

An Analysis of Calculation Strategies of Low Attaining Children

Koshy and Murray (2002) report on a study researching the calculation strategies of 30 of Year 3 children at the start of Year 3. The children had been identified of achieving below that expected for their age. It looked mainly at the calculation methods the children used for addition, although it also considered understanding of symbols and place value. Each child was assessed using a basic assessment schedule devised to find out:

- addition facts known as instant recall
- addition calculations that could be worked out or deduced from known facts
- strategies used for recall/deduction of facts

Children were allowed to use fingers or pencil and paper for jottings.

Analysis of the findings showed that children could be split into three groups, according to their calculation methods. These groups were:

1. Continuing Counters

These children tackled all the calculations by counting one by one. Some children just counted orally, others used fingers or other movements to support oral counting. They consistently used one by one counting and did not use other 'units' (for example when adding $10 + 8$, considering this as one ten and adding on 8).

2. Fact clingers

These children had instant recall of some addition bonds, particularly those to ten. Using this knowledge gave the children a way of answering some of the questions quickly and easily but they struggled when they could not use known facts. It seemed these children had remembered some facts but could not apply them because they did not appear to understand the meaning of the facts they had learnt.

3. Beginning strategists

These children showed evidence of a range of developing strategies alongside some known facts. Typically these children used some knowledge of numbers bonds to ten or twenty. Other strategies used included doubling and the use of near doubles and counting on from the largest number. However these children had a tendency to stick to the same strategy whatever the calculation.

Taken from: Koshy, V. and Murray, J (2002) *Unlocking Numeracy* David Fulton Publishers: London

Case study 1: Carlos

In the research study Carlos counted to obtain the answer to all the sums, telling each sum just as it was presented to him. He used his fingers to support oral counting, so $3+6$, for example, involved counting three fingers and then more. Asked to calculate with numbers more than ten, he used all available fingers, supplemented by nods of the head. With calculations totalling ten or more Carlos achieved accurate answers; with larger numbers, not surprisingly, he frequently mis-counted. Carlos appeared to have no factual knowledge of addition bonds, and no mental calculation strategies beyond counting one by one. His knowledge of two-digit place value was generally insecure, particularly his knowledge of how to partition numbers into ones and tens.

Carlos' school records showed that he had missed a great deal of schooling in Reception year. He had been very slow to learn to count a group of objects, ex-

periencing difficulties particularly with organising his counting and understanding the idea of the conservation of number. But it seemed that, once Carlos had learnt to count, he had applied the idea of counting on to all addition calculations. Consequently, he focused on each number to be added as a series of single units rather than realising that it could be added as a composite unit. Success in achieving the right answer with some calculations involving small numbers encouraged Carlos to continue using his basic counting method, when he really needed to move on to develop his factual knowledge and a wider range of strategies.

Although Carlos was low attaining in number work, his teacher said that he often achieved well in space and shape work. She felt that Carlos had good spatial ability, and was a strongly 'visual learner'.

Case study 2: Amy

Amy's records showed a pattern of underachievement at mathematics going back to Year 1. They also showed that she had often been very anxious about her work, particularly about 'getting sums wrong'. Not surprisingly, this anxiety had intensified at the time of her SATs in Year 2. Amy's parents had tried to ease her anxiety by helping her to learn number facts at home. They had set up a careful programme of rote learning in which Amy was rewarded for memorising addition bonds.

This knowledge provided her with a valuable confidence boost, a quick fix 'solution' for her mathematical problems and anxieties. By clinging on to her knowledge of these facts she could answer – and quickly – some of the questions her teacher asked in the introduction to each Numeracy Hour lesson. But, because Amy had no understanding of the underlying mathematical concepts, her knowledge remained limited. Furthermore, her ongoing lack of strategies for mental calculations meant that she was restricted in her development of new knowledge.

In the research study Amy answered half of the sums involving addition bonds totalling ten very quickly and confidently. Attempting to answer the remaining sums of a similar size, she froze, and after long pauses, said she couldn't do the sums because she had 'forgotten' the answer. Her knowledge of number bonds to ten was therefore patchy, and her ability to calculate totals above ten was limited. Her knowledge and understanding of two-digit place value was also limited; she could count orally from 1 to 100, but when questioned had little sense of number

order for numbers between 21 and 100. Partitioning two-digit numbers into tens and ones was also difficult for her. The assessment had to be finished early because Amy was becoming increasingly flustered by her inability to 'remember the answers'.

Case study 3: Ravinder

Ravinder spoke English as an Additional Language (EAL). In the assessments Ravinder showed considerable strengths in her knowledge and understanding of mental calculation. She knew some addition bonds to ten as instant recall knowledge. She had instant recall knowledge of the 'double facts' to ten, with the exception of $4+4=8$, and some 'double facts' to 20, including $10+10$ and $8+8$. She could also use this knowledge to work out accurately other answers using a 'near-doubles' strategy (see Figure 6.2). But these were the only mental calculation strategies she used during the assessments.

Interviewer: What's $7 + 8$? Can you work that out?

Ravinder: (after long pause) 15

Interviewer: Well done. How did you work that out?

Ravinder: (after some prompting) I said 7 and 7 14. 1 more 15.

Ravinder's mathematics records showed a pattern of underachievement in numeracy dating back to the Reception class, linked to her struggles to make sense of mathematical language. She had had ongoing problems with understanding aspects of two-digit place value in Year 2, particularly partitioning and the names and order of numbers between 11 and 100. But her Year 2 records also showed some rapid progress in ability to solve spatial problems and puzzles requiring logical and systematic thinking.

When interviewed, Ravinder's teacher expressed considerable surprise at the extent of her instant recall knowledge and her use of the 'near-doubling' strategy. In mental mathematics sessions the teacher observed that Ravinder rarely offered an answer, and sometimes found it difficult to keep up with the pace of the lesson. Many of these sessions included discussion of the variety of methods used for calculation, including children's explanations of their methods. But Ravinder's teacher was unsure how much benefit she obtained from such discussions. Both interviewer and teacher felt that, with some additional help, Ravinder could build on her existing strengths in numeracy to become an efficient mental calculator.