Learning Difficulties Australia

Learning Difficulties Australia is an association of teachers and other professionals dedicated to assisting students with learning difficulties through effective teaching practices based on scientific research.

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Dr Ange Rogers

B.Ed., M.Ed., PhD
Primary School Classroom Teacher/ Numeracy Leader
EMU Intervention Trained
Lecturer at RMIT University- School of Education
Founder of the Numeracy Teachers Academy
Mum of 4 children

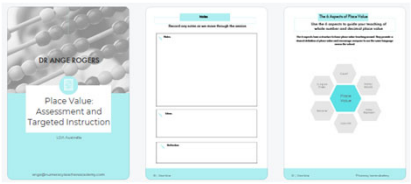
Bio:
Ange is a passionate presenter who regularly facilitates Professional Development for teachers and schools across Australia. In 2014 she completed her PhD in Mathematics Education focusing on the assessment and teaching of whole number place value in Years 3-6. In her PhD she developed the Place Value Assessment Tool (PVAT) and has since created a suite of teaching resources to support this assessment. Ange currently lectures part-time to pre-service teachers at RMIT University in Melbourne and mentors teachers and leaders through her online website the Numeracy Teachers Academy.

DR ANGE ROGERS

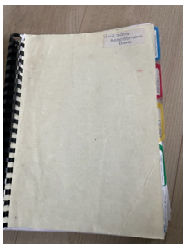
PLACE VALUE: ASSESSMENT AND TARGETED INSTRUCTION

NUMERACY TEACHERS ACADEMY

Workbook

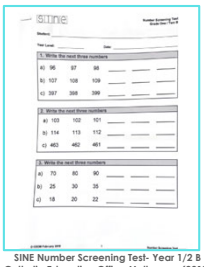


My Assessment 'Story'

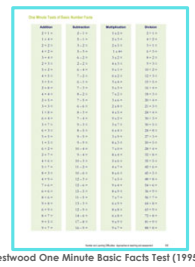


- This was my 'assessment book' in 2005
- Purpose: Compliance

Was I 'assessing' my students? Yes

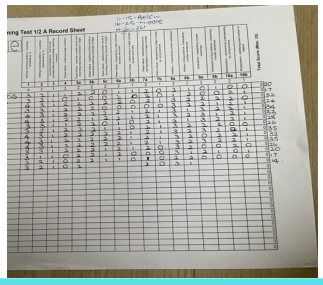


SINE Number Screening Test- Year 1/2 B
Catholic Education Office Melbourne (2010)



Westwood One Minute Basic Facts Test (1995)

Was I collecting data? Yes



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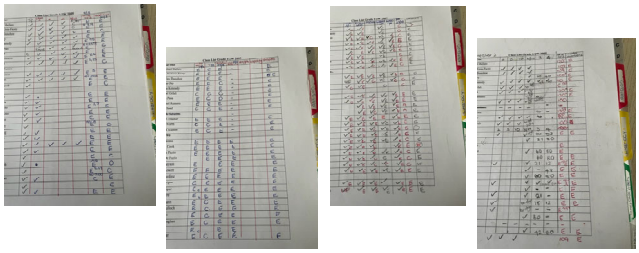
Did it look 'good'? Yes



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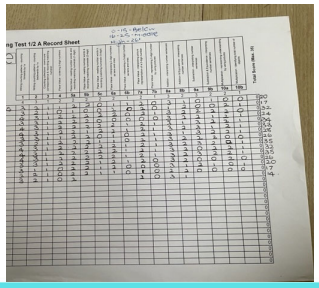
Did it guide my teaching? No!



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Why Not?

I had no idea what the data told me	• Inexperienced • Lack of Pedagogical Content Knowledge (PCK) • Lack of guidance/support
The data I gathered wasn't very useful	• Quality of assessments • Too much data • No clear links to instruction
I was too busy	• Teaching is full on! • Assessment= compliance= wasting time

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Was it worth doing? Probably not!

