

# Cockcroft: 'at-homeness', mathematics 'done in the head' and the politics of school mathematics

Mike Ollerton charts the journey from one *new beginning*, to the latest *new beginning*

1982.

I am listening to the midnight Radio 4 news; this usually got me off to sleep. Out of the darkness I hear Sir Keith Joseph's voice the then secretary of state for education. He was talking excitedly about 'maths missionaries'; about how expert teachers of mathematics were to be appointed to take 'new' ideas involving problem solving and investigative approaches to teaching and learning into schools.

When Cockcroft was published in 1982 I had been teaching for nine years at Wyndham School, an 11-18, a far-from-bog-standard comprehensive in West Cumbria. My head of department, Eric Love, a visionary teacher and soon to be a 'maths missionary' had always encouraged his colleagues to teach investigatively and move away from using textbooks. Eric had already led the department into a ground-breaking mode-3 'O' level underpinned by progressive assessment elements of investigative focused coursework, a problem-solving based exam paper and a traditional paper. The department also ran a mode-3 CSE course. Accreditation of student achievements for both courses were underpinned with reliability, validity, and accountability and evidenced through internal and external moderation.

Prior to 1982 Eric had written a paper to the Cockcroft commission about the nature of teaching and learning mathematics thus whenever I have cause to return to the report it is with something of a glow I notice, on p302, *Wyndham School, Cumbria*. Of course, Eric had the support of senior management which meant instead of wasting time on admin at department meetings we spent time discussing practice, exploring new ideas, how we might use equipment and the potential impact of those strange electronic gadgets which were beginning to appear on the educational horizon.

I write this not (only) to go down memory lane but to indicate how far advanced some schools were, not only pedagogically as far as developing problem-solving and investigative approaches to teaching and learning mathematics and the use of equipment including calculators and computers, but also with regard to wider assessment issues of mathematics for learners age 16. Such an underlying pedagogy was reinforced by the publication of the Cockcroft report which, in turn, gave rise to three further seminal texts all published in the same decade:

*Mathematics from 5 to 16* (1985)

*Better Mathematics* (1987)

*Non-Statutory Guidance* (1989)

Each of these publications developed key themes, all arising from Cockcroft; they offered teachers much to consider and delight in.

The phrase *at-homeness* appears in Paragraph 39 of Cockcroft as a possessive attribute to define the word *numerate*. One such attribute described being numerate as ...*an ability to have some appreciation and understanding of information which is presented in mathematical terms, for instance in graphs, charts or tables or by reference to percentage increase or decrease*. This paragraph ends with the following statement (in bold):

***Our concern is that those who set out to make their pupils 'numerate' should pay attention to the wider aspects of numeracy and not be content merely to develop skills of computation.***

Turning to Paragraph 255 this begins:

*We believe that the decline of mental and oral work within mathematics classrooms represents a failure to recognise the central place which working 'done in the head' occupies throughout mathematics*

2010.

I am doing a small amount of one-to-one work with some Year 8 students in the summer term. I notice how dependent some students were upon counting on their fingers; frequently using this 'strategy' whenever a calculation needed to be carried out. For example, when looking at divisors of numbers, such as 24, to determine whether 3 is a divisor they would count lots of lots of 3's to see if 24 appeared. The more such an event occurred the more I noticed how their finger-counting resulted in them:

- ... having little idea if their calculation was correct and ....
- ... having forgotten why they were carrying out the calculation in the first instance.

Given these students would soon be in Year 9 I wondered how they would ever be able to achieve an 'at-homeness' with numeracy, let alone engage with calculations involving percentage increase or decrease!

