Mental Computation Strategies[1]

The National Statement on Mathematics for Australian Schools stresses that **mental computation** should be regarded as the first choice in situations where a calculation is needed.

“Mental computation is the most common form of computation used in everyday life. It is used for quick calculations and estimations, but is more than ‘mental arithmetic’. Mental computation refers to the process of working out and obtaining exact or approximate answers mentally. When calculating mentally, students select from a range of strategies, depending on the numbers used. As they develop their repertoire of strategies, students select those that are more efficient and effective for them.

When teaching mental computation in the classroom, the learning focus is on the strategies used to obtain answers."[2]

Springfield Lakes State School Mathematics Program actively promotes the inclusion of many opportunities for students to use Understanding, Fluency, Problem Solving and Reasoning. The ‘Warm-Up’ section of lessons will incorporate these proficiency strands in relation to number facts as well as the entire Number and Algebra content strand of Mathematics. Students will use Understanding to build knowledge of facts as a foundation; Fluency will be used to recall number facts; Problem Solving will help the students to understand problems, choosing appropriate operations as well as appropriate mental strategy; and they will use Reasoning when they are explaining their thinking and justifying the strategies they have used.

MENTAL COMPUTATION STRATEGIES: EXPLANATION OF TERMS

Count on
‘Count on’ involves adding 0, 1 or 2 to a given number. Rather than recounting the entire group, students start counting from the larger number, and then add on 0, 1 or 2. For example, with 6+2, students begin with six and then quickly count on 2 more: “6, 7, 8. The answer is 8.”

Count up
The count up strategy can be used when the numbers in the subtractions fact are close together. Students find the difference between numbers by counting up from the smaller number to the larger number. For example, with 8 - 6, students start from 6 and then count up to 8, using fingers, counters or a number line to keep track of the number of ‘jumps’.

Count back
‘Count back’ involves subtracting 0, 1 or 2 from a starting number. For example, with 6-2, students begin with six and then count back 2: “6, 5, 4. The answer is 4.”

Turnarounds
The idea of ‘turnarounds’ (or commutative principle) shows students that the order in which addends are joined will not affect the answer. For example, 2+6 is the same as 6+2. (In this case, if the students are familiar with the turnarounds concept they will be able to use the ‘count on 2’ strategy to solve the problem more quickly).

Doubles

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[2] Mental Computation Strategies (Learning Place)

‘Doubles’ involves identifying objects which occur in pairs, couples or doubles, for example a pair of shoes. Doubles facts involve adding the same numbers together, for example 2+2=4. Students learn these facts by investigating real life examples of doubles (eg five fingers on each hand: 5+5=10). When learning strategies for multiplication, students should realise that when a two is one of the numbers in the calculation, the answer may be found by doubling the other number. When students can recall the doubles facts, they can begin looking at near doubles. *(Note: This strategy is also used as a subtractions strategy. Ie. 10 – 5 =).*

Near Doubles/ Doubles + 1
The ‘near doubles’ strategy relies on students’ knowledge of the doubles facts. If students can recall the doubles facts, they can quickly work out problems that are near those facts (i.e. double-add-1 or 2 or double-take-1 or 2). For example: 5+6, students use a known doubles fact (5+5=10) then add one more to make 11. *(Note: This strategy is also used as a subtraction strategy, for example 11 – 5)*

Double multiples of ten
This strategy uses the double strategy and extends it to larger numbers, for example, using 4 + 4 to solve 40 + 40. This can also be extended to the Doubles + 1 strategy, for example, 40 + 50.

Zeros
Zeros strategy is when all of a number is taken, for example, 4 – 4 where the answer is 0 or where none is taken, for example, 4 – 0 where there is nothing taken and the answer remains the same as the beginning number.

