Nau mai haere mai

Hui 4 – Rich inquiry

THE LEARNER FIRST™

Self-Understanding | Connection | Knowledge | Competency

A key challenge for us all

A major challenge facing teachers at all levels of education is the ability to address the diverse needs of individual students in the mathematics classroom.

A **task** that is cognitively challenging for one ākonga might be routine for another. However, research tells us that task design alone does not guarantee all ākonga will achieve their learning potential.

Classroom **norms** that respect differences and encourage individual autonomy are integral to classrooms where differentiated instruction is practiced and are reflective of ākonga-centered teaching approaches.

Complex Instruction- an aim of mathematical inquiry

Cohen & Lotan (1994, 2014)

1. Multiple ability – journeying through the big ideas and learning what it means to be smart
2. Instructional strategy – interdependence of groups, class norms, roles
3. Status and accountability – expectations, assigning competence

Two practices for addressing status issues

When teachers focus on strengths, they position young people as competent learners **(Cohen, 1994).** In the process, they support students to create positive math identities **(Jilk, 2014)**, and help them value their peers as intellectual resources **(Boaler, 2008; Cohen 1994)**

First and foremost, the key to managing status and affecting students' assumptions about who is smart and who is not is by creating a "mixed set of expectations' for competence **(Cohen & Loten, 2014)**

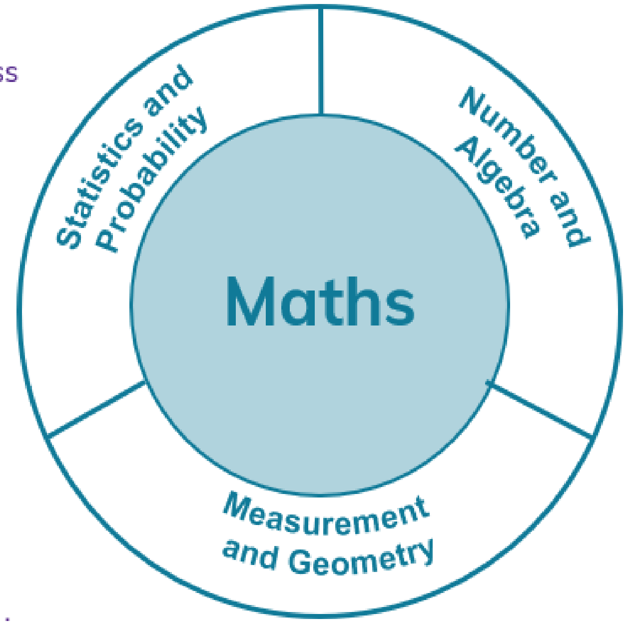
188

Supporting Teacher Noticing of Students' Mathematical Strengths*

Strengths lie in the proficiencies

Procedural Fluency

- **Calculate** with precision
- **Estimate** with reasonableness
- **Recall** definitions/facts
- **Use** appropriate methods & measures



Reasoning takes time and

- is not merely repeating another's arguement
- is more likely when ākonga develop a strategy, connection or justification themselves
- only happens when ākonga are working on tasks that they do not know how to solve

Conceptual Understanding

- **Recognise** representations
- **Describe** & **express** ideas
- **Connect** related concepts
- **Predict** outcomes, relationships