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Fast forward 5 years…

- Started a PhD
- Needed to investigate a giant novel 'problem'
- Thought back to my classroom days…
- Wanted to 'fix' place value

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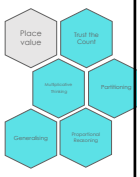
Place value is critical

- Big Idea in Number (Siemon et al, 2012)
- Underpins almost every part of the maths curriculum
- Relates to counting, estimating, money, addition, subtraction, multiplication, division, converting units, scientific notation & percentages.
- negatively impacts: sense of number (McIntosh et al., 1992) decimals (Moloney & Stacey, 1997) multi-digit operations (Fuson, 1990a, 1990b)
- Difficult to assess, teach and learn



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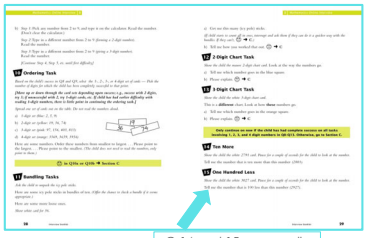
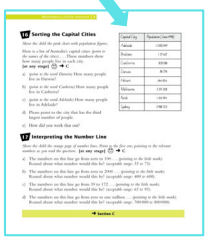
The 'gap'

Stop when incorrect answer?



Some students could answer Q16



Q 14 and 15 were really challenging

Reference: Mathematics Online Interview Victorian Interview Department of Education, 2001

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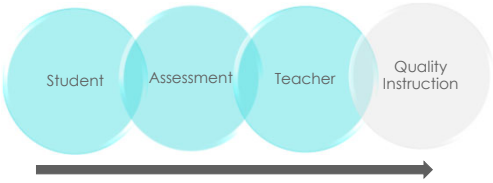
Where did I start?



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We need to know what they know…

- But also… what they don't know yet

This tells us:
- what to teach next
  and
- what is working in our teaching

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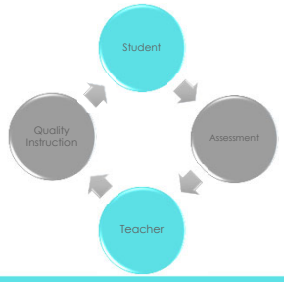
The Teaching Cycle



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Quality Assessment is critical

The most important single factor influencing learning is **what the learner already knows**. Ascertain this and teach him accordingly" (Ausubel, 1968, vi).

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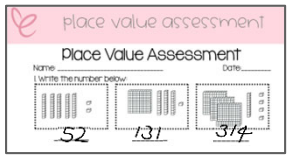
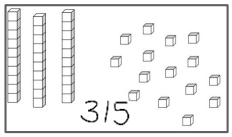
Appear to know more





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Appear to know less

'Noise' getting in the way

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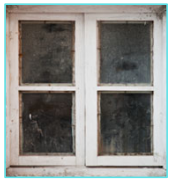
We are not mind-readers!

- Assessment provides a window into our student's thoughts and understandings… BUT



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An assessment can only tell you what you ask of it…

- It is never the 'end point'
- It doesn't determine good/bad
- It doesn't explain the 'why', just presents the 'what'
- Can provide a roadmap for us

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DEVELOPMENT OF THE PVAT

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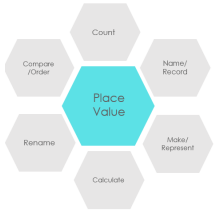
Problem 1: What is Place Value?

- 6 aspects (Rogers, 2014)



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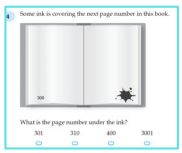
Problem 2: Quality Assessment

- If place value is the 6 aspects- how do we accurately assess?
- Superficial place value items-standardized tests
- Not many Place Value items
- Don't address all six aspects
- Interviews-Junior students only
- time consuming



Reference: NAPLAN Assessment Items- ACARA

Assessment Audit

- Most commonly used assessments in Australian Schools
- Year Level
- Number of PV Items
- Aspects
- Mode

valid assessment of PV?

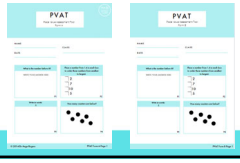
Assessment	Year Level	PV Items	Aspects	Mode
PAT-M (Yr 4) 2012	4	3/38	Name/Record Compare/Order	Paper
NAPLAN 2009	3 5	1/35 1/40	Name/Record Compare/Order	Paper/Online
ENI-PV Section	F-6	25/25	Name/Record Compare/Order Count Make/Represent Calculate	Interview
SINE	4	24/48	Count Compare/Order Name/Record Calculate	Paper

PVAT Blueprint

- **Test Objective-** develop a comprehensive whole number place value assessment tool
- **Test population-** Year 2-8 students (Tier 1,2,3)
- **Test administration-** paper and pen
- **Test evaluation-** Rasch Analysis

Form A and Form B

- Trialed with over 900 students
- Form A downloaded over 8500 times
- Both parallel, valid and reliable measures of whole number place value in Year 3-6 students



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PVAT Resources- 'PVAT+' course

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PVAT Form A

SCAN ME

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WHAT EXACTLY IS PLACE VALUE?

