

is SATy progress



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Teachers of Year 2 children have recently been struggling to make sense of the 272-page "Teacher's Pack" for the conduct of Key Stage 1 Standard Assessment Tasks. The pack comprises a self-explanatory "Handbook of Guidance for the SAT", and two documents — the "Teacher's Book" and the "Assessment Record Booklet" both of which give a detailed breakdown of the activities to be carried out by the children in relation to each Attainment Target to be tested.

The focus of this article will be on that section of the SATs concerned with the arrangements for the assessment of Mathematics Attainment Target 3 at Level 2 and Level 3. SoA Ma3/2a (to use the jargon) states that children should 'Know and use addition and subtraction facts up to 10', whereas Ma3/3a extends this to knowledge of number facts up to 20.

As Level 2 is the level of attainment expected of an average seven year old and Level 3 that of an average nine year old, these might seem to be realistic expectations. However, SEAC's interpretation of what constitutes evidence of attainment seems to fly in the face of much of the research evidence¹ amassed over the last twenty years into how young children learn their number bonds, and succeeds in counteracting in one fell swoop all the progress that has been made since the publication of the Cockcroft Report in 1982 towards an appreciation of the important role of understanding as opposed to rote learning in the teaching of mathematics.

We are informed by SEAC that "It is important that you assess each child's ability to add and subtract by using recall of number facts only, not by counting or computation." (Level 2), and are told categorically in bold type that "Know and use" means that children should not be using computation in any obvious way to arrive at the answers, and evidence of attainment can only be shown if

the number facts up to 20 are "known" by the child and produced spontaneously.

Unfortunately, this very narrow interpretation of what we might understand by the word "know", and the undue emphasis given to recall rather than to the use of personal strategies for the generation of number facts should give us cause for concern. How can SEAC ignore the wealth of mathematics education literature, the increasing volume of research reports on the learning and teaching of mathematics, the various enlightened curriculum development projects and the innovative assessment procedures that have appeared over the last decade?

There is now general acceptance amongst researchers that young children pass through a sequence of stages in their progress towards the acquisition of the number bonds. Given a situation where physical objects are available very young children will find the solution to an addition problem by counting out each separate set and then by counting the elements in the new set formed by combining the two smaller sets.

As they gain in experience they will count out the first set and then count on from the last number name in order to find the total. A further stage of development involves their counting on from the larger of the two numbers. With practice in this type of activity children begin to learn a few number facts — usually simple doubles like $2+2$ and $3+3$. Later they begin to use the doubles to help them work out the "near doubles" like $2+3$.

As their repertoire of known facts increases, so does the variety of the strategies they use to calculate other unknown facts. These heuristics have been well-documented in the literature, and it is the progressive integration of these heuristics with counting and calculation sub-skills that leads to the development of each individual's idiosyncratic repertoire of calculation strategies. Children simply do not just learn their number bonds by rote.

Does SEAC also expect us to ignore important issues or findings like the Cockcroft Report's discussion of "the so-called number facts" and its insistence that these are not actually "facts" at all since they are not unconnected or arbitrary but follow quite logically from an understanding of the number system; HMI's emphasis, in their "*Math-*

ematics from 5 to 16" publication², on the need to encourage children to develop their own methods of working in a subject seen by HMI as "a process, a creative activity", or Skemp's³ seminal work outlining the distinction between "instrumental understanding" and "relational understanding"?

I find it most ironic that it is the Non-Statutory Guidance — the document provided to help us interpret the National Curriculum for Mathematics — that argues more strongly than most other publications for children to be encouraged and helped to create and use their own methods, refining and developing them as they build up a range of ways of tackling calculations.

It is important to stress that the SEAC guidance on the conduct of SATs and the Non-Statutory Guidance are both focusing on the same National Curriculum for Mathematics document. But whereas the former is insisting that, at least in the context of Ma3/2a and Ma3/3a, we only accept answers produced by rote and discount those answers arrived at by other means, however creative, the latter actually celebrates the creation of personalised methods, even going so far as to illustrate the point with examples of young children's idiosyncratic written methods for addition and for multiplication. Is this yet another example of the left hemisphere of the brain not knowing what the right hemisphere is thinking?

The following example is given to illustrate some of the difficulties and anomalies associated with SEAC's narrow interpretation of what constitutes evidence for the attainment of SoAs Ma3/2a and Ma3/3a. In order to gain some experience of administering the SAT materials I decided to try out the Ma3 activities on my daughter who is nine and a half years old. The first thing I did was to persuade Anna to sit the NFER Basic Mathematics Test C on which she scored a standardized score sufficient to put her into the top five per cent of her age group in the standardisation sample. So as a mathematically competent child she should have no difficulty with National Curriculum Level 3 work.