<u>Tens</u>
Rainbow Facts
‘Rainbow facts’ are number facts that add up to 10 (eg 9+1, 8+2). Students initially learn these facts by visual association with the rainbow diagram. *(Note: This strategy is also used as a subtraction strategy).*

Rainbow Facts Extension (Compatible Pair)
The ‘compatible pairs’ strategy involves finding numbers whose sum is a multiple of 10, 100 or 1000.This strategy is usually used when adding 3 or more addends. For example, with 14+19+16, begin by adding the 14 and 16 to make 30 (using knowledge of rainbow facts), then add the 19 to find the total of 49.

Near Ten (or Bridge to 10)
The ‘Near 10’ strategy helps students identify the facts close to the rainbow facts, for example, 4 + 7 is one more than 4 + 6, which is 10 so 4 + 7 is 11. *(Note: This is also used as a subtraction strategy, for example, 11 – 4).*

Near 10 Extension (Round and Adjust)
This strategy involves rounding a number to the nearest multiple of 100 or 50 and then adjusting back the total. It’s particularly useful when working with money. For example, $29x4 is calculated as $30x4 less $4. $11.99x4 is calculated as $12x4 less 4 cents.

Make to Ten
The ‘make to 10’ strategy involves solving problems where one addend is close to ten (i.e. eight and nine). Students are shown that, by adjusting one of the addends to make 10, the problem will be easier to solve. Students are initially introduced to the concept by using a ten-frame to show how problems can be adjusted. For example, 9+6 is the same as 10+5.

Make to 10 Extension (Adjust Numbers)

This strategy is an extension of the 'make a 10' strategy. Number problems are adjusted to make them easier to work with. For example, one addend could be made a multiple of ten: the problem 59+13 can be adjusted to 60+12. Or one addend could be broken up to make a multiple of five: the problem 45+17 can be adjusted to 45+15+2.

Adding 9
This strategy is used by adding 10 to a number and subtracting 1, for example, 9 + 7 is one less than 10 + 7, which is 17. So 9 + 7 must be 16. *(Note: this is also used as a subtraction strategy, by taking 9 or 8).*

Fact Families
This strategy is effective when introducing subtraction and division. Fact families prompt students to think of the addition or multiplication facts that they already know in order to answer a subtraction or division problem. For example, 11-4 can be solved using the known addition number fact 4+7=11.

Multiplication Strategies

Double-Doubles
When learning strategies for multiplication, students should realise that when a four is one of the numbers in the calculation, the answer may be found by doubling the other number, then doubling it again. For example with 4x3, students could say "Double 3 is 6. Double 6 is 12. The answer is 12."

Double-Double-Doubles
When learning strategies for multiplication, students should realise that when an eight is one of the numbers in the calculation, the answer may be found by doubling the other number three times. For example with 8x4, students could say "Double 4 is 8. Double 8 is 16. Double 16 is 32. The answer is 32."

Build Up or Build Down
'Building up' or 'building down' from a known fact is used to calculate 3s, 4s, 6s and 9s facts. However, to be used effectively, students will need to have instant recall of their 2s, 5s and 10s facts. For example, 3x6 could be solved by starting with a 'fives' fact (3x5=15), then adding another 3 to make a total of 18. The problem 4x9 could be solved by starting with a 'tens' fact (4x10=40), then subtracting 4 to find the total of 36.

(A large range of multiplication and division strategies are outlined in the "Mental Computation Strategies" (Learning Place) booklet. This can be found in the Springfield Lakes State School Maths Program Folder)

Pull Apart Numbers
The 'pull apart' strategy involves breaking one addend into parts and then adding/subtracting the parts separately. For example, 35+24 could be solved by breaking the sum into 35+20+4. (NB this strategy may also be called 'using place value' or 'breaking up a number').

References: *Go Maths series* (James Burnett and Calvin Irons)
Mastering Mental Maths series (James Burnett)
Facts for Life series (James Burnett)
Yrs 1-7 Maths Syllabus Support Document (Paula Anderson)
*Mental Computation Strategies (*Learning Place)
http://www.australiancurriculum.edu.au/Mathematics/Content-structure