As published in the Courier Mail (13 March 2012)

MATHS MADE EASY!

Thinking Strategies in Primary Mathematics

As of this year, there is a new curriculum for English, science and mathematics. The main aim across all three subjects in the new curriculum is to promote *thinking*. For mathematics that means thinking strategies, mental mathematics, reasoning through complex situations and solving problems.

Consider some of the ways you have used mathematics recently. Your list might include:

- calculations involving time
- using dollar notes and coins
- checking invoices, bills or statements
- sharing the cost of a meal with friends
- investigating changed interest rates
- estimating the discount of a sale price.

When you use daily mathematics it is probably in your head or with a device like your phone or home computer. For most of us there is very little use of the old paper-and-pencil methods because those do not help you think mathematically. They are simply too slow, and there are too many ways errors can be made.

Young children can use these strategies throughout primary school

The *Australian Curriculum: Mathematics* (ACARA, 2012) strongly emphasises mental strategies. The aim is to encourage students to think on their feet. This article outlines just a few examples for early addition and multiplication in primary school that can be used in later years and throughout our lives.

A ZUPELZ Puzzle to Try

ZUPELZ is a series of thinking puzzles created by ORIGO Education. They are more mathematical than other 'fill in the square' puzzles but the rules are simple:

- Each number from 1 to 9 is used only once.
- Place the numbers in the grid so the sum of the numbers in each row equals the answers on the right, and the sum of the numbers in each column equals the answers below.
- Try to place the numbers without help. If you need a clue, use only one and then have another go.

ZUPLEZ is available as sets of boxed cards by year level (with CD version) or online from ORIGO Education.

			6
b.			19
c.	a.		20
15	17	13	

CLUES

a. an odd number **b.** a cubic number **c.** a square number

Multiplication Tables and Number Facts

This article uses "number facts" or "facts" to describe the key number knowledge (usually understood as the addition or multiplication of all single-digit numbers) that students need to learn, understand, and be able to say automatically. The tables method is one way to learn multiplication facts, but does not involve thinking or understanding, only practice through repetition. The most successful mathematics curricula worldwide stress both *thinking* and plenty of appropriate practice, not just tables! Number fact knowledge is the basis for using thinking strategies.

Challenge – Multiplication Persistence

Try this challenge. One example is worked through for you:

write a number	467
multiply the digits	4 x 6 x 7 = 168
multiply the digits again	1 x 6 x 8 = 48
and again	4 x 8 = 32
and again	3 x 2 = 6

The final result will always be a one-digit number. It took 4 steps for 467. Can you find a number that persists for more than 4 steps? Could you find one that persists for more than 11 steps? If so, let me know!

Think Tank Teaser

Use four 4s and any of the operations +, −, × and ÷ to write number sentences Example: (4 + 4) ÷ (4 + 4) = 1

a. ______________________ = 2

b. ______________________ = 3

c. ______________________ = 4

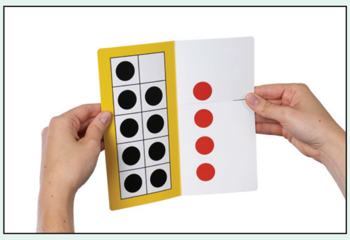
d. ______________________ = 5

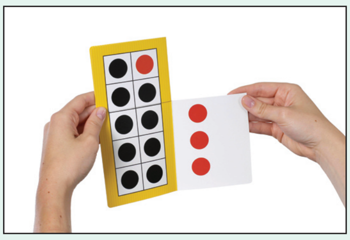
Prickly Problems

Addition

Using Nearby Numbers

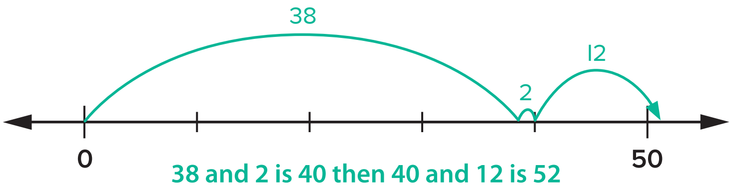
This is probably the most-used mental strategy for addition. At first, when the numbers are small, the most useful nearby number is 10. Dot picture cards like the one shown below can be used to introduce and reinforce this powerful mental strategy. A teacher can ask, "What do you see here?" and then, "What has happened now?" to lead the discussion.





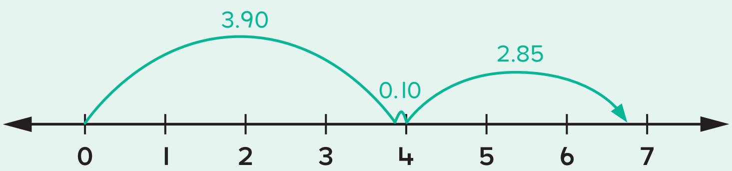
9 + 4 is the same as 10 + 3

For larger numbers and decimals, students are encouraged to draw – or think about – jumps on a number line and can then write number sentences to show their thinking. The real benefit of mental strategies is that they provide quick ways to work out the total. One of these is shown below for a question that students might encounter in Year 2.



38 and 2 is 40 then 40 and 12 is 52

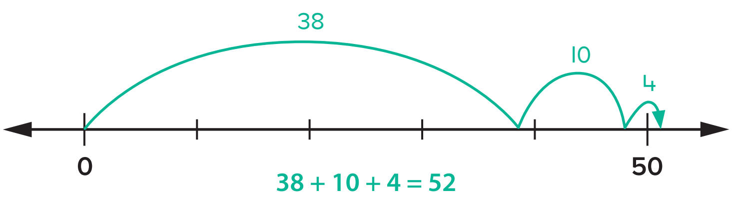
Nearby numbers are also ideal for adding decimals. Here is one way to solve the problem below. How would you have worked out the total?



