Presentation:
Literacy in Mathematics Years 9-13

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"It's important to learn math because someday you might accidentally buy a phone without a calculator."

Ko tōku reo
Tōku rangatiratanga

Learning Intentions

Develop understanding of:
1. Literacy in Maths
2. Vocabulary instruction
3. Preparing your students to read
4. Preparing your students to write

Programme

9am   Introductions
                 Why is literacy important?
                 Developing students' vocab knowledge

10.30am   Morning tea

10.50am   Developing students' reading skills

12.45–1.15pm   Lunch

1.15-3pm   Developing students' writing skills

3.15pm   Questionnaire and exit

Why is literacy important?

" All teachers are teachers of literacy because all students learn through language. Language is fundamental to thinking and learning. Language is the primary means by which we gather and communicate information."

Effective Literacy Strategies p7

Literacy in Secondary School

- "Secondary school presents learners with many literacy challenges. In every subject area students need to read and write increasingly sophisticated texts as they progress through secondary school."

- "Literacy teaching is just as important for academic success in Year 13 as it is in Year 9."

- "Teachers have a responsibility to find out where each individual student is at in their learning."

Effective Literacy Strategies p7

The Curriculum

For each (learning) area, students need specific help from their teachers as they learn:

- The specialised vocabulary associated with that area;

- How to read and understand its texts; how to communicate knowledge and ideas in appropriate ways;

- How to listen and read critically, assessing the value of what they hear and read.

NZC p16

Year 9 and 10 Baseline Data

To be considered at 'expected level' students should be reading at or above Curriculum Level 4 on entry to high school.

However, the Starpath Year 9+10 Baseline Data Report (Earl Irving) indicates that the following groups were at or below Curriculum Level 3 in AsTTle reading at the beginning of Year 9:

- 28.5% of New Zealand European students (n=6652)
- 56.3% of Māori students (n=8179)
- 70.4% of Pasifika students (n=8201)

Data from the PAT listening comprehension tool also indicates many students' oral listening comprehension is below expectation, with 66.8% of Māori and 91.4% of Pasifika students having scores at Stanine 4 or below.

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What does this mean for Maths teachers?

We must provide our students with language rich environments, where they have access to challenging texts and plenty of opportunities to read, write and talk about these texts.

Shanahan and Shanahan (2008)

FIGURE 1 *The Increasing Specialization of Literacy Development*
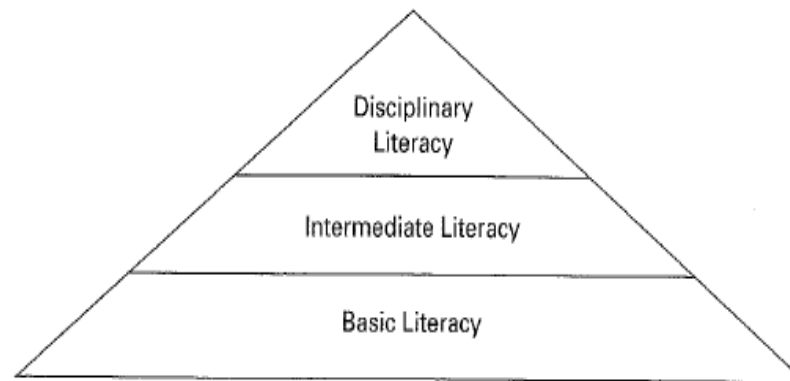
Basic Literacy: Literacy skills such as decoding and knowledge of high-frequency words that underlie virtually all reading tasks.

Intermediate Literacy: Literacy skills common to many tasks, including generic comprehension strategies, common word meanings, and basic fluency.

Disciplinary Literacy: Literacy skills specialized to history, science, mathematics, literature, or other subject matter.

