### CURRICULUM, PEDAGOGY AND BEYOND





# The problem with worded problems is the words!



Years F – 8

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### **Today's session**

This session will explore how 2- step worded problems can be tackled using a 'numberless' approach, where the numbers are removed, and the text adapted to help students focus on the 'essence' of the problem.

We will show how you can use Newman's interviews to triage breakdowns and then implement Numberless word problems to decompose a worded problem into a series of simpler statements designed to progressively reveal the mathematical relationships within the problem.

Removing the numbers enables one to draw students into a conversation by asking questions such as:

- What is going on in the problem?
- What do we know about the quantities and relationships in the problem even though there are no numbers?
- What is the question asking us to find out?

#### Overview

- Introduction
- Newman's interviews
- Example of a numberless word problem
- Applying the approach
- Questions

### Newman's 5-point framework

Newman's error analysis provides a 5-point framework for considering the reasons that students experience difficulties with mathematical word problems and outlines a process that can assist teachers with identifying where misunderstandings are occurring.

- 1. Reading and decoding the words and symbols in the problem
- 2. Comprehending what is read, making sense of it
- 3. **Transforming** the words to select a suitable mathematical strategy
- 4. **Processing** the mathematics correctly
- 5. Encoding the answer in the context of the problem

The framework arose from research into language issues in maths in the 1970s.

#### Why are 2-step worded problems challenging?

In your experience, what is it about 2-step worded problems that makes them challenging for many students?





Image source: ChatGPT4

### Newman's 5-point framework

Newman's error analysis provides a 5-point framework for considering the

1. Reading and decoding	40-80% of the time
2. Comprehending	the first error occurs
3. Transforming	(% varies across studies)
4. Processing	Intervention often targets this stage
5. Encoding	

Source: The Newman Procedure for Analysing Errors on Written Mathematical Tasks (1996)

### Identifying the sticking point

**74** Student Count

21.05 Average Duration (Mins)

**36** Max Possible Score 73 Student Count 21.59 Average Duration (Mins)

**38** Max Possible Score

#### NSW Check in assessments

62 Student Count

24.72 Average Duration (Mins)

40 Max Possible Score 67 Student Count

28.03 Average Duration (Mins)

40 Max Possible Score Years 3 - 6

#### **Data tracking**



Newman's Prompts

Where are our students at?

Data collection Term 3, weeks 1 & 2

Can read question	Can restate what is being looked for	Can identify maths process/es to be undertaken	Calculation errors	Correctly carries out processes	Answer makes sense to question
YES	YES	YES (prompted)	NO	NO	NO
YES	YES	YES	YES	YES	YES
YES	YES	YES	YES (prompted)	YES (incorrect answer)	YES
YES	YES	YES	YES	YES	YES
YES	YES	YES	YES (prompted)	NO	NO
YES	YES	YES	NO	NO	NO
YES	YES	struggled to articulate	NO (used calculator)	NO	YES
YES	YES	NO	NO	NO	NO
YES	YES	YES	YES	YES	YES
YES	YES	struggled to articulate	NO	NO	NO
YES	YES	NO	NO	NO	NO
YES	YES	YES	NO	NO	YES
YES	YES	YES (prompted)	NO	NO	NO
YES	YES	YES	YES (used calculator)	YES	YES
YES	YES	NO	NO	NO	NO
YES	YES	YES	YES	YES	YES
YES	YES	YES	NO (used calculator)	NO	NO
YES	YES	YES	YES	YES (incorrect answer)	YES
YES	NO	NO	NO	NO	NO
YES	YES	struggled to articulate	NO	NO	YES
YES	YES	YES	NO	NO	NO
YES	YES	YES	YES	YES	YES
YES	YES	NO	NO	NO	NO
YES	YES	NO	NO (used calculator)	NO (prompting)	YES
Absent					
Absent					

Absent Absent Contract Contrac

### Why one on one interviews?

Pros

Identify:

- Areas of strength and weakness
- Misconceptions
- Sophistication of strategy use

and

- Informs planning and differentiation
- Student-teacher relationships

#### Cons

- Time consuming
- Too much information
- Temptation to make a teachable
  moment

### Numberless word problems

Numberless worded problems are problems where the numbers have been removed and the text decomposed into a series of simpler statements, progressively revealing the mathematical relationships within the problem.

This process helps students to focus on the 'essence' of the problem.

Removing the numbers enables teachers to draw students into a conversation:

- What is going on in the problem? What can you picture in your mind?
- What do we know about the quantities and relationships in the problem even though there are no numbers?
- What is the question asking us to find out?

The simpler statements can also help students to feel less overwhelmed.