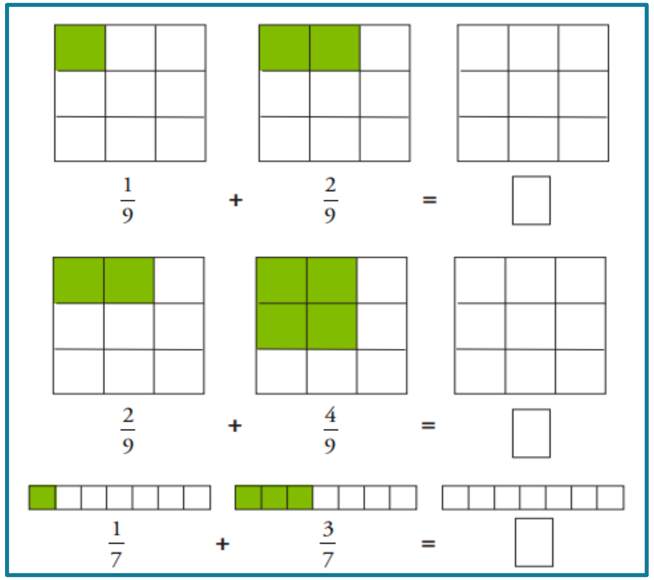
Problem Solving

- **Find** & use a model
- **Solve & pose** 'real' problems
- **Evaluate & adapt** strategies
- **Justify** reasonableness

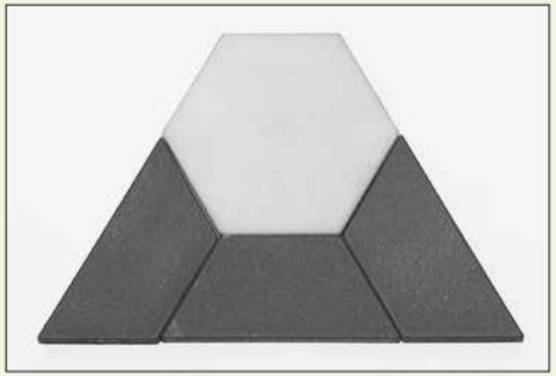
Productive Disposition

- **See** mathematics as worthwhile
- **Identify** meaning in their world
- **Believe** in one's own efficacy
- **Participate** effectively in groups

Checking ākonga demonstrate all proficiencies



Procedural Fluency



The shape made out of Pattern Blocks is worth 1. Using either the hexagon or the trapeziums, or both, what different fractions of the whole shape can you make? Draw and label your fractions.

Problem Solving

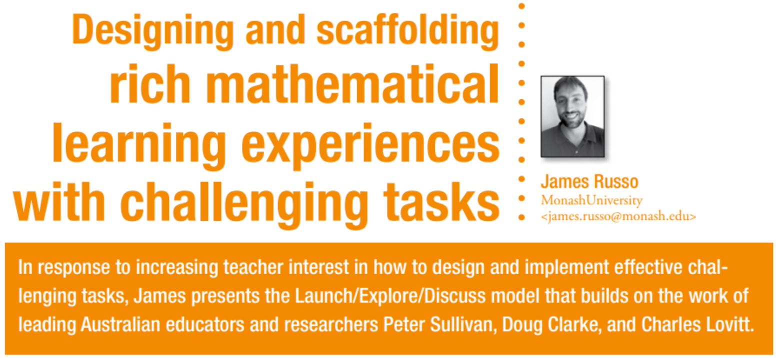
Adaptive Reasoning

Conceptual Understanding

Procedural Fluency

A brief delve into the task

Enabling and extending prompts are a tool to support differentiated learning experiences whilst allowing all students to learn mathematics through problem solving.
(Sullivan, Mousley, & Jorgensen, 2009).


Designing and scaffolding rich mathematical learning experiences with challenging tasks

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In response to increasing teacher interest in how to design and implement effective challenging tasks, James presents the Launch/Explore/Discuss model that builds on the work of leading Australian educators and researchers Peter Sullivan, Doug Clarke, and Charles Lovitt.

Enabling prompts –
to engage students who are not progressing on the original task, eg:

- a reduction in the number of steps,
- less complex numbers, or
- a variation in the representation involved in the task.
- Ākonga access them of their own choosing.

Importantly, these prompts do not tell ākonga how to proceed and are designed to re-engage them in the original task.

Ākonga need time to grapple first in that 'Zone of Confusion'

A brief delve into the task

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(Sullivan, Mousley, & Jorgensen, 2009).

Designing and scaffolding rich mathematical learning experiences with challenging tasks

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Extending prompts –
to engage students who find the original task easy and are intended to elicit abstraction and generalisation of solutions.

