DR ANGE ROGERS

Place Value: What really matters?

BMM Virtual Summit 2024

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WELCOME

Hi, my name is Dr Ange Rogers. I am a Maths Education Consultant from Melbourne Australia and I LOVE place value. I spent four years researching the teaching, learning and assessment of place value throughout my PhD.

In the 9 years since then I have continued to research and refine the resources I provide to support teachers and students.

I hope you find my session at the BMM Virtual Summit engaging and informative. In this workbook you will find resources that summarise the main areas I will cover and suggest some places to go for further learning.

If you have any questions, feedback or suggestions, please don't hesitate to reach out to me via email ange@numeracyteachersacademy.com

Many Thanks,

Ange Rogers

Dr Ange Rogers

Notes

Record any notes as we move through the session

Notes

Ideas

Reflection

The 6 Aspects of Place Value

Use the 6 aspects to guide your teaching of whole number and decimal place value

The 6 aspects form a structure to base place value teaching around. They provide a shared definition of place value and encourage everyone to use the same language across the school.

Place Value Unit Structure

When you are teaching place value you can use this 6 week structure

1 NAME/RECORD

- Read and write a number in words and figures
- Identify the names of each place value column
- Identify the value of digits in a number

2 COUNT

- Counting forwards and backwards in place value parts
- Bridging forwards and backwards over place value segments
- Identify the number before, after, next in a sequence
- Understand the idea of more, less, greater, larger, between

3 MAKE/REPRESENT

- Make, represent or identify the value of a number using a range of materials or manipulatives.
- proportional e.g., base-ten blocks), non-proportional (e.g. coloured counters)
- canonical (e.g., 3 tens and 9 ones is 39) or non-canonical (e.g., 2 tens and 19 ones is 39)

4 RENAME

- Rename numbers in multiple ways in terms of place value parts without the use of manipulatives
- 47 is equivalent to 3 tens 17 ones, 2 tens 27 ones etc

5 COMPARE/ORDER

- Compare numbers to determine which is larger or smaller
- Compare numbers in a multiplicative manner. e.g. tens times larger
- Locate numbers on empty, partially marked or complete number lines.
- Rounding numbers to the nearest place value part.

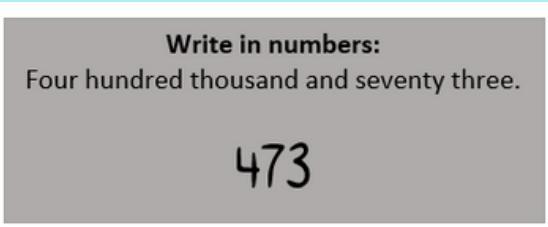
6 CALCULATE

- Apply knowledge and understanding of the place value system when completing calculations using the four operations

Name/Record

THINKING MISTAKE

When students attempt to record numbers, they often completely ignore place value conventions and simply write the numbers they recognize (in this case four hundred and seventy-three). Or as you can see below, they concatenate numbers, writing each part in sequence, for example (four hundred thousand, then 73).



TEACHING TIP

When we teach reading and writing numbers, we should encourage students to chunk (within the periods) and observe patterns (between the periods). Just as in literacy it is ok for students to be able to read some words they don't understand, it is perfectly ok for students to read and write numbers they have no comprehension of... yet! This place value houses template is very useful to teach the structure of our number system. Once students see the structure and conventions of recording numbers, they rarely make the errors seen above.