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What is Place Value?

- What words/activities/ideas come to your mind when you think of place value?
- Place value system
- Place value content

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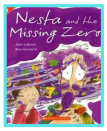
The place value system

- The conventions we use to **say and record** numbers.
- Base 10, only symbols are the **digits** 0,1,2,3,4,5,6,7,8,9
- The current system is derived from the Hindu system it is known as **Hindu-Arabic** system.
- Roman Numerals: MMMCDLVII is 3457!
- **Zero** is critical, a null value, not 'the place holder'.

(Read: 'Nesta and the missing zero')



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Vocabulary

The typical focus of Numeracy lessons

Tier 3 Domain-specific words used only in mathematics
- place value
- numeral
- Base 10

Tier 2 General academic words that change their meaning in a different context
- table
- column

Tier 1 everyday words
- large
- small
- up

Ref: Beck et al (2013) Bringing words to life: Robust Vocabulary Instruction

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Place Value Vocabulary

- **Place Value:**
The place of a digit in the numeral determines its value.

- **Digit:**
0,1,2,3,4,5,6,7,8,9 i.e., The digit 3 is in the tens place

- **Number vs Numeral:**
A number **is an idea**, the numeral is **how we write it**.
A **numeral** stands for a **number in a notation system.**
E.g., 12, twelve or XII are all numerals

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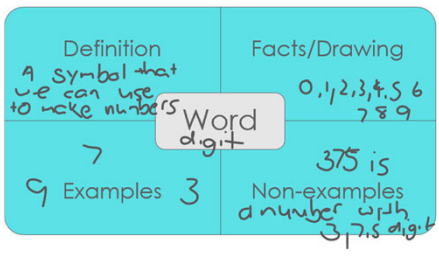
Frayer Model



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To teach place value we need a shared definition of the content…

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Key Ideas in Place Value

1.Base-ten Property: the values of the position increase in powers of ten from right to left
E.g., 333. 3 hundreds is ten times larger than 3 tens.

2.Positional Property: the position of the digit in the numeral determines its quantity.
E.g., 342. 3 is in the hundreds column so its value is 3 hundreds

3.Multiplicative Property: the value of an individual digit is found by multiplying the face value of the digit by the value of its position.
E.g., 342. 3 by 100 is 300

4.Additive Property: the quantity represented by the whole numeral is the sum of the values of the individual digits
E.g., 333= 3hundreds + 3 tens + 3 ones

5.Use of zero: a symbol for zero (0) exists and allows us to symbolically represent the absence of something
E.g., 303. There are no tens in 303

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The Six Aspects of Place Value- p. 2/3

Rogers(2014)

Shared Language

- Name/Record
- Count
- Compare/Order
- Rename
- Calculate
- Make/Represent

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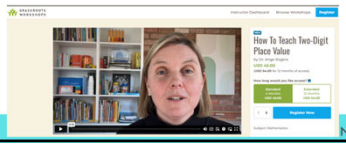
Are they even ready?

- Accurately count a collection to 20 and beyond
- Model, read and write numbers to 10
- Part-Part-Whole for numbers 1-10
- Starting to recognise numbers beyond 10 (1 ten and more)
- Two-digit place value- 6 aspects



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What are Thinking Mistakes?

Misconception: a view or opinion that is incorrect because based on faulty thinking or understanding

Thinking mistakes-errors made on the journey towards mastery of a topic.

- Show our brain is working hard, struggling to make thoughtful and logical conclusions.
- It is during these times that real brain growth occurs.

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Name/Record

- Read and write a number in words and figures

e.g., 75 is written as 'seventy-five'.

