again. They can verbalise this by describing the patterns they see. The regularity of the patterns helps them, for example, to check whether they have found all the pairs of numbers that total a given number. This is often one of the first indications of children working systematically.

The following activities provide a meaningful context for mathematical conversations and also provide opportunities for helping children to develop systematic thinking. The first activity gives children opportunities to develop and use appropriate mathematical vocabulary.

All the activities suggest having a second set of shapes on the table as this will encourage systematic thinking as well as helping children to develop their own mental imagery. They are suitable for KS1 children but are also a good starting point for KS2 children who may have difficulty with whole class number investigations, such as those described in the Investigations book*.

1. Put a Numicon Shape (unseen by the child) into the feely bag. Ask the child to describe the Shape s/he is feeling in the bag. For example, if the Numicon five Shape was in the bag, the child might say the following:

   It's got a sticking up bit......... it's not small and it's not big......

   Careful questioning by an adult can help children refine their thinking e.g. *So if it's got a sticking up bit, which Shapes shall we remove from the table? ....Do you think it's bigger than 4?.......Do you think it's smaller than 8?*

2. What's in the bag? This can be played with a partner or in a group.

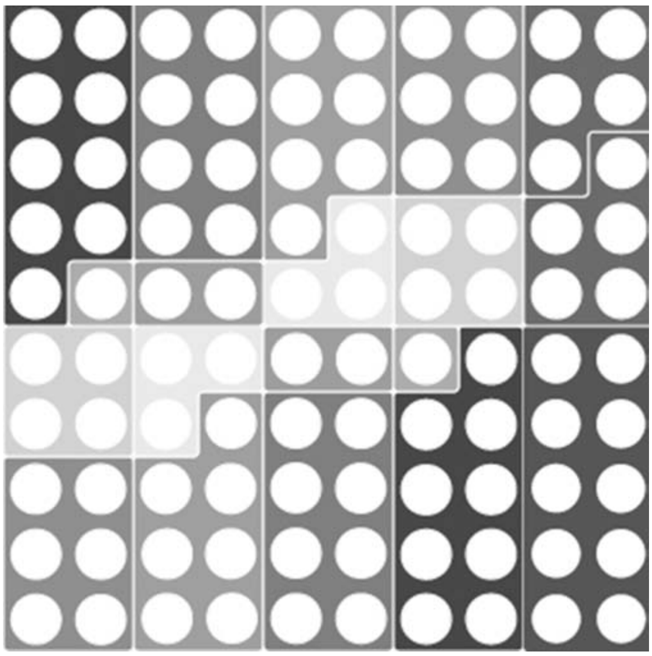
   One child puts a Numicon Shape in the bag and others guess the Shape by asking indirect questions (a direct questions would be *is it 6?* while an indirect question would be *Is it bigger than 4?*) By having the Shapes visible, children are reminded of the relationships between numbers which in turn prompts more useful questions in a way that using the numerals alone would not. For example, the ordered set (with alternating odd/even images) may prompt children to ask first *'Is the Shape odd?'* as this will remove half of the Shapes straightaway. Children can then remove the 'not' Shapes from the visible set. The next 'useful' question might be relating to size e.g. *is the Shape bigger than 5?* (or 6, depending on what is left) Having a second set of ordered Numicon Shapes visible and being able to remove the Shapes not in the identified set also helps the children to see the need for systematic thinking which is necessary in order to ask more 'useful' questions. Without a systematic approach, children's only strategy is to ask random questions, eventually leading to the correct Shape.

3. An extension of the previous activity would be to say *I've got 2 Numicon Shapes in the bag. Their total is 9. What are my Shapes?*

Without a set of Numicon Shapes in front of them, children would either need to know number facts to 9 or would have to resort to counting on their fingers to identify the pairs. Neither method is likely to be successful in this activity - memorising number facts is hard for children with special needs, and fingers do not provide a clue about the relationship between the pairs of numbers in the way that structured imagery does.