It exposes these students to an additional task that is more challenging using similar mathematical reasoning

An example

The total cost of a pair of jeans and a t-shirt is $77.
You know that the jeans were at least double the price of the t-shirt.
What could the cost of the jeans be?

Sullivan, 2016

A possible enabling prompt:

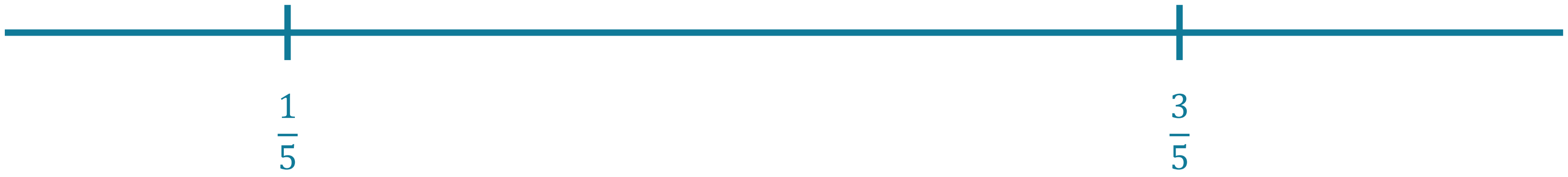
The total cost is $77. How much might the the jeans be?

A possible extending prompt:

What might the maximum mcost of the sandals be?
How can you be sure?

An example

What are some different fractions between $\frac{1}{5}$ and $\frac{3}{5}$



A possible enabling prompt:

Ākonga can give 3 or 4 fractions between $\frac{1}{4}$ and $\frac{3}{4}$

A possible extending prompt:

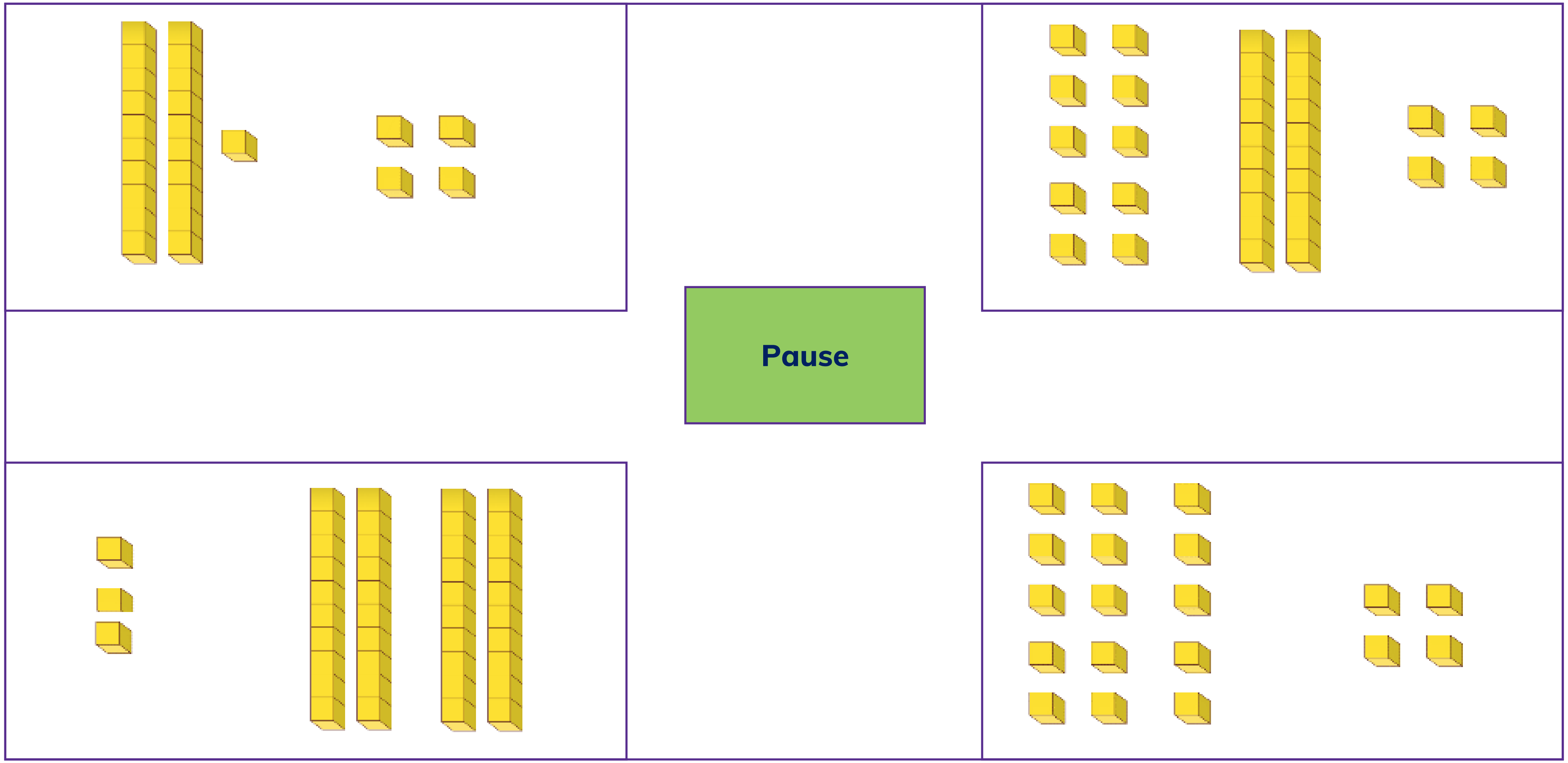
What fraction is half way between $\frac{3}{7}$ and $\frac{6}{7}$

