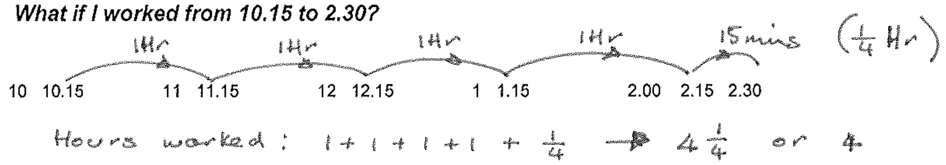
Hours worked: 1 + 1 + 1 + ½ → 3 ½ hours or 3.5 hours or sometimes 3.30

The final step depends on how it is written in their workplace, even if it is not strictly mathematically correct

What if I worked from 10.15 to 2.30?



Cost calculations – 'Estimate and Adjust'.

I suggest you begin with an easy example and introduce the symbol '≈' (approximately equal) as you go.

5 T shirts on special at $9.99 each. What about buying 2 of these shirts?

Estimate		**Adjust**
1 shirt ≈	$10	-1
2 shirts ≈	$20	-2
Cost:	$20 – 2c →	$19.98

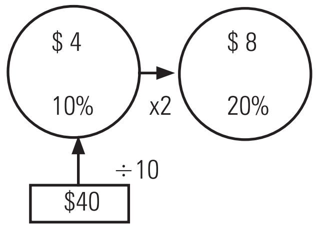
Since the cost of 2 shirts is $19.98 there is the potential for an interesting 'social numeracy' discussion – What about change now that we do not have 1 & 2 cent coins? – Is it the same if you buy for cash or using a card? (I remember in Italy when they used to give a small wrapped sweet as change in situations like this.)

Continue with 3 of these 6 of these etc. Then move to other item prices, gradually including prices like: $3.05; $5.90; $1.25; $1.75

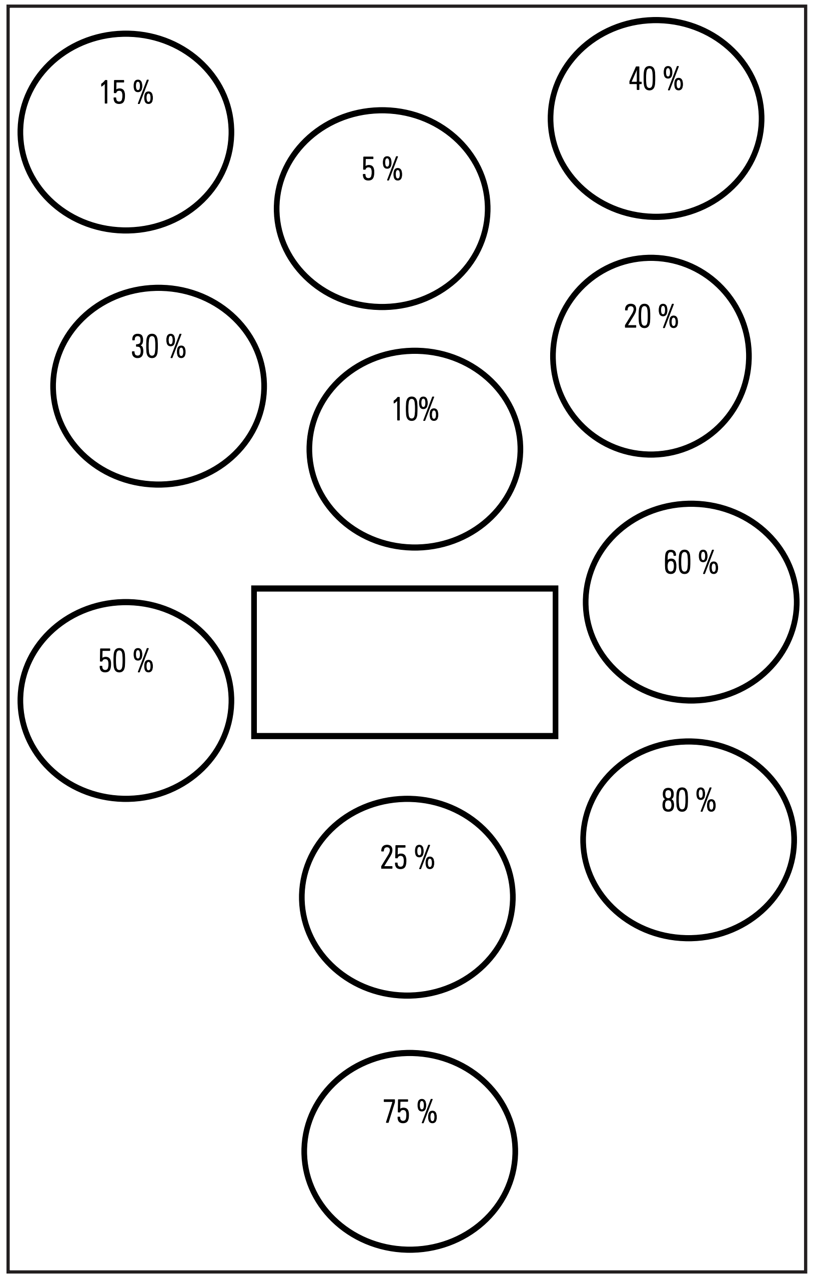
Using real catalogues to get 'specials' prices, or things your learners buy often is an even better approach.