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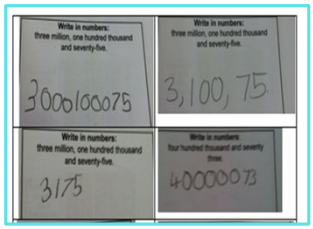
Common Thinking Mistakes

- Adding extra zeros
- Omitting zeros
- Writing what they hear
- Losing track after thousands



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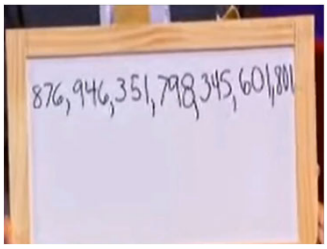
Reading Large Numbers



Reference:https://www.youtube.com/watch?v=wRyc7g5rNB4

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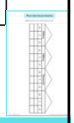
Reading Large Numbers- p.5

Billions			Millions			Thousands					
H	T	O	H	T	O	H	T	O	H	T	O
				4	2	1	2	3	4	7	5
			1	2	5	3	0	7	1	2	2



Reference:www.nzmaths.co.nz

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Investigate our Number System

- Don't be afraid of using big numbers!
- Children LOVE them!
- They show the pattern of our number system
- Let children investigate the names:

Trillion, quadrillion, quintillion, sextillion, septillion, octillion, nonillion

Googol (100 zeros)

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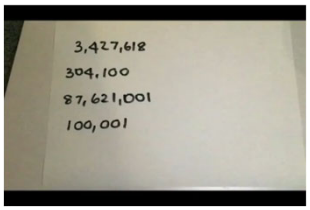
Teaching Tips

- Once students can read a three-digit number they are ready to move them onto larger numbers (think of reading)
- System structure becomes clearer
- Australia follows the international standard of using a space between periods. In many countries in the world a comma actually is a decimal marker.

Reading Numbers video

Resource: Paper cups



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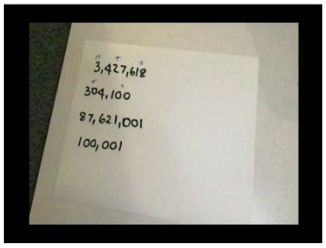
Writing Numbers video



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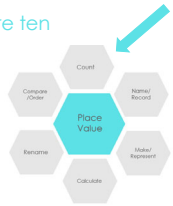
Count

- Bridging forwards and backwards over place value segments

e.g., 995 and one more ten



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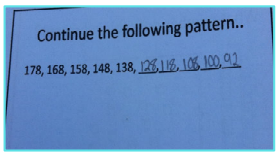
Common Thinking Mistake



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Count and Roll- p.7

- Start 456
- Count by tens
- Target: 716

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Clickview Mini Clips

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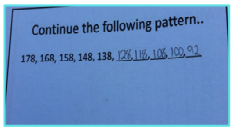
Teaching Tips

- Language: Before/After
- Let them see the pattern
- 1 hundred and…
- Explicitly Model *how* to solve counting patterns

✓F/B, difference #1, difference #2, check, continue

158,148,138,____,____,___



- Renaming Link: 15 tens 8 ones, 14 tens 8 ones, 13 tens 8 ones, 12 tens 8 ones, 11 tens 8 ones, 10 tens 8 ones, 9 tens 8 ones

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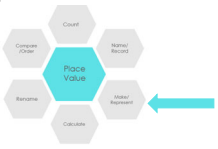
Make/Represent

- Use **proportional, non-proportional** materials to represent quantities.
- Create and recognise **canonical and non-canonical** representations of quantities



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Materials

Proportional Materials

Non-proportional Materials

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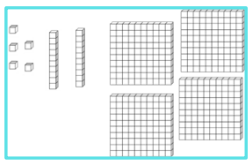
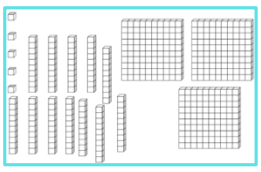
Representations

Canonical



Non- Canonical



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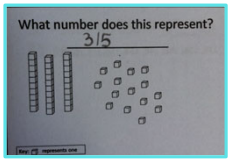
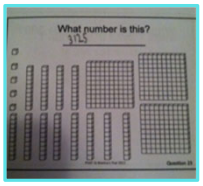
Common Thinking Mistake





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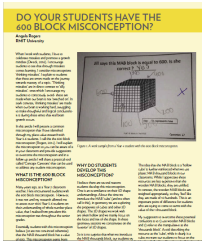
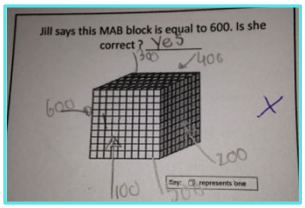
600 Block 'Misconception'


DO YOUR STUDENTS HAVE THE 600 BLOCK MISCONCEPTION?