Optimal conditions for literacy learning

- A language-rich environment in which students regularly read, write and discuss challenging texts

- An emphasis on students developing their own literacy strategies in a gradual withdrawal of support model

- Targeted teaching of specific needs identified through inquiry

Vocabulary key concepts

- Comprehension appears to depend on knowing between 90 – 95% of words in a text
- Students need frequent and repeated opportunities to experience and use new vocabulary
- Vocabulary is best learned in context

  Amplify rather than *simplify* vocabulary

Receptive & productive vocabulary

- Receptive = what you *receive* (through reading and listening)

- Productive = what you *produce (through writing and speaking)*

- Both are important and mutually beneficial

- Talking point: *"Students are better at understanding mathematics vocabulary than they are at using it."*

Three types of vocabulary

- Tier 2 vocabulary (high literate general use)
- Specialised subject vocabulary e.g. photosynthesis
- General academic vocabulary

Vocabulary Learning

- Academic verbs
- Vocab jumble
- Maths meanings/everyday meanings
- Traffic lights activity
- Prepositions
- Morphology
- Word map

Academic Verbs in Maths

Verb	Definition	Answer
Evaluate		
Relate		
Convert		
Calculate		
Compare		

Vocab Jumble

conjectures   prove   of   methods

generalisation   'co-ordinate plane'   **B** (1,4)

joining   reflection   point   reflect

 mirror line   steps   either   discussion

quadrilateral   or   'mathematical statements'

   must   cases   if   (0, 2 ¼)   vertices

   midpoints   (*a, b*)   'irrefutable proof' strategy

   co-ordinate geometry   always

 methods   apply   'extended abstract thinking'

   reasoning   set of points

Traffic Light Activity

Green: all words you are very confident you know the meaning of

Orange: words you have seen before but are a little unsure about their meaning

Red: words that are completely new to you

Maths Meanings/Everyday Meanings

Many of the words commonly used in Maths have different meanings in a non-Mathematical context. Students need to know differences in meanings in order to be able to use their Maths vocab correctly.

See the worksheet for examples. Are there others you can think of?

Prepositions

Prepositions locate nouns, noun groups, and phrases in time, space or circumstance e.g. at, on, onto, before, from, to, in, off, above, below

- The temperature fell *to* 10 degrees
- The temperature fell *by* 10 degrees
- The temperature fell *from* 10 degrees

Morphology

Roots, prefixes and suffixes. Teach word families. How many words can you think of related to:
- Formula
- Accelerate
- Equation
- Parabola

Math Word Map

Definition

Synonyms(s)	Antonym(s)

Math Vocabulary Word

What real world situations would you use this word in?

Draw a picture or visual example

Use it in a sentence

Preparing Your Students to Read

"When students have difficulty reading and understanding subject area texts, they hit a "literacy ceiling" that limits what they can achieve both in the classroom and in their lives outside of school."

Reading For Understanding p5

Preparing Your Students to Read

- Annotating text for vocab
- Road Blocks and Strategies – metacognitive exercise
- Strategies of good readers
- 3 Level Reading Guides
- Word problems

Annotating Text for Vocab

Using the piece of text given to you, identify:

- General academic words
- Maths subject specific words
- Tier 2 vocab

Class set of Roadblocks and Strategies

Road Blocks	Strategies

Metacognitive Conversations
(Braunger et al, 2005)

- Predicting – I predict… In the next part I think… I think this is…

- Picturing – I see… I picture…

- Making connections – This is like… This reminds me of…

- Identifying a problem – I got confused… I'm not sure… I didn't expect…

- Fixing up – I'll need to…, I think I will….

Strategies of Good Readers

Good readers will:

- Re-read
- Read forwards and backwards for comprehension
- Self-correct
- Attack new/unfamiliar vocab
- Read everything on the page
- Visualise as they read
- Re-establish concentration if it is lost
- Use headings, sub-headings, titles, captions, graphics etc
- Ask questions of the text
- Notice/pay attention to words in bold, italics, capitals, underlining
- Skim and scan
- Read at different speeds
- Activate prior knowledge and put this on hold if need be
- Make predictions
- Take breaks
- Make notes/annotations
- Continue reading – persevere – they don't give up

What Makes Text Difficult?

Language: density of unfamiliar, abstract, polysyllabic and technical or highly specialised words.