Using big ideas and elaborations to help us design

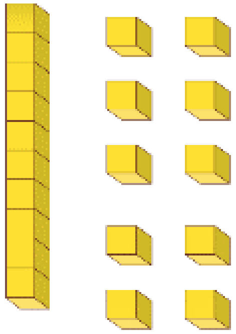
	Number knowledge – key ideas	Number Knowledge – elaborations
Level 1	**Objects in a set can be counted.** Students identify "how many' in sets of objects. They must produce word sequence accurately. One to-one matching- one word assigned to one object. Once counting by ones they can learn to skip count **e.g., 2s, 5s, 10s**	**NA1-3** Learn visual and symbolic patterns for numbers to ten so they can be recognised without counting. Names for ten (**6 + 4 therefore 10 – 4)** Doubles to at least ten (**3 + 3, 4 + 4)** Groupings with ten (**10 + 6, 8 + 10 teen numbers)**
Level 2	**Our number system is based on groupings of the number ten.** We have ten-digit symbols, 0-9, and their value is defined by their position. Digits in any column are worth ten times as much as those to the right. Students develop an understanding of place value. "Houses' can be used to show columns e.g., **7 in tens** represents **7 tens** or **70 ones.** Whereas a **7** in the **ones** represents **7 ones**	**NA2-4** Develop an **additive view** of whole number place value e.g., **456 is 4 hundred, 5 tens and 6 ones** Understand the **nested view** of place value eg (**456 has 45 tens and 456 ones)** Expose to **456 + 70 = [], or 456 – {] = 396 to promote nesting in calculations**
Level 3	**Numbers can be represented in a variety of ways incl fractions, decimals and percentages for representing small numbers.** Decimals extend the PV system. Decimal point separates the integer part of the number from the decimal part. (PV houses) Each column to the right of point is worth ten times less (a tenth of). Decimals can be referred to as decimal fractions Percentages thought of as fractions (out of 100 parts) Percent another name for hundredths.	**NA3-3** Know fwd/bwd counting patterns e.g., **1 000 000, 999 999, 999 998,** beginning with any whole number Know multiples of one, ten, hundred, thousand **1250, 2250, 3250, ??** Know **701 000** results in **691 000 if 10 000** is taken from it. **43 560** is **43 559** if one is taken. Know sequences in tenths **e.g., 4.7, 4.8, 4.9, 5….** **NA3-4** Have multiplicative view of whole number pv. In 239 456 the 3 means 3 groups of 10 000 Understanding the **Base 10** scaling view- **10 of these is 1 of those**- as digits move right or left Understands the **nested view** e.g., **239 456 has 23 ten thousand, 2394 hundreds, and 23 945 tens.**
Level 4	**Rational numbers can be represented and operated on in a variety of ways to solve problems.** All represented by number lines, tens frames, arrays exponents **e.g., 9^4 = 9 x 9 x 9 x 9 = 6561** expanded form **e.g., 8753 = 8000 + 700 + 50 + 3** Standard form **e.g., 8753 = 8 x 10^3 + 7 x 10^2 + 5 x 10^1 + 3 x 10^0**	**NA4-2** Express decimals as fractions and vice versa e.g., **2.47 = 2 + 4 tenths + 4 hundredths or 247 hundredths.**