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Teaching Tips

- Approx. 24% of Year 3-6 students displayed 600 block thinking
- Use a variety of materials, consistently
- Continue throughout Years 3-6!
- Ensure the students are thinking
- Don't assume students understand how place value relates
- Use Wooden MAB
- Use non-canonical representations often!

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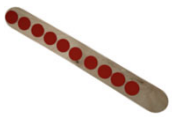



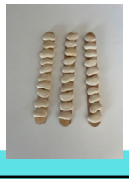


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Compare/Order

- Compare numbers in a **multiplicative manner**,
- E.g., ten times larger than 54 is 540.

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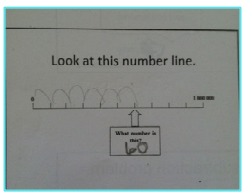
Common Thinking Mistake

- Number Lines
- Don't attend to the first and last number
- Not sure how to calculate the increments.



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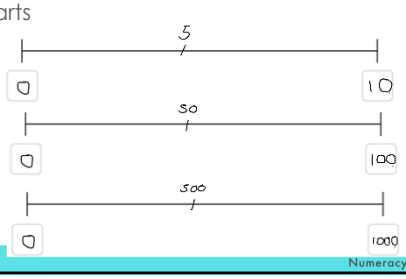
Halving

Think: Halves…

2 **equal** parts



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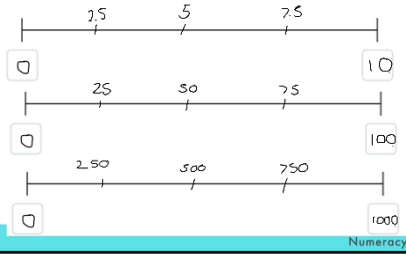
Quarters

Think: Half and half again

4 **equal** parts



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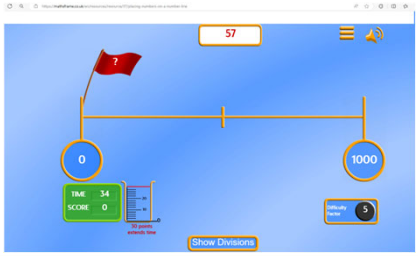
Placing Numbers on a Number Line



mathsframe.co.uk

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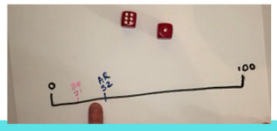
3 in a Row- p.10

0 100



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Rename

- Drawing on the ideas of grouping, regrouping and partitioning, rename numbers in multiple ways in terms of place value parts without the use of manipulatives

e.g., 1260 is equivalent to:
126 tens
12 hundreds and 6 tens
1 thousand and 260 ones

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Standard Renaming

2 digit numbers:
T,O
O

23
2 tens 3 ones
23 ones

3 digit numbers:
H,T,O
H,O
T,O
O

235
2 hundreds, 3 tens, 5 ones
2 hundreds, 35 ones
23 tens, 5 ones
235 ones

4 digit numbers:
Th,H,T,O
Th,T,O
Th,H,O
Th,O
H,T,O
H,O
T,O
O

1235
1 thousand, 2 hundreds, 3 tens, 5 ones
1 thousand, 23 tens, 5 ones
1 thousand, 2 hundreds, 35 ones
1 thousand, 235 ones
12 hundreds, 3 tens, 5 ones
12 hundreds, 35 ones
123 tens, 5 ones
1235 ones

Non-Standard renaming: infinite ways

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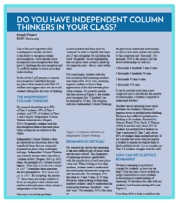
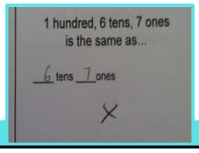
Common Thinking Mistake

- Independent Column Thinkers
- Look at each column separately
- Cannot see a link between columns
- Makes renaming near impossible
- 80% Year 3
- 48% Year 4
- 15% Year 5 & 6





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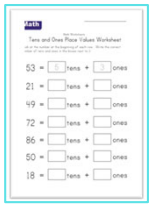
Teaching Tips

- Column Locator
- In 27, which digit is in the tens place?