Percentage Calculations

The strategy: start from the 10% circle in the top half and go to other circles from that; as you go draw an arrow and write beside it what you did, for example x 2 or x 3 or ½, as shown in these examples below:



I have expanded these ideas with my learners to encourage short-cut approaches to percentage calculations: again using a schematic layout to encourage this informal approach. →



Begin with 50% and move from there to the other circles. The number in the centre box should start with easily divisible amounts, such as $40, $600, gradually increasing in difficulty as learners become more confident.

You will find that students use a variety of paths to do this, not always those you expect. Remember there is no wrong way to go. Of course learners do need to be familiar with the first 10% calculation being 1/10 or (÷ 10). In Australia, dockets with GST clearly shown would be a good starting point for investigating 10%.

You will need to enlarge this diagram for your students to work on.

TUTOR TIPS

Department of Employment, Economic Development and Innovation
Funded under the *Skilling Queenslanders for Work* initiative

Keeping it informal- using connections between social practices and numeracy teaching?

Beth Marr

In his paper Dave Baker stresses the value of exploring the 'socially situated' numeracy of your learners: of taking the time to research their everyday, domestic numeracy practices and making links to and from them during subsequent teaching and learning. I found it very illuminating in my research to see the methods that have been developed in particular workplaces and the highly particular, context-related language that is used with the processes: so different from the language of the maths text books. Obviously, the more I can learn about learners' language and processes, and the more I can make links between those and subsequent training, the more effective I can be as a teacher.

However, considering the disparate groups of learners who come together in many Australian adult numeracy classes, it is easy to see why this might not be practicable for all teachers. Mixed groups of adult education students come to classes with little in common except their need to learn some numeracy skills. With these classes, one way to draw on social numeracy practices is by first demonstrating some of one's own and then prompting and inviting the learners to think of, and share, some of their out-of-class practices, thus validating their social numeracy and existing skills.

The numeracy 'social practices' that I share with my learners are those I have been introduced to during my varied work life. Most date from the days before shopkeepers and business people relied on computers, and instead came up with their own simplified strategies for common, everyday calculations. These strategies, passed on to apprentices and new workers, who in turn passed them down the line to the next generation of workers, became entrenched as 'social practices' or part of the tool-kit of workers. Dave Baker's paper refers to such things as part of workers' 'funds of knowledge'.

Those I was introduced to whilst working in shops and factories include some of the following strategies.

Example 1: Counting strategies – news sheets being bundled in hundreds for distribution.

Reliance on simple fanning and counting into fours and the easily remembered multiplication facts of the four times table. Count 25 bundles of 4, then 25 x 4 = 100 papers for distribution.

Example 2: Cost calculations – 'Estimate and Adjust'.

Cost calculations for multiple items of a single price, such as 5 lots of $3.99, using **E**stimation and **A**djustment techniques. I suggest you begin with an easy example and introduce the symbol '≈' (approximately equal) as you go.

