Girraween's Mental Computation Guide

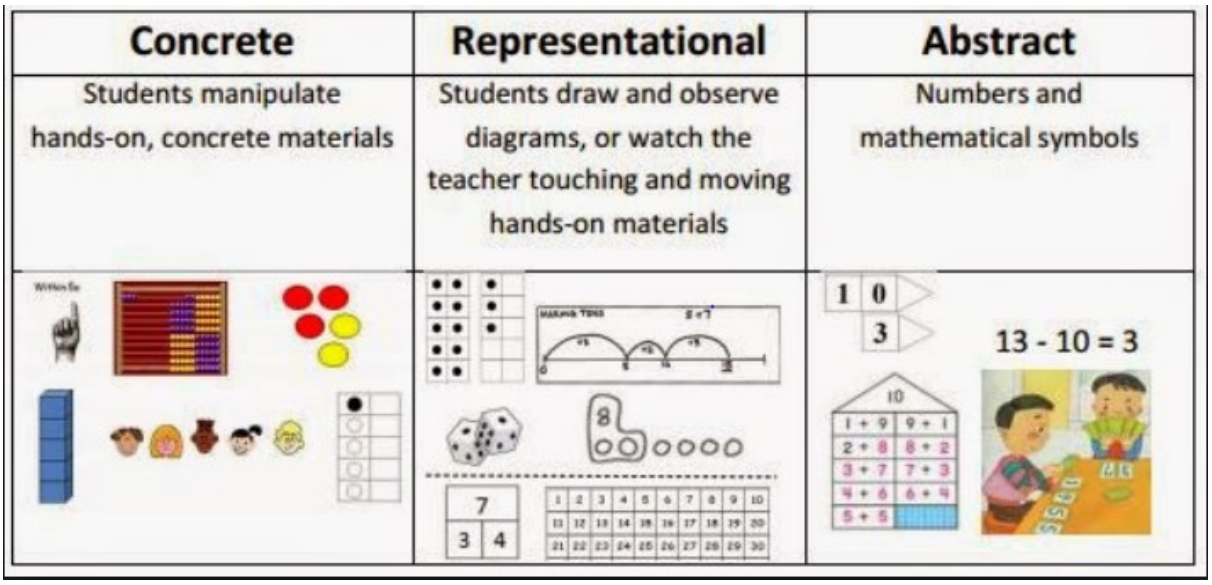
Overview

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 and 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. Each strategy needs to be taught and learnt through investigative dialogue where students can communicate their strategies and discuss the effectiveness of them. Frequent practice is required to develop competence and confidence and build fluency in this essential area.

- Number Talks
- Warm Ups
- Diverse use of Number Lines and number boards
- Think Boards
- Sentence frames to build oral language

Strategies move through the ….



This document aims to lists the facts and strategies in each year level from T to Year 6. It aims to be a trajectory for each strategy building on different entry points within suggested years.

Strategy Overview

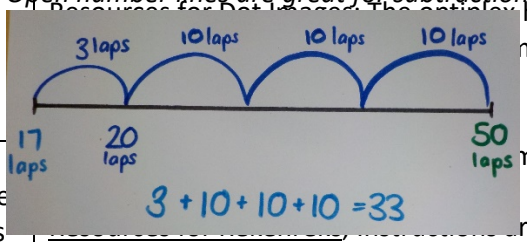
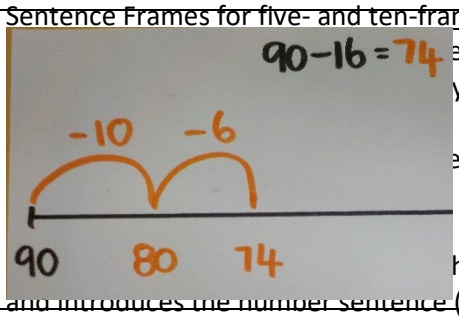
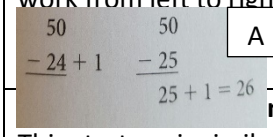
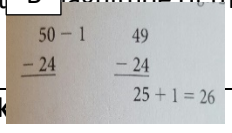
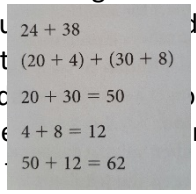
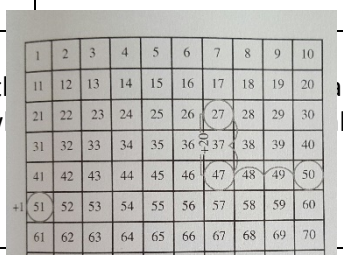
Term 1, 2020