Billions			Millions			Thousands					
H	T	O	H	T	O	H	T	O	H	T	O

Reference:www.nzmaths.co.nz

Count

THINKING MISTAKE

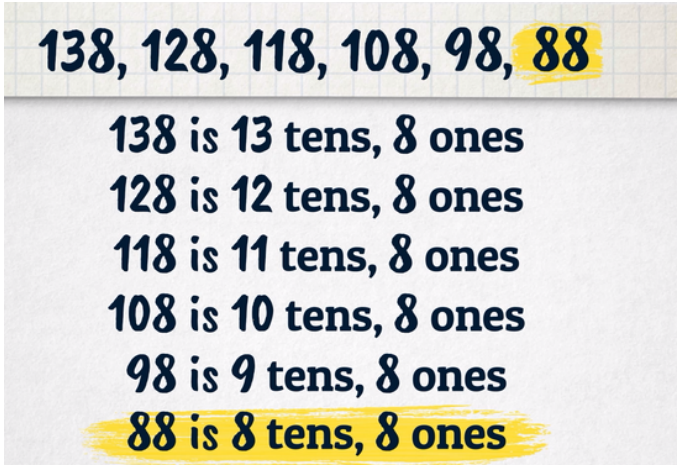
We all know there are 'flash points' that cause difficulties for students when they count. Going forwards or backwards over a place value part, whether it be tens, hundreds, or thousands is a challenge. The sample below illustrates this difficulty

Continue the following pattern . . .

178, 168, 158, 148, 138, 128, 118, 108, 100, 92

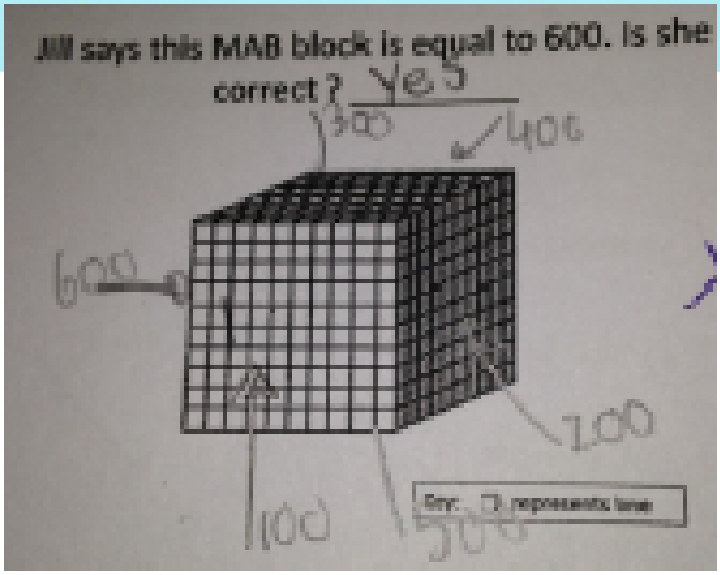
TEACHING TIP

Pattern is critical in counting. Whenever you count, provide students the chance to observe the pattern they are creating. In the above example, you could ask questions like: what do you notice is happening in the tens column? ones column? I also like to link renaming with counting. For example, 13 tens 8 ones, 12 tens 8 ones, 11 tens 8 ones, 10 tens 8 ones,. What comes next? Don't assume students notice patterns- often they are just rote counting-make them think!



THINKING MISTAKE

In my research I found around 24% of Year 3-6 students believe (or are not convinced otherwise) that the MAB (Base 10) thousand block has a value of 600 below. This thinking mistake stems from students counting each face of the thousand block as 1 hundred, so 6 by 1 hundred is 600.



TEACHING TIP

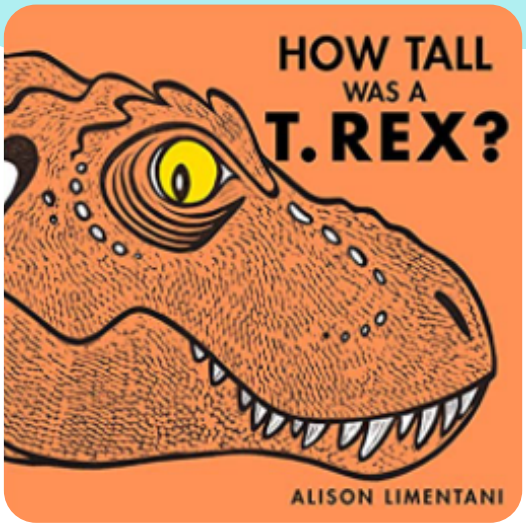
Avoid plastic MAB (Base 10) thousand blocks- these are not weighted like the wooden sets, and feel hollow, reinforcing the 600-block issue. Let students discover the value of the MAB thousands block themselves. Hand them the block and simply say, 'I want you to discover and prove to me the value of this block'. Sticking together hundred blocks with blu-tac is a highly valuable part of this activity.

