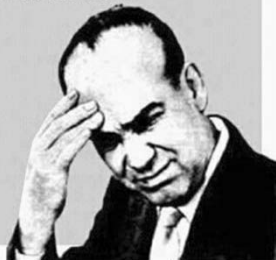



Everytime I see a math word problem it looks like this:  
 If I have 10 ice cubes and you have 11 apples.  
 How many pancakes will fit on the roof?  
 Answer:  
 Purple because aliens  
 don't wear hats.



arrg!ecards

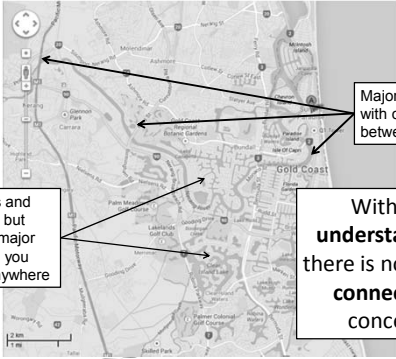
Tierney Kennedy, MASA keynote presentation, April 2014

### Does it drive you nuts?



"I didn't backup my brain over the holidays,  
 so I am going to have to start all over again  
 in maths this year!"

### Maths is like roads through a city



Major concepts with connections between them

Without understanding, there is no map to connect the concepts

Lots of facts and procedures, but without the major connections you won't get anywhere

### Fluency vs Understanding

Fluency:  
 Students develop skills in choosing appropriate procedures, carrying out procedures flexibly, accurately, efficiently and appropriately, and recalling factual knowledge and concepts readily...

<http://www.australiancurriculum.edu.au/Mathematics/Content-structure>


## Routine questions

Understanding:  
 Students build a robust knowledge of adaptable and transferable mathematical concepts. They make connections between related concepts and progressively apply the familiar to develop new ideas. They develop an understanding of the relationship between the 'why' and the 'how' of mathematics.

<http://www.australiancurriculum.edu.au/Mathematics/Content-structure>

## Weirder questions

### Which half is the biggest?



Year 4 kids with hands up think that half "D" is the biggest... even though each half is made from an A4 page.

### Intuitive understanding

What we deeply, intuitively believe about maths... no matter how many times someone has told us otherwise

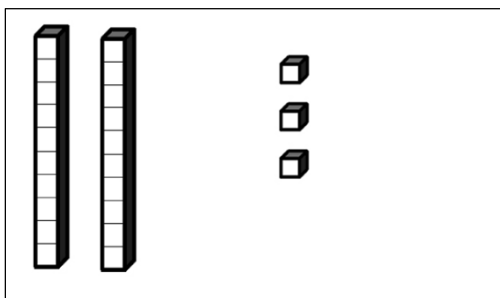


### My personal take on the key number ideas

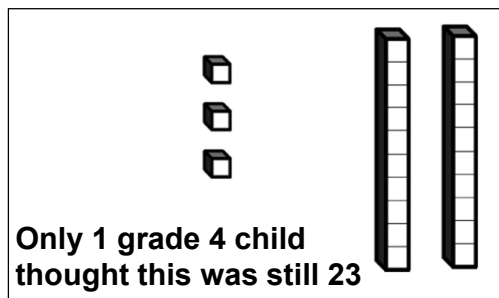
(MYRP by Dianne Siemon)

1. What changes a number and what doesn't? (trusting the count) F-2
2. Breaking a number into bits (partitioning) F-3
3. Relative size (place value) 2-6
4. Two-dimensional thinking (multiplicative thinking) 3-8
5. Proportional reasoning 4-9

### Place Value: Relative size of two-digit numbers



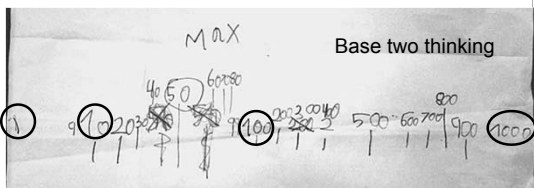
### Then rotate your paper...



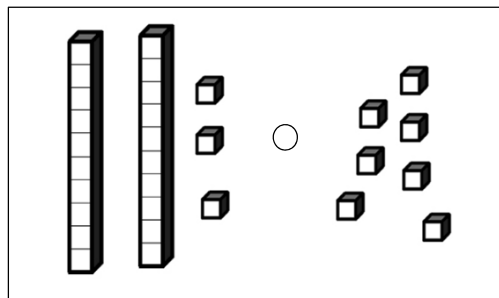
### Relative size... for three digit numbers

Who got stuck?