How many tens are in 84?

35=__tens and __ones

- Canonical representations reinforce
- Be aware of PV worksheets/questions/apps



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Teaching Points

- This is a really difficult concept but the ***most important***!
- Renaming requires multiplicative thinking
- Build up the idea of renaming slowly

- Use visualization to help them see the links between PV columns-
- "In 234 how many tens are there **altogether?"**
- Renaming has important links with the count, calculate, make/represent -make the links explicit!

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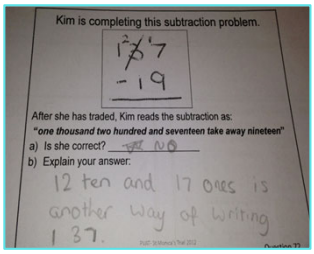
Make the link



- Use the language of renaming
- Avoid "borrowing, carrying"

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Place Value Battles- p.12

1. Everyone renames this number…
2. Reveal your hundreds
3. Reveal your tens
4. Reveal your ones
5. One point for having the highest in each column
6. First to 11 points

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Calculate

- Apply knowledge and understanding of the place value system when completing calculations
- E.g., 45 multiplied by ten is 450,
- 120 divided by ten is 12, which is ten times smaller than 120

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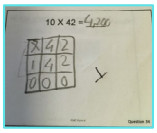
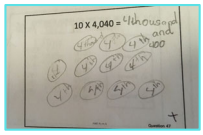
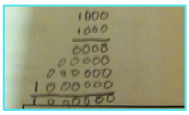
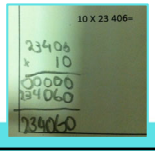
Common Thinking Mistakes









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Teaching Tips

- Use number slide to model
- Digits move NOT decimal point
- Relate x10 to moving up a place value column

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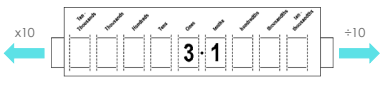
Activity- p.14



Reference: https://extranet.education.unimelb.edu.au/

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99 or Bust-multiply by 10 –p.15,16

99 or Bust

Turn	Number Rolled	Amount to be added	Total
1	3	30	30
2	7	7	37
3	6	6	43
4	2	20	63
5	3	30	93
6	5	5	98
7	7	7	105
Final Total			105

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Target your PV teaching

- Use 6 aspects to guide your planning

Week	Focus
1	Name/Record
2	Count
3	Make/ Represent
4	Rename
5	Compare/Order
6	Calculate

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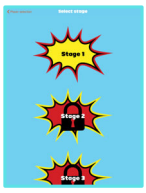
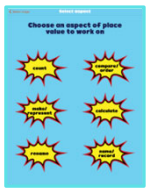
'Zero Our Hero' App

- Designed for: Years 2-6
- Silent





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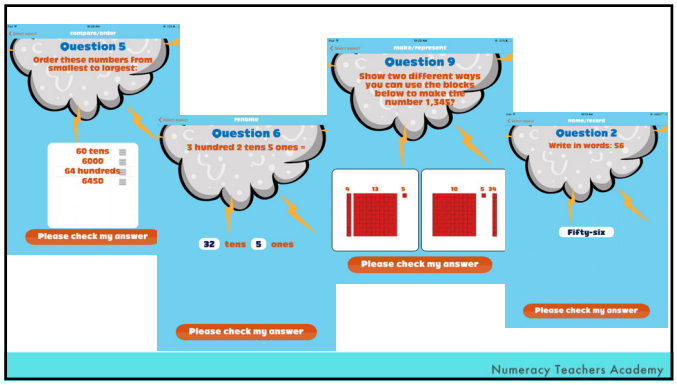

Growth Mindset Messages

No Sound

Review

- What is Place Value?- content/structure
- Thinking mistakes vs misconceptions
- 6 aspects of PV- thinking mistakes, teaching tips
- Be discerning: worksheets/apps/tasks/assessments
- Teach systematically- use the aspects as a structure

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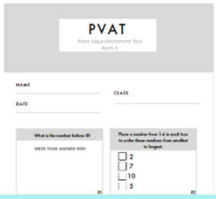
ADMINISTERING THE PVAT



NUMERACY TEACHERS ACADEMY

The Six Aspects of Place Value

Rogers(2014)