We started with the Level 2 activities as a warm up. Addition to 10 is tested by having the child throw two dice, numbered 1, 3, 4, 5, 5, 6 and 2, 2, 3, 3, 4, 4. The scores obtained are then added. Each child is allowed to make no more than one mistake in each set of four calculations. I tape-recorded the proceedings and asked Anna after each calculation how she had worked out the answers.

Her explanation of her correct answer to the first sum, $5 + 3$, was "I have a picture of fingers in my head". When pressed on this she informed me that she did not count the fingers as she could recognise the eight by just looking. Checking the SEAC "Teacher's Book" later I decided that Anna definitely had not counted nor computed, but neither did it seem to me like recall. However, as the book said nothing about mental pictures of fingers I decided to allow her that one. There was no problem with the next one, $3 + 3$, as she said that she just knew it.

Her answer of 8 for $6 + 2$ was given almost immediately, but when pressed she explained her method as "Six ... seven, eight ... in my head". This is obviously a counting-on strategy and should be penalised, but then I noticed that the Assessment Record Booklet uses slightly different language, saying "*without any OBVIOUS counting or computation*" (my italics). As Anna had found the solution without any obvious counting I accepted this as evidence.

The next throw of the dice produced $4 + 3$, which Anna did by counting on her fingers behind her back. I was amazed by the speed with which she did this, but, because of my years of experience interviewing young children about their mental calculating strategies, I can now spot a dextrous digit manipulator at ten paces. So, because Anna's answer involved calculation it could not be accepted. How-

ever, I did wonder whether less experienced interviewers would have noticed that she had used her fingers. I also wondered how I would have dealt with the most common strategy used by young children for dealing with additions of this type, namely, "Four and four is eight ... one less is seven".

This actual heuristic is used as an example by HMI IN "*Mathematics from 5 to 16*" (2) (p. 11) to illustrate how the development of an awareness of inter-connections can save pupils from having to remember too many facts. But, as this is definitely "calculation", then I assume that SEAC would not consider this to be a legitimate strategy.

Although I accept that an answer produced in this manner has not involved recall of the particular number bond in question, namely $3 + 4$, it has actually involved recall of a different number bond. As the AT being tested states that children should "Know and use addition and subtraction facts to 10", I think that a child using this strategy, which involves the use of one number bond to find a different one, could be said to be satisfying the requirement better than someone who has just recalled the fact without using it.

So Anna just managed to produce enough evidence to be classed as having attained the addition part of this particular Level 2 SoA. Addition at Level 3 caused other problems as Anna persisted in using the answers to previous questions to work out the current one. For example, she worked out $8 + 6$ as "Eight add eight take two", and later found $8 + 7$ by saying "Eight and six was fourteen ... so it's fifteen". Clever, but not adequate evidence I'm afraid!

Subtraction was even worse: calculation and counting were rife! $14 - 9$ was done by subtracting ten and then adding one; $18 - 9$ was done by saying "Nine and nine makes eighteen ... so it's nine"; to find $16 - 7$ she first took away six and then subtracted one; $12 - 9$ was done by "non-obvious" counting up from nine. She said to herself "Ten, eleven, twelve" whilst keeping a tally of the number of counting words spoken, and gave this tally as her answer; $17 - 7$ she obviously knew, but the last one took me a long time to understand — much to Anna's annoyance! It was $14 - 8$, and her correct answer to the calculation was explained as "Two sevens are fourteen, so take away another one".

Two examples of satisfactory evidence from the six questions was all that we could salvage from that particular activity. I could, however, console myself with the fact that if I had not asked her to explain her strategies then I could have persuaded myself — perhaps — that she was searching through her known number bonds each time to recall the appropriate one!

Anna's answers are typical of those produced by the hundreds of children interviewed for my own research into the calculation strategies of pupils in years two and three. I would estimate that fewer than five per cent of such children would be successful in generating the required addition and subtraction facts by recall rather than by counting or calculation. As someone involved in mathematics education for over twenty-five years I am prepared to admit that I do not know (SEAC's interpretation) the formula for the surface area of a cylinder. I hasten to add that I deliberately do not know it, because I can work it out in two seconds. Why should my daughter have to carry around in her head multifarious items of information that she too can work out in two seconds?

References

1. Dickson, L. et al (1984) *Children Learning Mathematics*, Holt, Reinhart and Winston.
2. HMI (1985) *Mathematics from 5 to 16*, HMSO.
3. Skemp, R. R. (1976) Relational Understanding and Instrumental Understanding, *MT* 77, 20–26.