Eliciting what ākonga bring with them

Which one of these shows **34?**



A rich task to explore concepts



1. Choose any 2-digit number
2. Create an example and non-example of it
3. Think of a way to make the wrong answer look right
4. Can you trick another group, another teacher?

How many ways are there to represent a 2-digit number with place value?

Try with a 3 digit or 4 digit number

If the  is worth 100, what numbers can you make now?

Open Ended idea

1. Roll the dice three times eg 5 7 0
2. Create and write 3 different numbers in digits.
3. Place these in asceding order on a number line.
4. Choose one of your numbers and model it
5. How many ways can you regroup it?
6. Find a friend and compare your numbers:
   - what is similar? what is different?
   - what is the sum? what is the difference?
   - show where they are on a number line?
   - what PV strategies helped you calculate?

A key challenge for us all

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Classroom **norms** that respect differences and encourage individual autonomy are integral to classrooms where differentiated instruction is practiced and are reflective of ākonga-centered teaching approaches.

Process and Norms

An instructional model to support planning and teaching student centred structured inquiry lessons

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Anticipate

The first and arguably the most critical element which is enacted prior to lessons as part of planning:

• *Identify the specific mathematical knowledge to be targeted, and articulating the learning goals and strategies for prompting students to learn the targeted knowledge; • Choose tasks based on the learning goals, the curriculum, and prior knowledge of students;*

• *Select resources, materials, and ways for students to represent their thinking;*

• *Anticipate students' solutions and strategies; and possible misconceptions*

• *Plan enabling and extending prompts.*

Launch

The first phase in the lesson.

• *Lead a preliminary activity related to the content of the lesson or a discussion to familiarise students with the lesson context;*

• *Pose the main task, with students reading the question for themselves where possible, without instructing students on solution path or method; and*

• *Invite questions to clarify language, materials, and representations.*

Learning Objectives to promote all strengths

When teachers focus on strengths, they position young people as competent learners **(Cohen, 1994).**

In the process, they support students to create positive math identities **(Jilk, 2014)**, and help them value their peers as intellectual resources **(Boaler, 2008; Cohen 1994)**

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Strengths lie in the proficiencies

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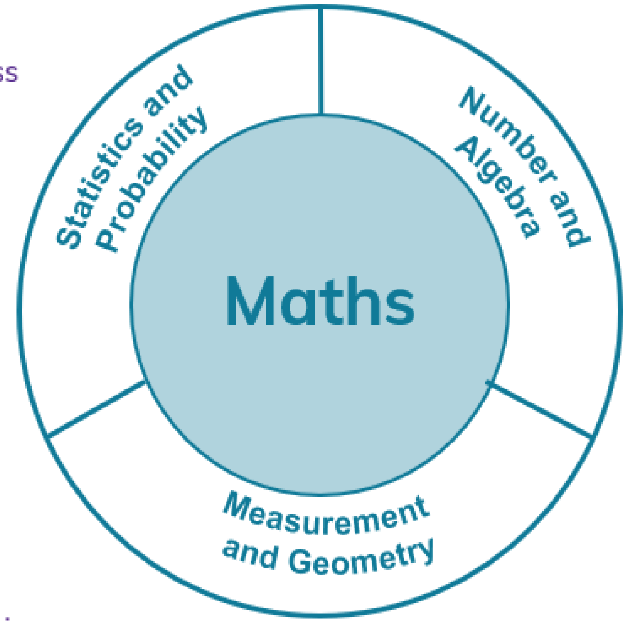
Adaptive Reasoning