Shared Language

- Name/Record
- Count
- Compare/Order
- Rename
- Calculate
- Make/Represent

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PVAT

Name/Record	Count	Make/Represent
Write in numbers: three million, one hundred thousand and seventy-five. 35	What number is ten more than 3,791? 25	How many of each coloured counter will be needed to represent 1,215? 33
Rename	**Compare/Order**	**Calculate**
1 hundred, 6 tens, 7 ones is the same as... _____tens_____ones 32	Look at this number line. What number is this? 48	10 X 4,040= 47

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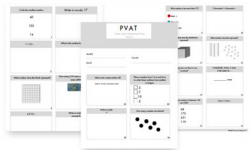
Form A

- Year 2-6 students (pre-PVAT F-2)
- Items are presented in increasing difficulty
- 4 Practice items- go through these together
- 58 items
- Complete as many items as you can
- 60 minutes to complete
- Average 32 minutes to complete
- Range: 15-57 mins
- Teacher can read items



my

When to administer?

- Purpose- guide teaching/ track cohorts?
- End of previous year (December/May)
- Students take paper to next teacher (transition)
- Marked by new teacher
- Ready to go at start of new school year
- Data will be mostly accurate (learning loss)
- Start of year/mid year

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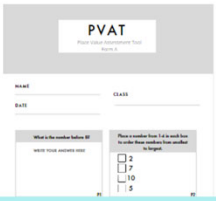
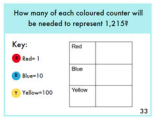
MARKING THE PVAT



NUMERACY TEACHERS ACADEMY

Marking Guide- p.20

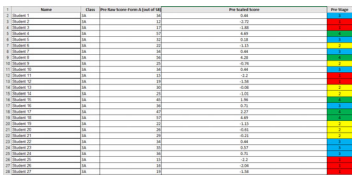
- Reliability in scoring
- Some have multiple acceptable responses
- Approx. 5-7 mins per student



Raw Score Translator- p.19

PVAT Stage	Form A Raw Score (not including Practice items)
1	1 to 20
2	21 to 31
3	32 to 44
4	45+

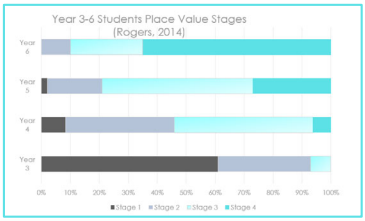
PVAT Stages



PVAT Stage	Colour
1	Red
2	Yellow
3	Blue
4	Green

PVAT Stage Data

- These data show the break-down of student achievement by stage.
- Ranges from 1-4



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Recommendations- p. 23

- If students are at the following stages they are considered 'at risk' or ready for 'enrichment' in place value

Year Level	PVAT 'at risk' Stage	Enrichment
2	Further Assessment	3,4,5
3	Low Stage 1	3,4,5
4	1	4,5
5	1,2	5
6	1,2,3	

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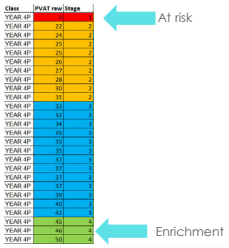
Stages Analysis-Class

- Sort by Stage
- Identify those 'at risk'
- Identify those who need enrichment
- What will you do with these students?

Year Level	PVAT 'at risk' Stage	Enrichment
3	Low Stage 1	3,4,5
4	1	4,5
5	1,2	5
6	1,2,3	



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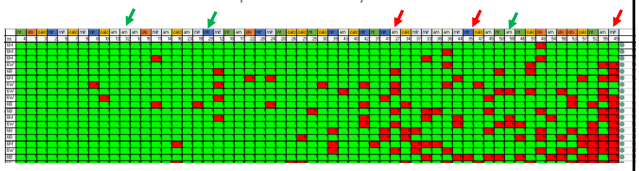
Item Analysis

- Guttman Chart
- Should be in order from 1-58 (difficulty)
- Which results are unexpected? Why? Look at the items



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What the PVAT allows

1. Item analysis
2. Value Added- Effect Size Improvement
3. Clarity around what students need
4. Clarity around what to teach
5. Guide to targeted teaching
6. Data driven decisions
7. Whole School Approach

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Structure your PV teaching

- Use 6 aspects to target student needs

Week	Focus
1	Name/Record
2	Count
3	Make/ Represent
4	Rename
5	Compare/Order
6	Calculate

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Your one take away?

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