		Year Level coverage E=expose, M=Maintain, T=Teach							**Resource Links**	
Category	Strategy	T	1	2	3	4	5	6	Number Talk Link	Page Link
Addition	Counting All	T	M	M						
	Counting on	T to 20 With turnarounds	T to 100 With turnarounds	M						
	Doubles	T to 6+6	T to 12+12 +/1	M						
	Near Doubles			E	T to 11+12	M				
	Zeroes	E	T	M						
	Making ten	E	T	T to 100	M					
	Landmark or friendly numbers – see poster		E	T	T	M				
	Place Value partitioning	T	T	T	T	T	T	M		
	Compensation – look at poster			E	T	T	T	T		
	Adding up in chunks or jump strategy			T	T	T	T	T		
	Adding 9s			T						
Subtraction	Adding Up		T	T	T	T	T	T		
	Removal or counting back		T	T	T	T	T	T		
	Subtracting in chunks or jump strategy				E	T	T	T		
Multiplication	Skip counting		T	T	T	T	T	T		
	Repeated addition			T	T					
	Doubling and halving				E	T	T			
	Breaking factors into smaller factors						T			
	Landmark or friendly numbers				T					
	Partial products						T	T		
Division	Repeated subtraction/ sharing or dealing out			T						
	Partial Quotients					E	T	T		
	Multiplying Up				E	T	T	T		
	Proportional Reasoning						E	T		

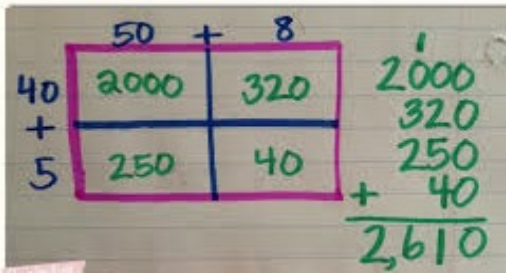
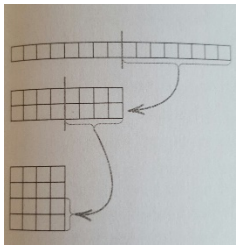
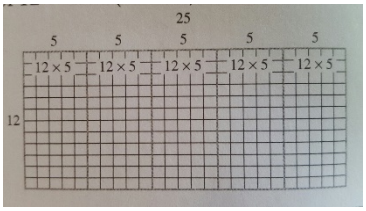
Building Understanding

Subtraction Strategies:

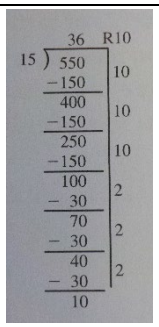
Addition Strategies

Explanation/Language	Suitable Sentence Frames and Resources
Counting Back **Counting All** Many students intuitively count back to solve subtraction problems. The key is to help them realise when this is and is not an efficient strategy. A teacher needs to look for appropriate times to discuss when this strategy is and is not appropriate.	100 – 98 = using count up or back is efficient 100 – 81 = counting back in chunks would be more efficient.
Adding Up **Counting On** The further apart the numbers are in a subtraction the more likely a student will use the adding up strategy. Creating a problem that implies distance will also encourage a student to move forward from the smaller number.	Use Dot Images, Rekenreks and five and ten frames in transition Number Talks. The focus remains on fluency. Using these tools creates opportunities to explore the same concept in a variety of ways. Sentence Frames for Dot Images; "How many dots do you see? How do you see them?" *Open number lines are great for subtraction.*  Resources for Dot Images: The optiplex has a power magnetic dots many beads do re on the optiplex for making your own rekenreks.
Making Ten Developing fluency with number combinations that make ten is an important focus in the primary grades. Students are able break numbers apart quickly to make ten. *Mrs Chatto's goal is to walk 50 laps around the school oval. She has already walked 17 laps. How many more laps does Mrs Chatto need to walk to reach her goal?* **Level 1**- 2 numbers that make 10 (incl 8+4+2) **Level 2**- 2 pairs of numbers that make ten (incl 3+9+7+1+5) **Level 3**- requires one number to be decomposed to make a 10 (8+5)	Sentence Frames for five- and ten-frames; "How ee them?" "How y are left after emplates for he above tools and introduces the number sentence (3+2). Using a number sentence that matches a student's thinking helps students move from the representational stage to the abstract.
Removal The main consideration in helping students when thinking about the removal strategy is to create a context that implies taking or removing an amount out of the whole. **Zeros** Exploring the zero must not be over looked. *Mrs Chatto has 90 paperback books. She plans to donate 16 to the staffroom library. How many paperbacks will she have left?* **Doubles / Near Doubles** Beginning in transition students are able to recall sums for many doubles. **Level 1**- doubles/near doubles up to 10+10. **Level 2**- doubles/near doubles between 10 and 20. **Level 3**- doubles/near doubles between 20 and 50 and up to 100. **EXTENSION**- doubles/near doubles with 3 digit numbers	 40 – 21 Partition and take 1 from 0 leaving -1 20 from 40 leaving 20 20 and -1 make 19. Try this out on a number line that goes into the negative
Negative Numbers This strategy contradicts the theory that you can't 'take a big number away from a smaller number' you will be left with a negative amount.	57 - 24 Partition and take 20 away from 50. Leaves 30. Take 4 away from 7. Leaves 3. 33 remaining.
Subtracting in Chunks When you partition numbers using place value and subtract in chunks. Will work with negative numbers also.	
Landmark or Friendly Numbers These are numbers that are easy to use in mental computation. Fives, multiples of ten as well as monetary amounts such as twenty-five and fifty are examples of numbers that fall into this category. **A note on Compensation** Taking a specific amount from one addend and giving that same amount to the other addend to make a friendlier number. Knowing that this does not alter the outcome of the sum is a big mathematical idea in addition.	72 – 35 Partition and do 70-30 = 40 and 2 – 5 = -3 40 and -3 leaves 37.
Adjusting One Number to Create an Easier Problem **Partitioning using Place Value** A strong understanding of part-part-whole in subtraction is necessary here. Each addend is broken into expanded form and like place value amounts are combined. When combining students work from left to right to maintain t agnitude of the 50 – 24 in two different ways.  	Student A changed 24 to 25 making it easy to subtract thinking of money. They took away too much so need to add back to their answer. Each addend is broken into it's place value. Tens are combined. Ones are combined. Partial answers are combined Student B changed 50 to 49 so they cou subtract changed they nee back to 
ng up in Chunk This strategy is similar to partitioning using place value. **Keeping a Constant Distance** One number is left whole while the adding on the other in easy to use chunks. More efficient than Partitioning. This strategy adjusts both the Whole and the part by the same amount which 'keeps a constant distance between them. The answer no longer requires adjusting. Number lines provide a great visual tool for this strategy.	27 +24 27 + (20 + 3 + 1) 51 – 26 Start at 27 By taking one from both Add 20 makes 47 the equation 50 – 25 w 47 + 3 makes 50 to mentally calculate. 50 +1 = 51  akes bers