- 80-90% year 3s
- 70-85% year 5s
- 50-75% year 7s

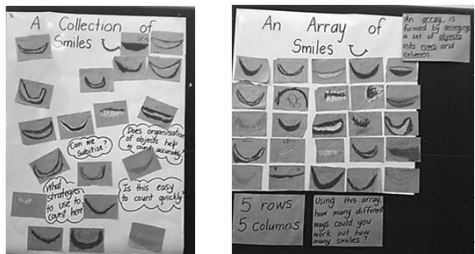


### Relative size of decimal numbers





**Multiplicative thinking means picturing arrays rather than "groups of"**



**Multiplicative thinking... of two-digit numbers**

What does it look like to multiply 23 by 35?  
4 year sixes could do it!



23 windows on a house, with 35 ants on the path



23 bags with 35 coins in each

**Proportional reasoning: what are these?**



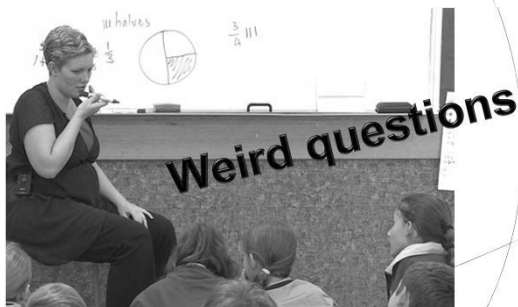
**Uneven thirds!**

Irregular thirds, irrational thirds, uncommon thirds, improper thirds...

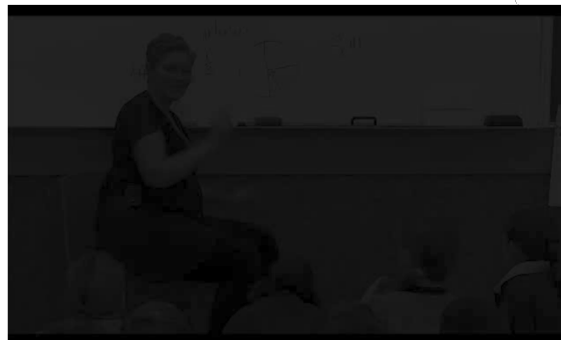
**Finding and fixing the problem in 4 steps:**

- ⦿ Work out how deep the problem goes
- ⦿ Confront it to force the kids to change their own minds and realise that they are wrong BEFORE we
- ⦿ Lead them to make the connections
- ⦿ Generalise the principles

**1. Diagnostic Questions: find the problem**



**2. Confronting Questions:**

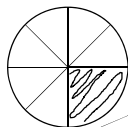


Confronting Questions: Force them to realise the illogicality of their thinking



They thought this was a third initially. As I broke the circle into more pieces, the blue quadrant became:

- 1/4
- 1/5
- 1/6
- 1/7



Taking it to an illogical extreme: 100 bits!



3. Leading Questions: making connections



Would this be 1/2 then? Why not? Draw the lines to make it make sense

4. Generalising: Fractions have nothing to do with the number of pieces, it is about how BIG the pieces are! Different sized pieces have different names.

But does this actually, really work for things like NAPLAN?

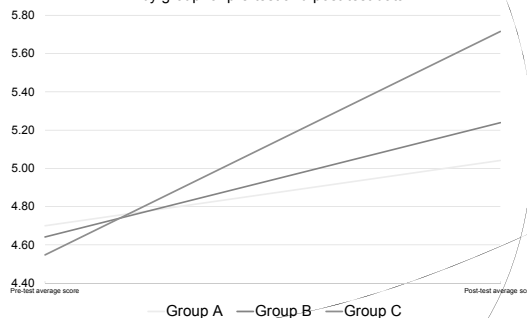
What about the time crunch?