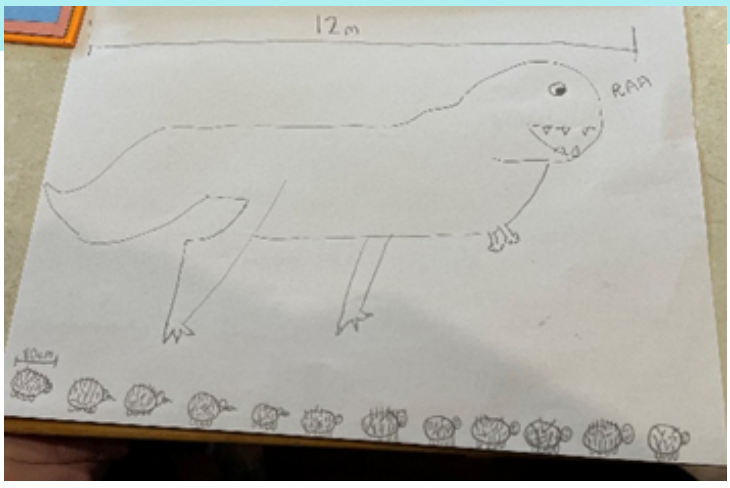
THINKING MISTAKE

Students find multiplicative comparisons (x times larger or smaller) a difficult idea. Below you can see the student is thinking in an additive way and simply subtracts ten. They do not comprehend the meaning of the word “times”.

TEACHING TIP

A fabulous book and activity to reinforce this idea is to read “How Tall was a T.Rex” by Alison Limentani (see below). In this book students are prompted to consider multiplicative comparison scenarios. For example, ‘a T-Rex is as long as 6 lions’. This presents an authentic context to talk about the lion being 6 times smaller than a T.Rex or a T.Rex being 6 times larger than the lion.

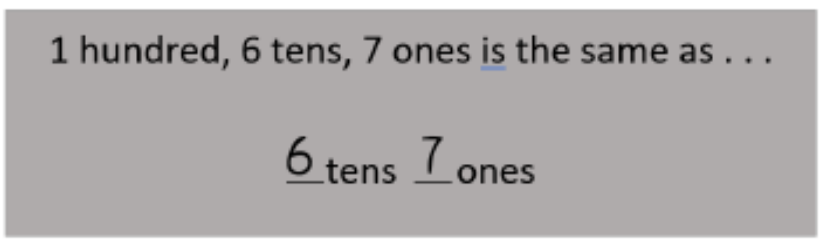




Rename

THINKING MISTAKE

My research found that up to 80% of Year 3 students, 48% of Year 4 students, and 15% of students in Years 5 and 6 display the characteristics of Independent Column Thinkers (Rogers, 2014). These students believe each place value column does not relate to the others. This stems from an over-emphasis on the idea that "this is the hundreds column and hundreds live in there". From this, students fail to understand the multiplicative idea that hundreds are composite units with smaller 'tens' and 'ones' units 'hiding' within them. The figure below shows the typical response of an Independent Column Thinker- they simply ignore the fact that 1 hundred can be renamed as 10 tens.