Building Understanding

Multiplication Strategies:	
Explanation/ Language	**Suitable Sentence Frames and Resources**
Skip Counting Students who can skip count by rote can use skip counting sequences to work out answers to multiplication facts. For example, to work out 6x5, students can count in 5s along six of their fingers or along six jumps on a number line.	5,10,15,20,25,30 Number lines can assist here.
Repeated Addition Consider the problem 3x12. Students could solve this problem by adding each group of 12 together. The student may also add 10+10+10=30 and 2+2+2=6.	Note here that a student might attempt to add 12, 3's. allowing them to complete this in both ways and explain which was most efficient can assist students.
Landmark or Friendly Numbers Often a multiplication problem can be made easier by changing one of the factors to a friendly or landmark number.	9 x 5 becomes 10 x 15 makes 150 150 - 15 (1 group of 15) makes 135
Partial Products When students understand that the factors in a multiplication problem can be decomposed or broken apart into addends, this allows them so use smaller problems to solve more difficult problems. 12x15	The array model is an excellent way to help students think about multiplying when breaking factors apart. 
Doubling and Halving The intent of this strategy is to change the problem into a friendly problem to solve. This concept is best explored using the array. Providing students with opportunities to build arrays with the **same area** and study the patterns of the dimensions will assist with this strategy.	1 X 16 2 X 8 4 X 4 All have a product of 16 
Breaking Factors into Smaller Factors This strategy is especially helpful when problems become larger and one of the factors can be changed to a one-digit multiplier. 12x25 can become (12x5)+(12x5)+(12x5)+(12x5)+(12x5) because the factor 25 can be represented by 5x5 What other ways could this problem be broken? (4x25)+(4x25)+(4x25) because 12 can be represented by 3x4 etc	This example highlights how the array model can be used to explore ways of breaking up large factors into more manageable parts. 

Building Understanding

Division Strategies:	
Explanation/ Language	**Suitable Sentence Frames and Resources**
Repeated Subtraction/ Sharing or Dealing Out Repeated subtraction is one of the least efficient division strategies. The goal for a child using either of these strategies is linking multiplication with division. Using what a child does know about multiplication to help them understand division.	If students share their strategy for 12 ÷ 2 as; 12 – 2, - 2, - 2, - 2, -2 scaffold to multiplication with; 3 x 2 = 6, 3 x 2 = 6 So ….. 6 x 2 =12 So ….. 12 ÷ 2 = 6
Multiplying Up This strategy allows students to build on multiplication problems that are comfortable and easy to use such as multiplying by tens and twos.	384 ÷ 16 10 x 16 = 160 10 x 16 = 160 2 x 16 = 32 2 x 16 = 32 10 + 10 + 2 + 2 = 24 24 x 16 = 384
Partial Quotients This strategy will work with any division problem. It maintains the integrity of place value and allows the students to approach the problem by building on multiplication problems with friendly multipliers such as 2, 5, 10. Note: this strategy **looks** similar to the traditional algorithm for long division	550 ÷ 15 
Proportional Reasoning Division of whole numbers can also be represented as a fraction with the whole divided into a specific number of parts. For example, I have 100 lollies to be shared between 4 classes. 100 would be my whole (numerator) and 4 would be the number of parts the whole will be divided into, or the denominator. 100⁄4 Knowing the divisor and the dividend share commo factors, students can simplify the quantity to any of the following equivalent fractions.	100 ÷ 4 = 100⁄4 , becomes 50⁄2 , then 25⁄1