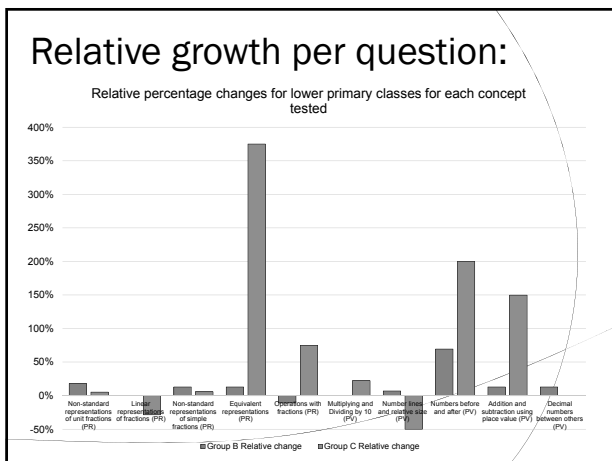
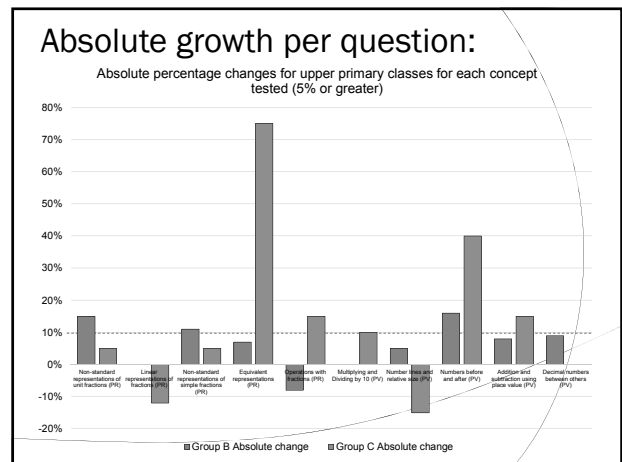
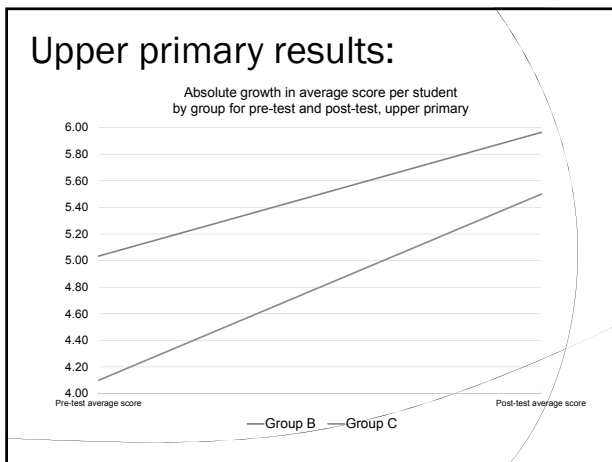
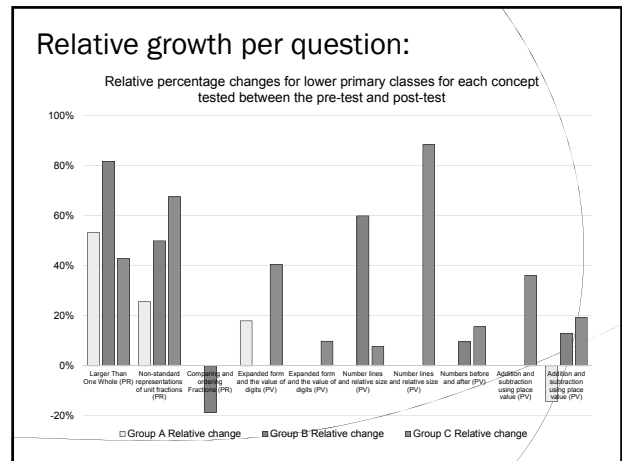
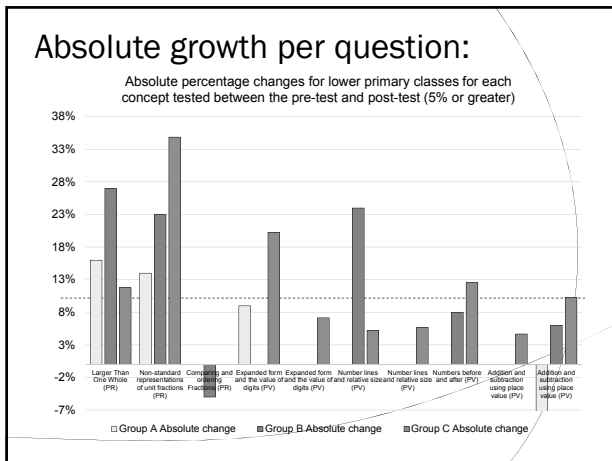
10 week Education Queensland project, Semester 2, 2013

- 2-day facilitator training course for numeracy coaches and key teachers
- Pre-test and post-test of 10 NAPLAN questions on place value and proportional reasoning
- 8 lesson intervention run by the teachers using Back-to-Front Maths lessons, 42 C2C lessons
- 1 day with me in a school to diagnose problems and plan how to intervene
- 5 classes 50 C2C only, 5 classes 42 C2C + 8 lessons B2F, 4 classes permission to use B2F

Lower primary results:

Absolute growth in average score per student by group for pre-test and post-test data





If we always teach how we have always taught, our students will only ever learn what they have learned before.

Different outcomes require different inputs.

[tierney@kennedypress.com.au](mailto:tierney@kennedypress.com.au)