Using the visible set of shapes, children can identify all the pairs that total 9: 1/8, 2/7, 3/6, 4/5. Discussing with the children about appropriate questions to ask may reveal that odd/even questions would not help (as all pairs have both an odd and an even number). However, looking at the difference between each pair of Shapes might help. We could ask *Is the difference between the 2 Shapes greater than 4?* Structured images again ensure that children who haven't memorised the relevant number facts will be able to 'see' the pairs of Shapes where the difference between them is more than a 4 Shape.

4. 2 in the bag:



I've got 2 Numicon Shapes in the bag. Their difference is 2. What could they be?

With the Numicon Shapes visible, children may notice that when you have a difference of 2 , the numbers are 2 apart which means both numbers in each pair will be either odd or even. By asking whether the Shapes are odd or even, you can eliminate half of the pairs – either 1/3, 3/5, 5/7, 7/9 or 2/4, 4/6, 6/8, 8/10

The second question could be: *Is either Shape greater than 5? Or less than 5?* which will further eliminate pairs.

At first, activities should be modelled by an adult who guides the children to think of the most useful questions to ask. Instead of the children asking questions, the game is played with the adult providing 'clues' about the hidden Shape as this will give the children an idea of the range of possible questions to ask. Once the children are more familiar with the range of questions to ask, encourage them to use 'prompt' cards e.g. *Is the Shape bigger than....... is the Shape odd?....* Children can look through the cards and discuss in pairs which question would be most 'useful' to ask next. Once the children are familiar with the format of the game, they can progress to playing it in a group of three, each taking turns to be the question poser.

By encouraging them to work in pairs to ask questions, children can share the reasoning needed to solve a problem which in turn necessitates having 'conversations' with each other. Not only is mathematical language being used and practised in a meaningful way but children will also have opportunities to verbalise their thinking.

Teachers sometimes find it difficult to assess children's abilities in Using and Applying Mathematics, especially those who struggle with mathematics. The evidence needed to assess children's understanding is what they do and say. By using Numicon Shapes to provide a context for two way communication, we can gain valuable insights into their understanding of the mathematics involved and also their use of language. Using the opportunity to ask probing questions also helps us to take the children to the next level of their understanding.

**Investigations with Numicon* – ten mathematical challenges or pupils in Key stage 2.

Numicon

Group work is great, providing…

Mundher Adhami has written much to promote group work and learners' talk. Here he places some caveats based on earlier psychological writing with implications for structuring classroom activities.

The current drive to encourage classroom talk is not a baseless fashion. Discussion and argument in mathematics and science lessons are both motivating and enlightening, something often missing in the traditional 'telling-and-practice' mode. This is evident not only for the large number of youngsters disenchanted with schooling who see no relevance of lessons to their lives, but even for those who do play the game, and who realise the need to get the qualifications so valued by society. Inner motivation and genuine enlightenment are often missing even in individual investigation mode. So anything that gives pupils a greater role in lessons, whether in teacher-pupil talk, or between pupils in groups, is to be highly valued.

It is easy to show that talk does not automatically lead to learning useful things or developing the ability to think for oneself.

So what is the caveat? Where is the holding back? Isn't a trivial point to argue that class-room talk, discussion and arguments are not a panacea on their own? Surely we all know that! We know that there must be a relevant content for the talk. So what else?

I argue here that classroom talk is best seen as a diabolical issue, i.e. apparently benign but with the devil in the details. We should strive for more group interaction and whole class discussion, but also for the thoughtful framing of such interactions. They are necessary but not sufficient. I would go further: that unless some conditions apply, talk and group interactions can be a hit-and-miss affair, as likely to be harmful as useful. Just like all teaching!

The haphazard-ness of talk

It is easy to show that talk does not automatically lead to learning useful things or developing the ability to think for oneself. Look at the excitement of teenager girls or boys in groups talking about what they fancy, or on the mobile phone about what they are doing; there is always exchange of information, but not always any use or growth. Much of it would be a waste of time, irrelevant wrangling and posturing, or even misleading and harmful. The blubbering talk of bigots and other idiots, and the gossipy talk throughout history have done much harm. Development of language did allow progress, but also allowed regress. Just like any technology or facility, talk is not value-free. Values come from a higher plane.