Sentence Length and complexity: Long sentences are harder to read than short ones. Complex sentence structure also affects difficulty.

Conceptual difficulty: Difficulty of a text depends on how abstract the ideas are and the amount of prior knowledge they require.

Idea density: the density of ideas and the ways in which they are embedded affect text difficulty.

Relevance: How important is this text to the reader? Texts about motivating topics 'feel' less difficult.

Reading for Understanding, p143

The Three Level Reading Guide

Purpose:

Three level thinking guides promote active reading for meaning at different levels and encourage critical reading. The class discussion that takes place after the students have completed the guide is an important part of this strategy.

Effective Literacy Strategies p91

Three Levels of Thinking

A three level thinking guide consists of a series of statements, about a specific text, presented at three levels of thinking:

Level One	knowledge	fact	reading on the lines
Level Two	comprehension	interpretation	reading between the lines
Level Three	application analysis synthesis evaluation	elaboration	reading beyond the lines

Effective Literacy Strategies p94

Some Tips for the Teacher

Select a text with content that is worth studying with close attention, because the guide takes time to prepare and to work through with the class. Begin by writing the higher level three statements and work backwards to levels two and one.

Do not use this strategy as a homework exercise or as a test. The value of the activity lies in the discussion it generates among the students as they give their views and justify what they say by referring back to the text.

Provide plenty of time for the students to work through the guide, because it has the potential to stimulate a lot of lively discussion and debate in the classroom.

Effective Literacy Strategies p92

Three Level Reading Guide
For Students

Level One: Literal Meaning – Reading on the lines - the answers are in the story.

Select the statements which say what the text says.

Level Two: Inference/Reading between the lines - to interpret what the author might mean

Select the statements which you think are true from what the text says. Be prepared to give reasons for your answers.

Level Three: Evaluative – Reading beyond the lines - I will have to think for myself.

Select the statements you think the author would agree with. Be ready to give reasons for your answers.

Features of Mathematical Word Problems

Word problems are "stylized representations of hypothetical experiences- not slices of everyday existence" (Lave, 1992, p. 77).

"One of the most significant problems provided by many of the contexts used in mathematics classrooms occurs when students are required to engage partly as though a context in a task were real whilst simultaneously ignoring facts pertinent to the real life context" (Boaler, 1994, p. 554).

Other Issues

- Meaney and Irwin (2005) found that Year 8 NZ students were far more successful at recognising the need to 'peel away' the story shell of word problems.

- Students' real world concerns sometimes get in the way of their mathematical problem solving, For example, when asked to describe, "How much of the pizza is left? A year 4 student responded, "All the herbs." !

- Lower socio-economic students were more likely to focus on the contextual issues of a problem at the expense of the mathematical focus, (Lubienski, 2000)

Trigonometry

A wallerer is at the top of a vertical clanker. The top of the wallerer is 60m above the ground at the base of the clanker.

Sione walks away from the base of the clanker along horizontal ground until he comes to a jumba. He measures the angle of elevation from the ground to the top of the wallerer as 69 degrees. He then walks in the same direction until the angle of elevation is 40 degrees and stops.
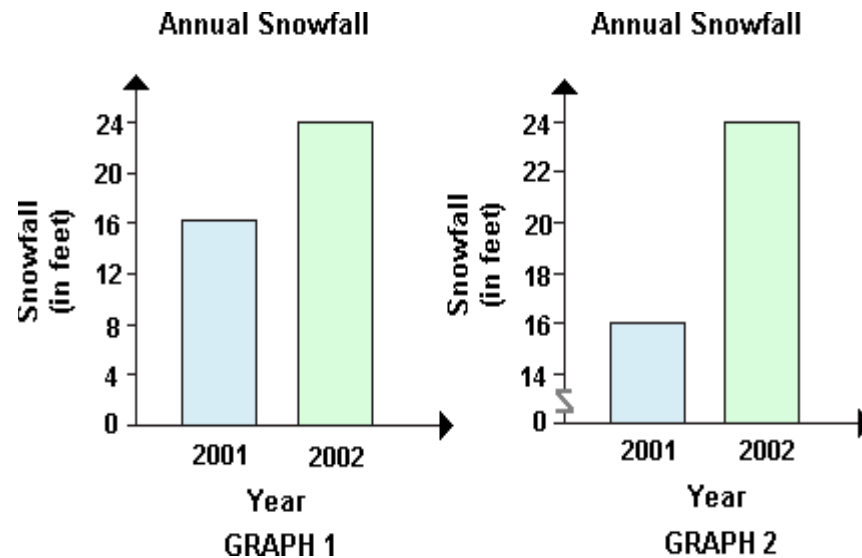
How far from the jumba did Sione walk?