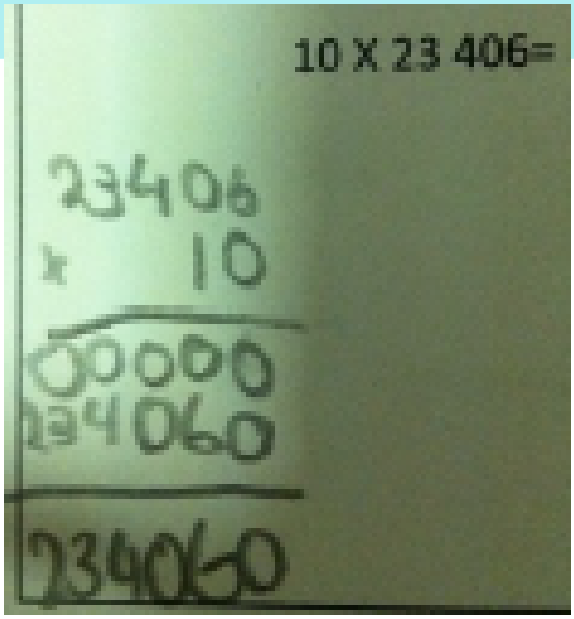


TEACHING TIP

We know renaming is an abstract concept for students, but visualisation can assist students to develop their understanding. To introduce this idea, I use Russian nesting dolls. These dolls help to reinforce the idea that in place value there are smaller units within larger units. I encourage the students to close their eyes. If we are talking about the number 356, I ask them to imagine 3 of the 'hundreds dolls'. I then ask how many smaller 'tens dolls' would be inside each, and ask them to visualise them being 'let out'. There would be 10 tens in each hundred, so 30 tens. This visualisation assists students to appreciate there are units within units and that each column is related to the others.

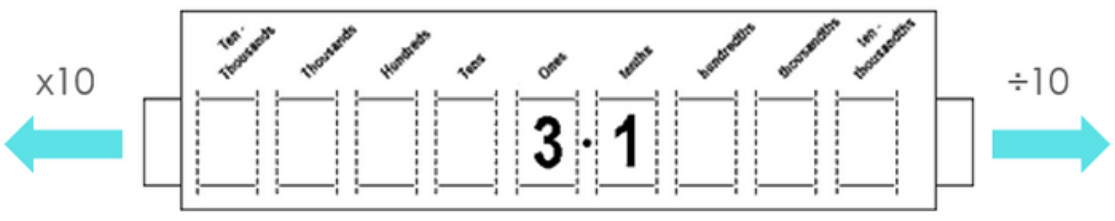
THINKING MISTAKE

Students need scaffolding to see that if we are multiplying or dividing by a place value unit (10,100,1000) we can simply move the digits (the decimal point does NOT move). For example, in the equation below, we want students to recognise it is highly inefficient to use the traditional algorithm.

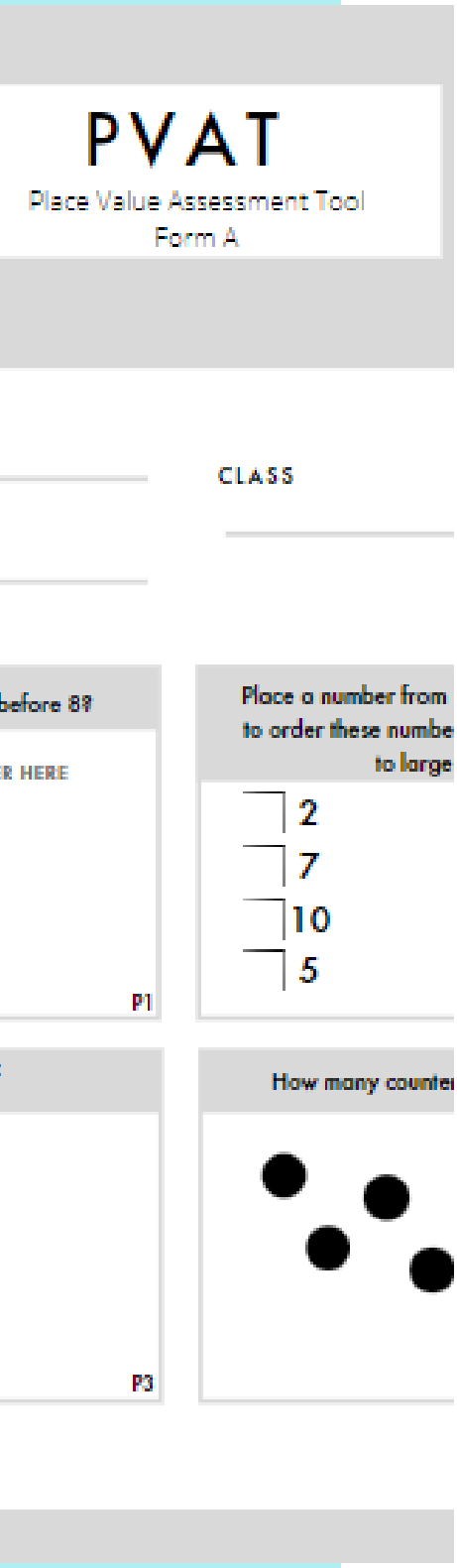


TEACHING TIP

A Number Slide (see below) is a perfect resource to help students visualise the idea that the digits are moving when you multiply or divide.