5 T shirts on special at $9.99 each:

I use 9s because most of us would prefer to avoid tackling that example as a normal multiplication.

Estimate	**Adjust**
1 shirt ≈ $10	1 cent less (-1c)
5 shirts ≈ $50 (5 x 10)	5 x 1c less = 5 cents less (- 5c)
	Real cost: $50 less 5 c → $49.95

*Try to keep it loose not set up as formal 'sum'. Remember that you do not want to replace one form of orthodoxy with another. After a few examples use **E** and **A** as shorthand.*

Example 3: Calculating sales tax

Calculations of the 17½% sales tax added to printing jobs using simple division by 10, then halving and adding.

> A quick method of calculating sales tax, for example, for a job worth $360, went like this:
>
> Job cost: $360
>
> Tax calculation:
>
> 10% → $ 36 (360 ÷ 10 → cross off 0)
>
> 5% → $ 18 (5% is ½ of 10% → ½ of $36)
>
> 2 ½ % → $ 9 (2 ½ % is ½ of 5% → ½ of $18)
>
> Total (17 ½ %) $ 63
>
> Cost to the customer: $360 + $63 → $423

All of these strategies made me feel quite powerful at the time, as if I'd been introduced to a secret 'trick of the trade'. None of them was learned at school in maths classes.

Since then, in my teaching, I have harnessed most of the above practices and introduced them as alternative strategies to the formal methods that students have learned, often unsuccessfully, at school. Since these are 'alternative' strategies I try to keep them looking as different from the formal methods as I can. One way to do this is by using rough pictures or sketches of the process.

Why are these informal processes important?

To illustrate the damage that can be done to learners' confidence by reaching for rote learned algorithms or formulae that don't actually make any sense to them, I'll refer to an example which comes from an old professional development video for maths teachers. A young child, asked how much change he would get if he gave $5 to buy a chocolate worth 45 cents, had no hesitation in working it out in his head and replying '$4.55'. Then he was asked to do a formal calculation of 500 – 45 (set out as a school sum). He laboured over 'decomposing' numbers on the top line and ended up with a completely nonsensical answer. A look of horror and confusion spread over his face. He began to doubt his original response.

In this case, confidence and rationality had departed. The child had entered the world of formal mathematics where things are not really expected to make sense; so why would they? I'm sure you can think of many more similar situations for yourselves. This is one reason that honouring domestic numeracy strategies in the classroom or training situation is helpful. Sometimes we don't need formulae: we can find simpler ways to approach the calculation. We should be empowering students to select from their own repertoire of strategies, always selecting the simplest, most appropriate for the situation.

Informal approaches to calculations, sometimes called 'in-the-head' or 'back-of-envelope' calculations, are powerful and important. They focus on 'number sense' rather than algorithms, rules and formulae. They draw on and validate the strategies adults tend to use outside the classroom, but which they often do not think of as legitimate in 'maths class'. In-the-head strategies are particularly important in industry and workplace settings where estimation is often used more than, or at least as much as, a calculator. Quick checks of calculator results are essential in workplaces to ensure that you don't get nonsense from the calculator. Mistakes leading to wasted materials and labour are expensive in a work situation.

But this is not all about job skills: shortcuts and practice at using in-the-head techniques can make adults feel really empowered. Once you help them acquire new strategies it is amazing how they will suddenly find uses for them, or bring to class stories of sharing them with others.

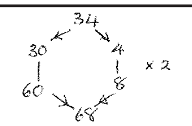
From talking to workers in factories and observing adult learners in Timor-Leste I realise that there are many people who tend to avoid multiplication, preferring instead to use repeated addition, and many, many more who would never even think of trying division; somehow multiplication or repeated addition will get them close enough to the answer they need. These people get very fast and skilled at addition. Some of the strategies below, in part tap into that skill, and perhaps provide the means of learners extending their repertoire without actually having to use the algorithms that they did not feel comfortable with.

