Numeracy is very important in primary schools today, with mental calculations being a central part of the mathematics curriculum. These mental methods of calculation should be encouraged from an early age, mathematics is used in our everyday lives without many of us realising; checking our change at the shops and leaving the house in order to arrive at school on time.

It is advised that Numeracy lessons start with a 5-10 minute starter of oral or mental calculation work, working as a whole class to rehearse, sharpen and develop the children's skills. Various ways can be used to sharpen these skills including counting in steps of different sizes, practising mental calculations and the rapid recall of number facts; this can be done through playing interactive number games 'a number one less than a multiple of 5' etc.

Mental calculations are introduced to children in the autumn term of year 1 at a basic level of addition and subtraction. In key stage 2 these mental calculations have become more complex; children include multiplication and division according to the National Numeracy Strategy.

However, these mental calculation strategies are not as straight forward as just asking the class a question in order to get a response, individualisation or 'over-differentiation' in the teaching of mental mathematics has been hailed as a major barrier to the effective learning. It is clear from this statement from Professor David Reynolds that individualisation is indeed an obstacle:

"We're clear about what went wrong. Methods of teaching introduced in the 70's and 80's, had deleterious effects on maths in particular. All the research agrees that the one thing that badly affects performance in maths is letting children work on their own."

(Times Educational Supplement, 10 July 1998)

This idea by Reynolds was supported by classroom observational studies. These studies noted that allowing children to work as an individual provided many opportunities for avoidance strategies. Holt (1984) introduced the idea of 'fence straddlers' these were pupils who prefers to leave the thinking to other students, they tended to; "*produce a mime of tortured contemplation while waiting for someone else to respond".* Measor and Woods (1984) introduced 'knife edgers' these were children who preferred, to a majority, to leave the thinking to others. However they went as far as to raise their hands, showing their participation in the lessons, but timing their participation so it was unlikely that they would be asked for the answer. Lastly we have 'easy riders' these were devised by Galtan and Wilcocks (1983) these pupils developed the idea and skill of working at the slowest pace possible. It was also noted that in mathematics it was not unusual for *"as many as 80 per cent of the pupils to be engaged in easy riding".*

Possible due to this research many teachers find that it is helpful to teach mental mathematics to children organised into pairs. Some teachers believe in mixing the ability of the children in the pairs, with the intention of supporting and encouraging the less confident, whereas other teachers believe that by mixing the ability of the pairs it can lead to the more able or confident child restricting the contribution of their less able partner. The most important benefits of working in pairs however include the sharing of ideas, encouragement of mathematical language and talk, response to questions; 'How did your partner work out that answer?' etc.

Answering devices used within mental mathematics are intended to reduce the opportunities for pupils to exploit the avoidance strategies described earlier. The devices

are used by individuals, however opportunities to discuss answers with partners before responding is encouraged. Digit cards are held up to show the correct answer, these are more suitable if the child has a desk in front of them so that the cards can be spread out and easy to look at and easily obtainable. Number fans work well if children don't have a desk in front of them; one limitation is that teachers have to avoid questions that give answers containing two or more of the same digit. As children advance more complex fans can be used, including a decimal place or extra 0. Flip overs are an excellent format for understanding place value, and finally flashback boards not only help the teacher see who is struggling with gaining the correct answer, but with younger children it helps to discover who can write their numbers and place them in the correct form and way around.

At an early stage children are taught to split numbers up into five and a bit. This makes addition and subtraction easier for children to manage. For example; 8 = 5 and 3. When adding numbers such as 8 and 7 children split 8 into 5 and 3 and 7 into 5 and 2 leaving the sum to be **5+5=10** **3+2=5** and finally **10+5=15.**

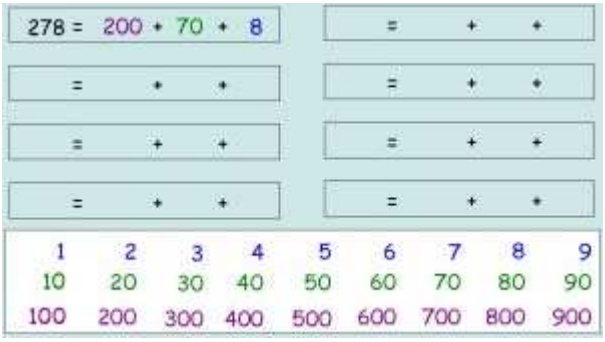
In key stage 2 this strategy expands into hundreds tens and ones. See appendix A for examples of questions taken from the National Numeracy Strategy.

