Children develop their own methods for solving maths problems: Ian Thompson investigates different uses for doubling

Double up and double back

Researchers looking at how adults use mathematics in daily life have found that the teaching of maths, with its emphasis on standard written methods, has left many people with feelings of anxiety, fear, panic and guilt about their performance in the subject.

Some adults have admitted to feeling inadequate because they are aware that they do not use what they think is the proper method. Many of the interviewees even apologised for their methods. They said things like: 'I know that this isn't the correct way to do it, but it always gets me the right answer'.

There is also a substantial amount of research which suggests that, on many mathematical topics, secondary school children do not, on the whole, use the techniques they have been taught in school. They either adapt those methods to suit their own purpose or replace them with their own idiosyncratic methods.

Children quickly incorporate basic number bonds into problem solving

My own research with children in Years 2 and 3 (described in *Child Education* December 1989) has shown that very young children often use non-standard techniques for doing calculations. In that article I discussed and gave examples of a common strategy - the use of 'complements in ten' - and suggested activities and games which might help young children to understand and make use of this technique in their everyday calculations.

This article will take a similar format by considering the most common mental calculation strategy - using a known double.

How doubling is used

Once children have learned a few basic number bonds they appear to incorporate these facts quite quickly into their problem-solving repertoires.

They invariably learn the doubles first, probably because of the symmetry of the situation or because of the ease of setting up the same number of fingers on each hand. A great many of them, at some stage in their development, make use of these doubles to solve sums where the addends differ by one. They use a 'one more than a double' or a 'one less than a double' strategy as illustrated in the following example.

Nicola, a Year 1 child, gave the following explanation of her correct answer to 11 + 12: 'I know that 12 and 12 makes 24; 11 is one less, so it's 23'.

This technique was used by a great many children in Years 2 and 3.

The following explanations of their correct answers illustrate how children use knowledge of the doubles in a much wider range of situations than simply for calculating sums that differ from a double by one.

Hannah, asked to subtract nine from eighteen answered: 'Nine, because nine and nine makes eighteen'. This use of a known double to solve a subtraction problem is part of a more general strategy, used by older children, of using a known addition fact to work out a related subtraction. This suggests that teachers need to stress the inverse relationship between the operations of addition and subtraction so that children can use this information in the development of their problem-solving repertoire.

Tim, asked to take five from nine replied: 'Four, because ten is two fives... so I take away one five... there is only a five and a four... take away five and there's four left'. Tim uses the fact that five and five makes ten to derive the fact that five and four makes nine.

Anna, asked what four sets of six were, arrived at her answer: '...because 12 and 12 is 24'. Anna has obviously doubled six and then doubled her answer. If doubling is such a natural process then why do we not teach the two and the four times table in this way? This would mean that as children grow older they might learn to multiply numbers larger than ten (or 12) by four in their head. The eight times table would just be 'double, double, and double'!

Scott, adding six and seven: 'I had five and five and I just added three on'. It is quite easy to understand Scott's thinking in this example. I shall leave it to you to sort out his strategy for finding the correct answer to 7 + 4: 'Five and five and you add six on'. Looking at my puzzled face he continues: 'You have five and it comes to eleven with the other one'. Five and five is obviously Scott's favourite double!

The following games and activities should help other young children to develop similar strategies for use in a variety of mental arithmetic contexts.

Double it

This is a simple calculator game for children who are just learning their doubles. The calculator is made into a doubling machine by making use of the constant facility, usually by pressing the keys 2 x x =.

Children play in pairs. The first player enters a number from one to nine. Her partner has to say the double of this number before pressing the equal sign to see the correct answer in the calculator display. A correct answer scores a point and the players' roles are then reversed.

Remember that, when using the constant facility, the display is not cleared before entering the next number. The game can be extended by increasing the size of the numbers.

The calculator is made into a doubling machine by use of the constant facility

Beat the calculator

You need a set of cards numbered from one to ten and a calculator.

Player A turns over a card and tries to say the double of the number on the card before her partner. Player B uses the calculator to find the answer. The winner keeps the card.

If the children are just learning their doubles facts, then player B finds his answer by entering, say, 6 + 6 =, thereby giving his partner more time.

Older or more knowledgeable children should use the constant facility. By setting the calculator to multiply by two any number entered, this reduces the number of key presses to just two: 6 and =.

Doublecross

Set up the calculator as a 'dividing by two' machine by pressing the keys 2 ÷ ÷ =. Children play in pairs using a numbered grid (figure 1) and five coloured counters each. The aim of the game is to place three counters of your colour in a row horizontally, vertically or diagonally on the grid, in noughts and crosses fashion.

In order to place a counter in a particular numbered square, the player has to enter the double of that number into the calculator and then press the equals sign. He then puts one of his counters in the square whose number appears in the calculator display.

A more advanced version uses a four by three rectangle containing the numbers one to twelve.

5	2	7
8	6	4
3	9	1

Figure 1

Tricksy

Use a set of 15 cards numbered one to nine and the even numbers from 10 to 20. Deal five cards to each player, and put the rest face down in one pile with the top card face up to form a rejects pile next to it.

At the start of the game players put down pairs of cards which are doubles - their tricks. Then they take turns to select a card from the top of either pile and place one of their cards on the rejects pile.

The winner is the player with the most tricks when all the cards have been picked up, or when they have no cards left.

This game can be adapted or extended by using cards with numbers in word form, by using a combination of numerals and words, or by extending the range of numbered cards used.

Adapting games

The modified games of snap, pelmanism and dominoes discussed in my previous article can all be adapted easily to develop children's knowledge of the doubles facts.

The rules of many board games can also be changed in such a way that the number of moves made is double the result of the throw of the die.

Using mental skills

The widespread use by young children of mental methods based on counting, counting on, complements in ten and doubles suggests that perhaps a higher profile should be given to this type of activity in primary maths.

The various methods that children use should be discussed with the teacher and between the children themselves, particularly as they can often understand each other's methods better than the teacher can.

The children should be encouraged to explore the methods used by other children and say what they think of them. This could lead to some of them adopting a more efficient method of calculation.

Children also need to feel that their methods are valued. They need to be praised for using idiosyncratic non-standard methods, not told or even led to believe that these methods are inferior to the standard algorithm or the more usual methods of solution.

Children need to be helped to develop the necessary confidence to use their mental methods wherever possible, and to know when the use of written methods may be more appropriate.

One of the most interesting aspects of the different techniques and strategies used is that, except for the use of known number facts, none of these methods is likely to have been taught explicitly to the children, by either their teachers or their parents.

These informal methods have been developed over several years by individual children in order to cope with the real world problems they have met in their everyday lives. They have succeeded in combining discrete mathematical facts and ideas learned in these contexts and in school, in order to generate strategies for solving more abstract problems like 6 + 7... and these children are only seven years old!

Ian Thompson is a lecturer in mathematics education at the University of Newcastle upon Tyne.