3.90 + 0.10 = 4.00 4.00 + 2.85 = 6.85

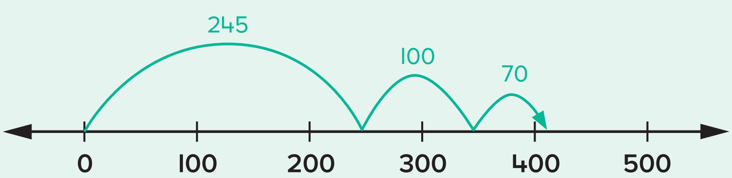
Adding Parts of a Number

Here is another strategy; shown below for 38 add 14. Start with the larger number, then add two parts of 14 – in this case 10 then 4. Again, this is only one of several ways this strategy can be used.



38 + 10 + 4 = 52

Primary students can extend their use of this strategy to three-digit numbers.



245 + 100 + 70 = 415

A special thank you to Dr. Calvin Irons, Senior Lecturer in Mathematics Education at Queensland University of Technology for sharing his expertise and ideas with Headst@rt readers.

Dr. Irons is passionate about mathematics. He believes that many more individuals can be successful at mathematics if it is taught in a sensible manner, in a sound sequence, and in a genuine way.

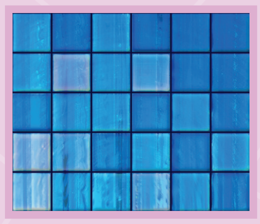
Multiplication

Words and Pictures

Mental mathematics is made easier with *pictures* to help demonstrate the thinking strategies, and *language* that makes sense.

Thinking about early multiplication becomes needlessly difficult when students are not given the appropriate models or words. For example, the word "times" – while in common use – does not make a lot of logical sense and confuses young students.

The most useful visual model for multiplication is an array of objects arranged in equal rows. Real-world examples are easy to find – even for young students. In the local shop, stacked water bottles, eggs in boxes, and packed canned goods are all fine examples of arrays.



In the home you can find arrays in floor tiles arranged in equal rows. The example above shows 5 rows of 6 tiles.

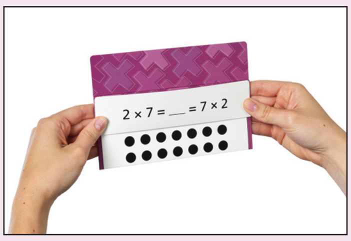
To introduce multiplication teachers ask students to find examples of items or objects in equal rows and describe what they see. The most meaningful word for multiplication is "by" because it can be connected to a strong visual model. So, for the array of tiles above, we write "5 x 6 = 30" and say "five by six is thirty".

With helpful words and pictures, young students are better equipped to use mental strategies for multiplication.

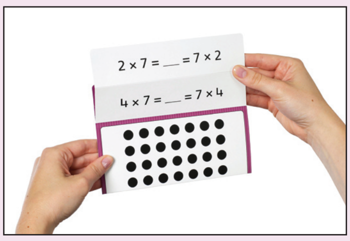
Doubling

Doubling helps with both addition and multiplication. Multiplying by 2, by 4, and by 8 all use doubling strategies.

This card shows how to 'double-double' to multiply by 4. The number sentence on the card shows the students that there are two number facts they should already know (7 × 2 and 2 × 7).



I know this. It is double 7.
That is 14.



This is just double the first picture.
Double 14 (28). That means 4 by 7 is 28.

This thinking can be extended to greater numbers. How would you work out the area of each path below?

4m by 15m

I will double 15 to get 30.
Then double 30. That's 60.

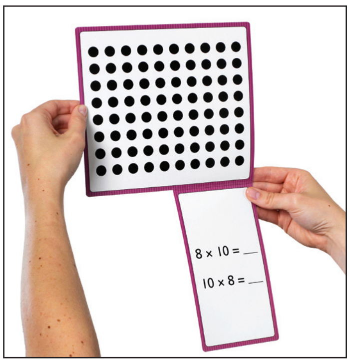
4m by 35m

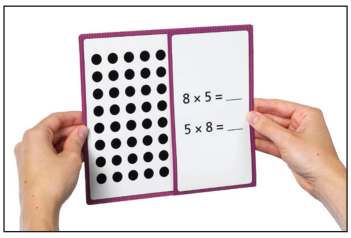
When I multiply by 4,
I just think double-double.

Doubling strategies work for fractions and decimals as well (e.g 8 × 0.35) so this way of thinking provides a strong foundation for mathematics in later years.

Halving

A good way to multiply by 5 is to multiply by 10 and then halve that answer. That means that students need to know how to multiply by 10 first, but that is usually an easy skill to master. Here is a card that helps to show the halving strategy for multiplying by five. Try using this strategy to solve other 'x 5' problems.





To solve 8 x 5, I could count in steps of 5, but that is slow.
I'll start with something easier. I know 8 by 10 is 80.
Cutting that in half gives the answer of 40.

As with all strategies, students can and should use the same thinking with greater numbers.

18 x 5 = ___?___ = 5 x 18

I'll multiply 18 by 10.
That's 180. Half of 180 is 90.

46 x 5 = ___?___ = 5 x 46

It is easier to start with 10 by 46 or 460, then cut that in half to get 230.