- **Deduce & defend** arguments
- **Form** logical conclusions
- **Prove** generalisations
- **Identify and explain** patterns



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Our Competencies

Manaakitanga
- Please respect my culture
- Understand my sense of humour
- Use te reo Māori in class

Whanaungatanga
- Talk to me about my learning
- Listen to me and my peers' views
- Care about what we think
- Share your views with us

Wānanga
- Know my whānau, community
- Know who my friends are
- Make sure we get on well together
- Know me as a person, my identity

Ako
- Know where my learning is
- Expect the best from me and never give up
- Know what works for me
- Enjoy learning from us

Tangata Whenuatanga
- Know how to involve me in learning
- Know what I bring to my learning
- Make learning relevant to me
- Encourage us to explore and discuss

Using symbols and texts
- Communicate with mathematical terminology.
- Applying ICT to calculate, communicate and create
- Interpret mathematical texts, graphics & representations

Relate to others
- Using norms to share and gather learning.
- See maths in new contexts
- Involves school, whānau, global

Managing self
- Explain what they learn, where they are and where they need to go
- Persevere with their learning
- Set & describe their learning goals

Particpate & contribute
- Collaborate and listen to solve problems together
- Sees group work as catalyst to try new ideas
- Understands opportunities to compete and cooperate

Thinking
- Reflect on their own learning
- Critically evaluate evidence and make sense of complex learning
- Explore alternative strategies and create new learning and ideas

Explore

There are two key actions for kaiako: interact to stimulate ākonga thinking and persistence; the other is preparing for next lesson phase. Kaiako are advised to:

- *Allow individual think time after which students might work collaboratively;*
- *Interact with students, observe and monitor how they are responding;*
- *Offer enabling prompts to students who are stuck and extending prompts to students who have finished;*
- *Select student work samples for subsequent sharing and discussion; and*
- *Intervene after about 10 min if many students are not progressing, encourage sharing of partial solutions and/or discuss misconceptions that have arisen.*

Ways to value, support and praise all strengths

Group work

Multiple Pathways

Multiple entry points

Roles within a group Facilitator, captain, recorder, reporter

Quality interaction discussing and debating [maths] ideas

Teacher as facilitator prompting, role modelling, praising

Use of home language awareness helps facilitate learning

Multi representational Promotes proficiencies, competencies, skills

Creating Equitable Practices – Jorgensen, Grootenboer, Boaler, Niesche, 2008)

Praise and publicise
Class pause- I would like to share with you a great example of ----------

Call on Roles
Please could I call up all the captains to share-------

Maintining "us" culture

Norms- 'messy maths'
A visual record for all membes
Place in middle to access ideas
Talk moves to maintain focus
Ensure matching to motivate reasoning
All voices heard to share strengths

THE LEARNER FIRST

Summarise/Review

Two interrelated and simultaneous aspects. The elements are:

• *Sequence the selected work samples;*

• *Support students in articulating solutions and strategies by revoicing when necessary; and*

• *Pose questions to stimulate student thinking, connect mathematical ideas and build understandings.*

Kaiako, at this phase, lead discussion of ākonga solutions, engage other ākonga, and build connections between solutions and discussions

The review involves a shift in the focus of authority from ākonga to the teacher. We encourage teachers to:

• *Synthesise, emphasise and record key mathematics points building on student contributions.*

The article looks at more traditional methods

Active Mathematics Teaching

This could be summarised as:

- Teacher poses some questions to check student facility with pre-requisite skills.
- Teacher explains goals and solution methods, including ways of setting out responses.
- Teacher poses further exercises and asks students to work out the answers. Some students explain what they have done.
- Further questions are posed in sets of similar demand on students.
- Students' responses to set exercises are corrected, and some further examples are posed to check both their accuracy and capacity to explain the process they used.