Reference: https://extranet.education.unimelb.edu.au/SME/TNMY/Decimals/Decimals/teaching/models/numslide.htm



PVAT Form A

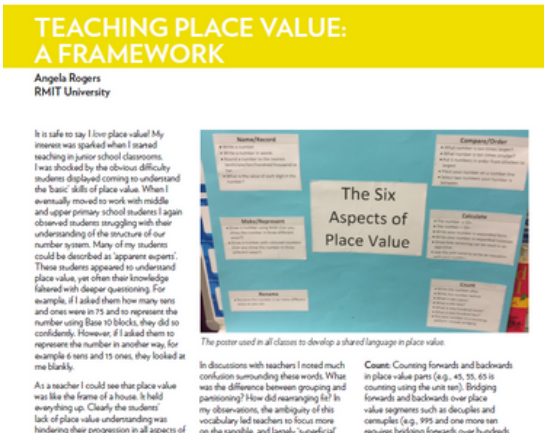
Form A of the PVAT is a paper and pen assessment used to measure student achievement in whole number place value.

- ✓ 4 practice items
- ✓ 58 items
- ✓ Valid and reliable measure of whole number place value in Years 2-6
- ✓ Addresses 6 aspects of place value
- ✓ Equivalent in difficulty to Form B

You can download the PVAT Form A Assessment here

Further Readings

The following are short articles Ange has written for teachers. You can access these on the NTA website: https://www.numeracyteachersacademy.com/DrAnges-FREE-Resources. She also has written many blogs related to place value which you can find on her website.

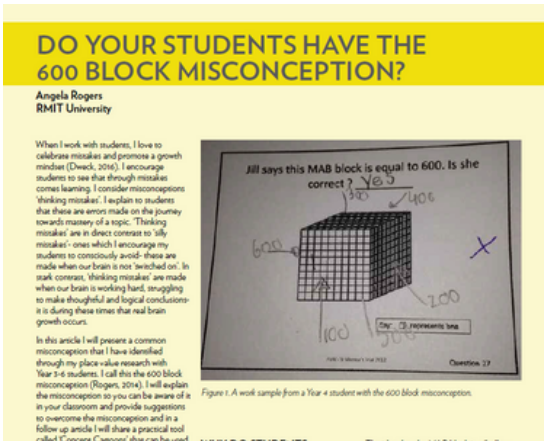

TEACHING PLACE VALUE:
A FRAMEWORK

Angela Rogers
RMIT University

The Six Aspects of Place Value

1 | Teaching Place Value: A framework.

This article details a structure to follow when you are teaching your place value unit. It explores the 6 aspects of place value.

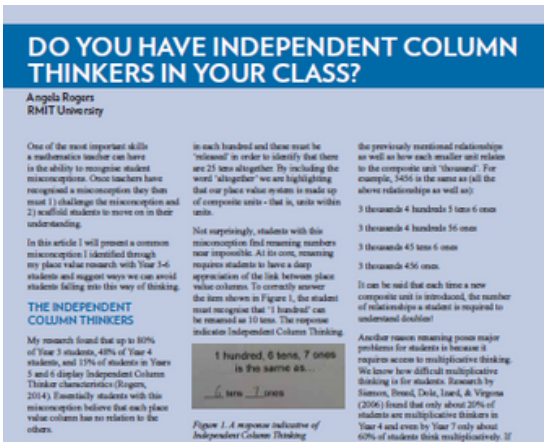

DO YOUR STUDENTS HAVE THE 600 BLOCK MISCONCEPTION?

Angela Rogers
RMIT University

Jill says this MAB block is equal to 600. Is she correct?

2 | Do your students have the 600 block misconception?

This article explores the 600 block misconception. This is a common misconception students have with the Base 10 thousands block.


