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See page 65 for the review of BEAM's Booster packs

they're counting on us

Every Child Counts is a programme of interventions in mathematics, currently in the pilot stage. Ahead of its national roll-out in September, Mike Askew, director of BEAM Education, looks at what really needs to be done to help children get to grips with maths...

Over the years, working with teachers and pupils, we have gained a real insight into the best way to help children master the numeracy skills they need to succeed at secondary school.

Two buses, three bicycles and four cars went past the school gate. How many wheels went by?

I met Tom and Sam a few years ago when they were both in Year 3. I had posed this problem orally for them to work on and was interested in how they set about finding the answer. After we agreed that there would be six wheels on each bus both boys were clear that there would be 12 + 6 + 16 wheels. Their strategies for finding the total differed markedly. Sam, after a few moments' silent thought, announced that there would be 34 wheels. Asked to explain his method, he replied "Well there's 12, and the 10 from there [pointing to the 16] makes 22. There's another 6 left [from the 16], so that's 28. Two from there [the 6] makes 30 and there's 4 left [from the 6] so that's 34." Tom, in contrast, said, 12, 'counted on' six to 18, using his fingers keep track of the counting, got to 18 and counted on another 12, agreeing that it would be 34 wheels.

These two approaches to calculating illustrate the differences between children following a procedure, or thinking and working strategically in mathematics. Tom only used one procedure: 'counting on' in ones. It worked, it got him the right answer, but it's not effective or efficient. And, importantly, it's not likely to have provided him with the basis of long-term success. Sam, however, displayed an effective and efficient approach. Look at the number of strategic choices he made and skills he needed to be fluent in to carry this out. He looked at the numbers involved, choosing to deal with the 12 and 16 first. He partitioned the 16 into 10 and 6 in order to use a fluent skill – adding 10. Adding the 6 is easy – he knows his number bonds to ten. Six more to add, but it's easier to add 2 to make 30 – fluency in knowing the complements to 10. Adding a single digit to a multiple of ten is an easy romp home. In short, Sam used a sophisticated blend of known and derived number facts.

The problems with counting on

Research shows that these two aspects of mental mathematics – known facts and derived facts – are complementary. Higher-attaining pupils are able to use known number facts to figure out other number facts (Gray, 1991; Steffe,1983). The evidence suggests that those who can make these links between known and deduced number facts make good progress, because the known and derived support each other. Eventually, some of the number facts the child has been deducing become 'known' number facts (a child who figures out that 5 + 6 = 11 from the known fact of 5+ 5= 10 eventually comes to know the former as well). As a child's range of known number facts expands, the range of strategies available for deriving new facts expands as well.

On the other hand, children can get to the end of primary school and still rely on counting on procedures. This is one of the reasons that the national numeracy strategy initially advocated delaying the introduction of standard algorithms. The beauty of standard algorithms is that you only have to work with single digits. The danger is that children can appear to be confident in working with large numbers but they are actually only dealing with single digits and using counting on procedures. They haven't developed the sort of number sense that Sam displayed.

All this points to the importance of paying careful attention to the strategies children are using. Children who are relying on counting on strategies beyond their usefulness (even the Sam's of this world will have gone through a period of using counting on) are, mathematically, at risk. While some children seem to move spontaneously away from counting procedures, some do not. After all, from the child's perspective, counting on 'ain't broke' – it's a tried and tested method, it gets the right answer and, followed properly, it's accurate.It's these children who need intervention around the end of KS1.

Effective intervention

To be effective any intervention programme must address four aspects:

- Detailed diagnostic assessment
- Supporting the move from the practical to the mental
- Developing strategies through connecting to what children already know
- Applying knowledge to problems.

Detailed diagnostic assessment

Detailed diagnostic assessment of all pupils entering any programme is essential so that the intervention can be personalised. Children are not uniform in the difficulties they experience and intervention needs to recognise this. Diagnostic assessment needs to identify what children can do, so that the mathematics worked on can be developed out of and connected to existing knowledge

Supporting the move from the practical to the mental

Many children who find mathematics difficult fail to make the transition from treating the subject as a practical activity to being able to work mentally. Traditional models of the curriculum often do not challenge these perceptions of mathematics as a practical activity: moving from number bonds to 20 to bonds to 30 is not a sufficiently large step-change to challenge learners to reorganise their thinking and strategies. Helping children appreciate that knowing 3 + 3 = 6 also provides the solution to 300 + 300 or 3000 + 3000 helps them construct mental mathematical objects. It is also empowering for the learner who may have been restricted to working only with single digits in the belief that these need to be 'mastered' before they can move on to larger numbers.

Practical materials do play an important role in helping children develop knowledge and understanding but teachers need to be aware of strategies for helping learners move into the realm of the mental: this does not happen spontaneously for all children.

While new technology, especially interactive white boards, doubtless has much to offer teaching, it should not be introduced at the cost of regarding 'low-tech' equipment as antiquated.

Connecting to what children already know

Even those children having extreme difficulties in mathematics have some mathematical knowledge and understandings to build upon. For example, very few children do not know simple doubles to 5 + 5 or how to figure out which of two collections has more in it. Such understandings form the foundation for other knowledge to be developed. So while children in the programme will need to become proficient in knowing and rapidly recalling a core of number facts, any intervention needs to help them to use these strategically.

What is BEAM?

BEAM Education is a specialist publisher of mathematical books and resources, and provides training and consultancy in mathematics education. They publish a range of more than 1200 books, CD-ROMs, mathematical games and equipment, for use in nursery settings, primary schools, maths clubs and at home. Their resources are of particularly high quality and educational integrity. BEAM ensure their relevance by trialling all their materials with teachers and practitioners. The company is an acknowledged expert in the field of mathematics education and is part of Nelson Thornes.
Visit www.beam.co.uk for more information

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