At issue is how these students, and doubtless many of their peers, just beginning their teenage years, arrived at such a numerical impasse; whilst others could carry out such calculations in their heads almost *without thinking*. I suggest this notion of *without thinking* is akin to an *at-homeness* with many numerical and mathematical competencies such as:

- Determining the prime factors of, say, 60
- Converting between fractions, decimals and percentages
- Making connections between sequences, functions and graphs
- Being able to sketch sine, cosine and tangent graphs
- Being able to produce partial fractions for a given expression
- Using vectors to solve geometric problems

Now, the reader may think I have gone off my trolley (which may well be true); one moment I was writing about basic numeracy and the next I am referring to concepts within the A-level curriculum. However, the issue of students gaining an at-homeness, of being able to do things in their head are as important for young children as for Year 8 students, and as for A-level and undergraduate students. At issue is how learners of any age are encouraged and enabled to achieve an at-homeness with the mathematics per se.

#### 2014.

Another National curriculum, another government, another secretary of state and articles in the media about why children are leaving school without being able to perform basic calculations. The three aims of the new NC are fluency, reason mathematically, and solve problems. The latter two can easily be traced back to paragraph 243. With regard to fluency, I suggest this is akin to at-homeness. So, what has changed with regard to teaching and learning mathematics in the thirty-odd years since *Cockcroft*?

Well, one aspect of school mathematics that has changed is the focus on testing, on (spurious) targets and the absurdity of measuring progress in twenty minutes. Week after week I hear complaints from teachers about having to spend inordinate amounts of time on admin, on providing meaningless data, on tick/kiss type marking, and less time on one of the more important aspects of teaching – lesson planning. Even more worrying is when a teacher plans a lesson which might well be investigative by nature only to be confronted with the question: *Is this going to be on the test?* I am beginning to depress myself so if the reader is still hanging on in there I would like to offer something more positive.

There are hundreds and thousands of ideas within the domain of school mathematics which can support the development of mathematical reasoning, problem solving and fluency. These include publications by the ATM and the MA, resources on the NRICH, STEM, NCETM websites, the MEI who run eight day 'Teaching A-level Mathematics' courses... and even Twitter ref @educatedmaths, from which I found an interesting ideas which can be taken into any KS2, or KS3 classroom.

The idea is to write the first seventeen counting

numbers in a mixed up order such that when adjacent pairs are added together their sum is always a square number; a part solution might be: 3, 6, 10, 15, 1, 8...

Another idea was one given to me by Daniela Vasile, Head of Mathematics, South Island School, Hong Kong and works as follows: Starting with the number 485 you are allowed either to strike off the units digit (to make 48) or double the starting number (to make 970). The challenge is to end up with 14; there are several ways of achieving this outcome, and demonstrating that all solutions have been found, in the shortest number of moves, provides a further challenge.

The beauty of such tasks is how they can be used to help students' *at-homeness* with number whilst at the same time having lovely reasoning and problem solving aspects to them. The challenge is to consider how to develop schemes of work which eschews the over-use of textbooks, and draws upon the wealth of problems and tasks available to provide learners with coherent and progressive ways of learning mathematics; which weave together the processes of doing mathematics with content knowledge; which encourages conjectures, generality and, ultimately, proof as a natural way of thinking and working mathematically.

As the new national curriculum begins to take hold in schools and a new Secretary of State for Education is appointed I believe it important that we, that is anyone with an interest in supporting the learning of mathematics, understand the key pedagogic foundations which must underpin how the 2014 version of the curriculum is brought to life in classrooms.

Revisiting *Cockcroft, Mathematics 5-16, Better Mathematics*, and the original national curriculum *Non-Statutory guidance* might be useful places from which to begin...

Policy makers, please take note.



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##### References

*Mathematics from 5 to 16* (1985) can be found at:

<http://www.educationengland.org.uk/documents/hmi-curricmatters/maths.html>

*Better Mathematics* (1987) can be found at:

<http://www.nationalstemcentre.org.uk/elibrary/resource/5448/better-mathematics>

*Non-Statutory Guidance* (1989) can be found at:

<http://www.nationalstemcentre.org.uk/elibrary/resource/3022/mathematics-non-statutory-guidance>