Year Group: Year 3

Numbers and the number system - Know what each digit represents. Partition numbers into hundreds, tens and ones.

This activity is used in conjunction with the computer software 'Textease' it can be used as part of a whole class activity or in small groups. With this activity the teacher types in

a number before the '=' sign and the children partition the number by dragging in the appropriate hundreds, tens and ones.

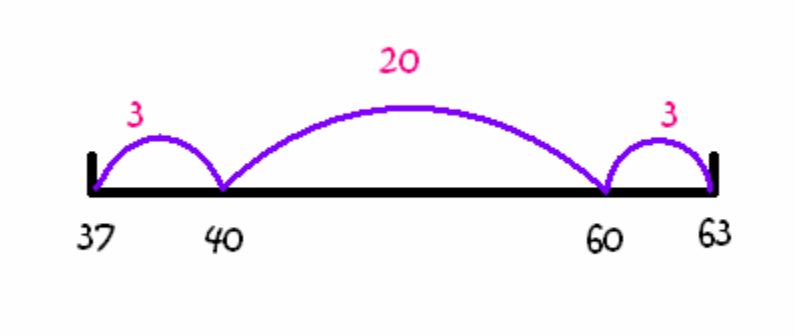


To partition numbers into tens and units, children need to develop a secure understanding of place value. Teachers need to provide opportunities for children to gain experience of grouping in tens and units in different contexts using concrete equipment e.g. packing boxes, using structured equipment such as Dienes rods and money. Teachers can also get children to relate these experiences to recording numbers using hundred grids, place value charts etc. Arrow cards can be a useful resource in supporting children's understanding of partitioning and recombining.

Counting on

Counting on is a good method for subtracting numbers mentally. It is used during key stage 2 mental calculations. When a child is asked to find the difference between 37 and 63 they are advised to picture a blank number line in their head with 37 at one end and 63 at the other. Count on from 37 to 40 and keep that 3 in your head. Now count on from 40 to 63, which is 23 Add the 3 to 23 to make 26.

Some children find it easier to do this method by writing it down on a piece of paper as shown in the following diagram:



The child would then have the mental strategy written in front of them and would be able to see the calculation in order to do it in their heads.

Counting on in tens can be an activity for a whole class or group. Children need to be confident with written and spoken numbers to 100. In the mental and oral part of the lesson, teachers should encourage them to count on in tens and multiples of ten from any number, indicating the written numerals on a hundred grid. E.g. ask the children to start at 6 and count on in tens to 66. The teacher can record the numbers as the children chant to highlight the pattern in the numbers. Ask the children what they can tell you about the pattern, which number changes and which stays the same and relate this to 100 square.

Teachers can also ask the children to count on in 100s with you starting from any number and record the numbers spoken E.g. 2, 102, 202, 302, 402 …. Etc. 45, 145, 245, 345 etc. Encourage them to look for patterns in the written numerals and note which digits change and which stay the same.

It was the psychologist Piaget that realised that children's ability to think and understand matures through a series of stages. There are four cognitive stages of development; stage 1, The sensorimotor stage, stage 2, The pre-operational Stage, stage3, The concrete

operational stage and stage 4 The formal operational stage. It is the third stage that is linked with key stage 2 as children develop a degree of logic and reason, but it is limited to practical problems and specific examples, they master principles of classification, seriation – the ability to organise objects into some kind of order, for example order or size, class inclusion and, eventually, full conservation of volume, number and quantity. Individual children develop at different rates, due to their rate of physical development it is up to teachers to help and differentiate class work to coincide with the children's development.

However an alternative to Piaget's' view of cognitive development was provided by the Russian literary critic and psychologist Vygotsky. He distinguished between lower functions of human psychology like recognizing and sensation, and higher functions like thinking and understanding. According to Vygotsky 'What a child can do in cooperation today, he can do alone tomorrow'. He talks about the Zone of Proximal Development, which is their level of actual development of their level of potential development, what they can do with help of an instructor. The ZPD is an indicator of the teachability of the child. Vygotsky suggested it gave a better measure of a child's capacity than any test of current ability, such as an intelligence test.