Writing Activities

- In Your Own Words – metacognitive task
- Strategies of good writers
- Sentence combining and deconstructing
- Sentence starters for sophisticated inferences
- Vocab toolbox
- Using visuals for writing

In Your Own Words

Explain, in your own words, which of the two graphs below is misleading, and why.

Strategies of Good Writers

Good writers will:

- Determine their purpose and audience
- Invest time in their writing
- Find, select and use the most appropriate content or ideas
- Use topic statements
- Use suitable vocabulary/subject terminology
- Structure and sequence content appropriately, using headings/sub-headings/captions as necessary
- Use connectives to link ideas
- Present the text, with suitable visual material for the intended audience
- Attend to surface features (spelling, grammar and punctuation)
- Edit – review drafts (edit later and edit lots)
- Proof read the writing and make necessary corrections
- Ask for feedback on their writing
- Share their writing with others

Sentence Combining

Tara's aunt invests $2000 for her when she is born.

The interest rate is 3.5% per year.

This rate does not change as long as the money stays invested.

The interest is added to the amount she has invested on her birthday each year.

The value of the investment after t years can be modelled by the equation

$$A = 2000 \times (1.035)^t$$

where the A is the value of the investment.

Sentence Deconstructing

- Some researchers claimed that the relative risk of a man not being cured is two times as great for a man who uses Moisturising Cream B, compared to a man who uses Medical Cream A.

- The probability that any part Sammi makes on machine A will be faulty is 0.01 and the probability that any part he makes on Machine B will be faulty is 0.005.

- Reflect the point (4,1) in the mirror line joining the points (0, 2 ¼) and (4 ½,) and find the co-ordinates of the reflection.

Sentence Starters for Sophisticated Inferences

- One limitation of the sampling in this study was that...

- The size of the sample was...

- The collection of data could be chosen a different way.

- An assumption of the report was that ...

- The relevance and usefulness of my findings is.....

Vocab Toolbox
For Writing a Report on a Statistical Profile

Tier 2 Vocab	Statistical Vocab

Questions arising from the data profile:

Conclusions:

Writing Based on Visual Texts

1. Choose one of the visuals and create a word bank describing what you see, using appropriate Maths vocab that students might use. Include technical terminology. (As an extension you could include some words that are NOT applicable).

2. Swap your visual with another group. This group will use your word bank, and add to it, writing a few sentences to form a paragraph, explaining what is shown in the graph/table.

3. Higher level thinking task – write suitable word problems that could be used for this visual.

Exit Questionnaire

Please use this link to our questionnaire and provide us with some feedback on today's workshop:

http://goo.gl/forms/10JqSNt6y6

Summary of Strategies

To help you with the questionnaire, here is a summary of strategies we have promoted today:

Vocab:
- Academic verbs
- Vocab jumble
- Traffic lights activity
- Maths meanings/everyday meanings
- Word map

Reading:
- Annotating text for vocab
- Road blocks and strategies
- Three level reading guides
- Final word strategy

Writing:
- In your own words
- Sentence combining/sentence deconstructing
- Vocab toolbox
- Using visuals for writing

Resources

- Reading for Understanding by Ruth Schoenbach, Cynthia Greenleaf and Lynn Murphy
- Effective Literacy Strategies in Years 9-13 Ministry of Education
- I've Got Something to Say by Gail Loane with Sally Muir
- TKI – Literacy Online
- TKI – ESOL Online
- TKI – Literacy Leadership