That would seem to rule out autonomous learning without guidance and direction. It would lean towards 'telling' and training, and even towards suppressing of peer talk! Not so, unless you wish to produce clones for mindless mass production, or foot-soldiers for war, rather than free citizens. Teachers or anyone in authority cannot influence learners while developing their autonomy without interaction at their levels, least of all to know the routes in which to do the influencing. For most people that interaction would involve talk, including talk amongst peers, into which to intersperse input.

Hence the puzzle: you cannot trust peer talk, but you cannot do without it. Solving such 'puzzles' is the essence of the professional job of the teacher, as opposed to their technical job of child-minding, and the training in rule-following of the curriculum.

One answer to 'what kind of classroom talk to promote?' comes from the didactic orientation: you only encourage task-focused, or curriculum-framed talk. But that is an oxymoron, since talk is in the vernacular while curriculum is formal. Unless authentic, such talk is neither motivational nor enlightening, but rather a wooden question-and-answer interchange, and in groups a half-hearted effort at finding correct answers.

Another answer comes from the investigative orientation: we should allow all exploratory talk, in informal or formal ways, prior to sharing ideas. It is clear such approach is nearer to the aims of children's autonomous and collaborative development implicit in current reforms. This is what is in need of elaborating, since it is crucially dependent on the task design and the form of questioning, and how all that ties up with the curriculum! Learners may have a heated exchange but may not make any progress.

The issues of task-design and forms of questioning, and combining authentic talk with genuine learning, are too big to elaborate in this article. What I suggest however is something more basic: how to judge when some interaction, on whatever focus, is useful or not? You could see this is what a non-specialist inspector or teacher needs in evaluating a scene in a lesson, and what all teachers need in deciding when and how to intervene.

What I suggest however is something more basic: how to judge when some interaction, on whatever focus, is useful or not

Conditions and implications

One set of conditions may provide us with a framework for making a judgement on whether an episode of group work or interactions amongst pupils is fruitful, and to what degree. It comes from an old friend of pupils and teachers, Jean Piaget (1896-1980), whose wisdom is often sidestepped in teacher training, like most other social psychology and epistemology, which deals with how we acquire knowledge. Part of the reason must be that much of Piaget's work is untranslated, or badly translated from the original French.[1]

Piaget delineates three requirements that need to be present in interchanges between peers in order to contribute to learning, which he calls in psychological jargon 'cognitive reorganisation'. Recast in practical terms for any interchange at any level these are:

1. They engage with each other, comment, respond, listen and exchange ideas. This is opposed to a series of utterances or statements.
2. They use inter-subjective terms and meanings. This is opposed to not agreeing meaning of terms.
3. They conserve their ideas until they are convinced of the need to change them. This is opposed to appeasement, emotional reactions, or other politics.

We can even go simpler and say that for talk to be useful people must be a) talking about the same thing, b) using words which they all understand in the same way, and c) saying what they genuinely believe. It all seems very straightforward until you think about the many pitfalls in each phrase.

This simple 3-part frame goes beyond evaluating an episode of interactions in a group of pupils around a piece of mathematics, i.e. whether the peer-talk is helping, worthless or even harmful. It helps in both design of activities and in guiding the teaching. The activity must start by being at an accessible level for most learners in the group; they must have time to agree terms and meanings they use in talking about it and the challenges placed before them, and they should feel at ease in changing their minds, or sticking to their ideas.

But we know, don't we, that there is more to peer-group work than some pupils talking around a table.

Cognitive Acceleration Associates

1. This issue is discussed at some length in Paul Cobb and Heinrich Bauersfeld (Eds.1995) The Emergence of Mathematical Meaning. Hillsdale New Jersey: Lawrence Erlbaum. This book has 8 chapters on integrating psychological and sociological perspectives. Chapter 3 is by Cobb entitled 'Mathematical learning and small group interactions: four case studies' pp25-130. On page 108 Cobb discusses Piagetian perspectives, based on a 1967 article by Piaget on Logical Operations and the Social World, in French, in Etudes Sociologiques of Geneva, Librairie Droz. It looks as if Cobb relied for that on Roggof, B (1990) Apprenticeship in Thinking: Cognitive Development in Social Context. Oxford England: Oxford University press.

The Tallest Tree

A 135 year old fir tree on the banks of Loch Fyne is 64.24m tall and has been officially named the tallest tree in Britain.

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