While there are aspects of mathematics for which such approaches are suitable, there are risks that teaching only that way can make ākonga dependent on the kaiako, as opposed to think for themselves.

A snippet from one research study

Year 8 - 9

A container and 3 eggs weighs 170 grams.
The same container and 5 eggs weighs 270 grams. What is the weight of the container?

7g 50g 30g 20g

Year 5 - 6

You need a travel card before you can travel in Melbourne. It costs $4 to buy a travel card and you need to put extra cash on the card to travel. If each journey costs $2.50, what is the total cost of 6 journeys?

$15 $6.50 $19 $10

Students were asked to choose

a) one of three options to indicate the degree of task difficulty that they preferred; and
b) one of three options to indicate their ways of working.

STUDENTS' WILLINGNESS TO ENGAGE WITH MATHEMATICAL CHALLENGES: IMPLICATIONS FOR CLASSROOM PEDAGOGIES

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Data for us to discuss from Sullivan et al study

Year 8 - 9

	I prefer much **harder.**	I prefer about **as hard.**	I prefer **much easier.**	
I prefer working by **myself**	37	48	5	**31%**
I prefer working with **other students**	15	89	21	**43%**
I prefer listening to explanations from **the teacher** before I work on the question	4	47	17	**26%**
Total %	**25%**	**63%**	**12%**	293

Year 5 - 6

	I prefer much **harder.**	I prefer about **as hard.**	I prefer **much easier.**	
I prefer working by **myself**	329	123	15	**64%**
I prefer working with **other students**	60	114	24	**26%**
I prefer listening to explanations from **the teacher** before I work on the question	28	45	20	**10%**
Total %	**55%**	**37%**	**5%**	758

Data for us to discuss from Sullivan et al study

Taken on face value this suggests that,

- far from being reticent to engage with challenging tasks, many ākonga welcome the opportunity.
- most ākonga want to work on a problem before having solution pathway explained.
- Some ākonga want opportunities to work individually on tasks alongside group

We, as teachers need to find ways to respond to the individual needs of ākonga when facilitating challenging tasks

Summing up

Extenders and enablers

- Interact with the elaborations and big ideas

Curriculum elaborations | NZ Maths

The best tasks have aspects of challenge for all learners and they

- provide appropriate contexts and complexity;
- stimulate cognitive networks, thinking, creativity, and reflection;
- provoke insights into the structure of maths and the strategies/methods for solving problems,
- address significant mathematical topics explicitly.

(Anthony and Walshaw, 2009)

Sharing ideas

[TLF Maths - Ideas and Insights | Facebook]

Rich Task Full workshop (2 hrs 15 mins)

https://us06web.zoom.us/rec/share/egQDR9LEXNvtd9pT6eZan4KVWWCdYzciuZYKcneH9sXDyu4LXHfaX0h3Xd1K46Dp.DBpMdxpr5-TJeC9q?startTime=1628715964000

Assessment Zui (50 mins)

https://us06web.zoom.us/rec/play/vxkGegU72w3k3HaN5TRNORoD72kdlGgfjs7QorLf2aM90i-aAiFyaQAJEq98pynV7rBOVWrFNTuxnhJJ.j1Jya3w6f-42LN_K

Planning & Rapid routines Zui   (20 mins)

https://us06web.zoom.us/rec/play/0mUN1Fe6f9UOGyyK0lnkL8sgmr04cDq6MzzbevTm5D08zBEqQNKBsNY7lWM_a8plip9HrsXknmRHGxA.c9F28k3U0-bpGszE

Some ideas we could have a chat about☺

What resources are working for you that you would like to recommend?

What are your immediate concerns/issues with engaging mixed ability learning?

Is your school trying any new ideas out? The good, the bad, the ugly!

What professional development has helped you with this?

What could professional development do better to help with this?