DO YOU HAVE INDEPENDENT COLUMN THINKERS IN YOUR CLASS?

Angela Rogers
RMIT University

THE INDEPENDENT COLUMN THINKERS

1 hundred, 6 tens, 7 ones is the same as...

3 | Do you have independent column thinkers in your class?

This article explores the independent column misconception. This is a common misconception where students don't appreciate the link between place value columns.

Zero Our Hero

Zero Our Hero is Ange's research-based app designed to support your teaching of whole number place value. It aligns with the Stages of place value development you can determine through the PVAT Form A assessment.

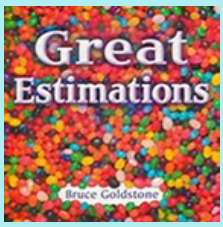
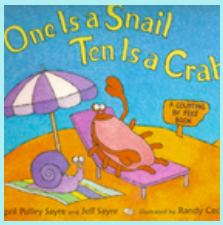
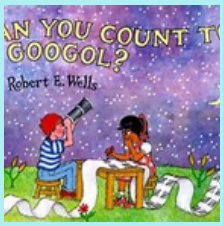
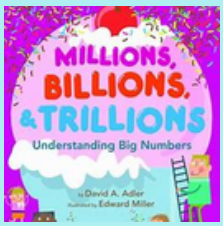
- Suitable for Year 2-6 stduents
- Over 480 items
- Addresses 6 aspects of Place Value
- Items sorted by 4 PVAT Stages
- Growth Mindset messages
- No sound on the app to limit distractions
- Available through the App Store on iPad or iPhone devices

PVAT MINI COURSE

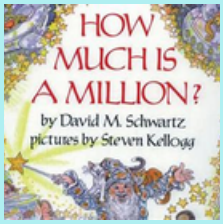
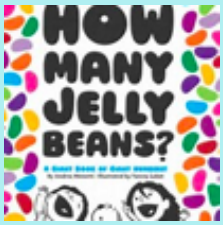
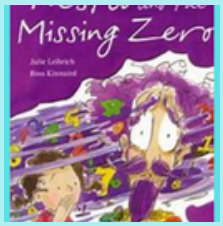
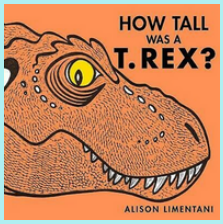
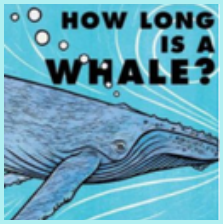
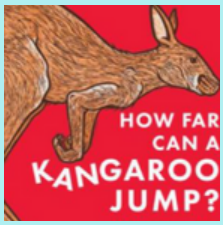
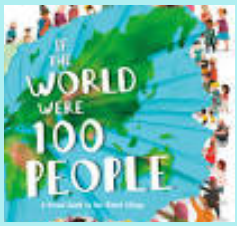
Ange has developed an online mini-course to assist teachers and schools with administering and analysing all the three of the PVAT assessment tools: Form A (pre), Form B (post) and Stage 5 (Decimals).

"Assessing Place Value in Years 3-6" is a 4.5 hour course that is research-based, practical and provides you with unlimited access to the 3 PVAT assessment tools, and the associated spreadsheets, score converters and templates. You can find out more here: https://www.numeracyteachersacademy.com/PVAT_mini_course

Picture Books-Place Value

	Great Estimations	
	How much, how far, How heavy, how long, How tall is 1000?	
	How big is a million?	
	If... a mind bending new way of looking at big ideas and numbers	
	The history of Zero	
	One is a Snail, Ten is a Crab: A Counting by Feet Book	
	Can you count to a Googol?	
	Millions, Billions & Trillions	

Picture Books-Place Value

	How much is a million?	
	How many Jelly Beans	
	Nesta and the Missing Zero	
	How tall was a T-Rex?	
	How long is a whale?	
	How far can a kangaroo jump?	
	If the world were 100 people	
	One lonely Fish	

THANK YOU!

I hope you have found this session personally and professionally valuable!

If you have any questions please reach out.

Ange

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