Doubling and halving using visual models

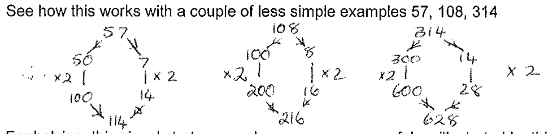
> Many people who normally avoid multiplication are nevertheless quite good at doubling or halving if the numbers are not too complex. These skills can be extended quite easily to larger numbers and then to allow for multiplication by 4 (doubling twice) or 8 (doubling three times) or finding a quarter (25%) (halving twice). *[Thanks to Stephanie Mitchell from Perth for this representational method] Before going on with this method make sure that your students can double single digit numbers with ease.*

Doubling 34:

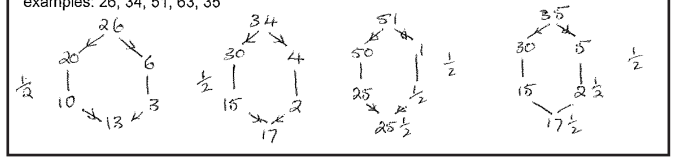
I can start by imagining I am pulling the number apart into its two parts (30 and 4), then to double it, I double the two parts (double 30 is 60) and (double 4 is 8). At the end, I simply combine them together again (60 and 8 is 68). But all of this I show in a very simple sketch.



See how this works with a couple of less simple examples 57, 108, 314



For halving, this visual strategy can be even more powerful as illustrated by this sequence of examples: 26, 34, 51, 63, 35



Most of the strategies I mention above can be extended from their original use to be applied powerfully and easily in other common situations which may be relevant to students in or out of numeracy classes. For example, 'counting on' when represented as a sketch can be used for any subtraction, but is also particularly powerful for time calculations: working out 'How long since?' or How long ago was? or 'How many hours of work should I be paid for?' The strategies I learned for calculating 17 ½% tax can be used for heaps of percentage calculations, freeing learners from ever having to use the confusing, meaningless, percentage formulae again.

Using visual models and informal strategies

Working out change – 'Counting on'

Most of us learned this as part of everyday shopping.

The informal method of counting on can be illustrated visually or schematically as in the following:

How much change do I get if I buy something for $5.95 and pay with a $10 note?

+5c + $4

$5.95 $6 $10

Change is: 5 cents + $ 4 → $4 and 5 cents → $4.05

Or if smaller steps needed:

5c $1 $1 $1 $1

$5.95 $6 $7 $8 $9 $10

Change is: 5 cents + $1 + $1 + $1 + $1 → $4 and 5 cents → $4.05

What if I pay with a $20 note?

5c $4 $10

$5.95 $6 $10 $20

Change is: 5 cents + $ 4 + $10 → $14 and 5 cents → $14.05

What if I buy something for $12.75 and pay with a $20 note?

5c 20c $7

$12.75 $12.80 $13 $20

Change is: 5 c + 20 c +$ 7 → $7 and 25 c → $7.25

What if I buy something for** $4.05 **and pay with a $50 note?

5c 90c $5 $40

$4.05 $4.10 $5.00 $10 $50

Change is: 5 c + 90 c +$ 5 + $40 → $45 and 95 c → $45.95

Extending the method to time calculations

This sort of representation can be extended to time calculations such as:

The Vietnam War ended 1975. How long ago was that?

5years 10 10 10

1975 1980 1990 2000 2010

It was 35 years ago (5 + 10 +10 +10)

Or, for students who need less support (fewer steps):

5 20 10

1975 1980 2000 2010

It was 35 years ago (5 + 20 +10)

Or sometimes we want to go backwards:

My friend turned 43 last year, I wonder what year she was born?

10 10 10 10 3

1966 1976 1986 1996 2006 2009

Sometimes it helps learners if you photocopy a timeline for these types of calculations, for exampl

1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010

I am also wondering if a similar strategy would work for learners who need to calculate how many hours they have worked for filling in time sheets or checking wages. I know I always used to find myself counting around a sketch clock-face for my own calculations. Would a timeline approach work?

eg I worked from 10.00 AM to 1.30 PM what do I fill in for "hours worked"?

1Hr 1Hr 1Hr 30mins (½ Hr)

10 11 **12** 1 1.30