#### **Question:**

Ari has 6 times as many footy cards than her brother, Ty. Ty has 34 footy cards. Carlo has 202 footy cards. Who has more footy cards, Ari or Carlo?

How might students respond to this question?

**Original question:** Ari has 6 times as many footy cards than her brother, Ty. Ty has 34 footy cards. Carlo has 202 footy cards. Who has more footy cards, Ari or Carlo?

#### Scaffolding the question through a numberless word problem approach:

[1] Ty has some footy cards. Ari has more footy cards than her brother Ty.

- What information have you been given?
- What do you understand about the information given?
- What do you think the problem might be about?
- What operation(s) might it involve? (eg +, -, ×, ÷)
- What information would be helpful to solve this problem?

**Original question:** Ari has 6 times as many footy cards than her brother, Ty. Ty has 34 footy cards. Carlo has 202 footy cards. Who has more footy cards, Ari or Carlo?

#### Scaffolding the question through a numberless word problem approach:

[2] Ty has some footy cards. Ari has 6 times as many footy cards than her brother Ty. Carlo also has footy cards.

- What does the new information tell you?
- How does the new information help you organize your thoughts?
- What operation(s) might it involve?
- Have you changed your thinking as to what the question might be about?
- What information would be helpful to solve this problem?

**Original question:** Ari has 6 times as many footy cards than her brother, Ty. Ty has 34 footy cards. Carlo has 202 footy cards. Who has more footy cards, Ari or Carlo?

#### Scaffolding the question through a numberless word problem approach:

[3] Ty has 34 footy cards. Ari has 6 times as many footy cards than her brother Ty. Carlo also has footy cards.

- What does the new information tell you?
- How does the new information help you organize your thoughts?
- What operation(s) might it involve?
- Have you changed your thinking as to what the question might be about?
- What information would be helpful to solve this problem?

**Original question:** Ari has 6 times as many footy cards than her brother, Ty. Ty has 34 footy cards. Carlo has 202 footy cards. Who has more footy cards, Ari or Carlo?

#### Scaffolding the question through a numberless word problem approach:

[4] Ty has 34 footy cards. Ari has 6 times as many footy cards than her brother Ty. Carlo 202 has footy cards.

- What does the new information tell you?
- How does the new information help you organize your thoughts?
- What operation(s) might it involve?
- Have you changed your thinking as to what the question might be about?
- What information would be helpful to solve this problem?

#### **Reveal the actual question**

Ty has 34 footy cards. Ari has 6 times as many footy cards than her brother Ty. Carlo 202 has footy cards. Who has more footy cards, Ari or Carlo?

- How might you solve this problem?
- What strategies could you use?
- What operation(s) will it involve?
- Are there other ways to solve it?

Let's complete one together.

#### **Question:**

There are ten people on a bus. At the next stop 6 people get off the bus and 4 people get on the bus.

How many people are on the bus now?

### Applying the numberless approach

#### **Question A:**

Oliver has 5 less sponsors for the fun run than his sister, Evina. Mia has one third of the sponsors her friend Oliver has. Evina has 44 sponsors; how many sponsors does Mia have?

#### **Question B:**

A 1.5-litre bottle of juice costs \$3.60 at Boles.

A 2-litre bottle of the same juice costs \$4.76 at Toollies.

Which shop provides the best value for money?

In pairs, select one of the questions and decompose it into a series of simpler statements.

#### **Creating your own numberless worded problem**

When creating your own numberless worded problem, start by considering:

- the operations you want to include (often × or ÷ and + or -)
- a relevant context
- then complete the numberless scaffolds, either by taking a bottom-up approach, starting at the end and working your way to the top by removing text and numbers, or the reverse
- used the template to help guide the process

#### **Benefits of Numberless word problems**

- Reduces anxiety, as students can focus on understanding the context, without getting caught up in calculations
- The gradual unfolding of information slows down the process, increasing accessibility and engagement
- Promotes deeper understanding of mathematical relationships, operations and associated language

#### **Data tracking**







Newman's Prompts Where are our students at? Data collection Term 3, weeks 1 & 2

Can read question Can restate what is being Can identify maths process/es Calculation errors Correctly carries out Answer makes sense to looked for to be undertaken processes question YES YES YES (prompted) YES (prompted) YES (prompted) YES YES YES YES YES struggled to articulate YES struggled to articulate YES YES YES YES YES YES YES YES YES (prompted) YES YES YES (used calculator) YES YES YES YES NO YES (incorrect answer) YES YES YES YES YES struggled to articulate YES Absent Absent







Newman's Prompts Where are our students at? Data collecti

t? Data collection Term 3, weeks 9

Can read qu	estion	Can restate what is being looked for	Can identify maths process/es to be undertaken	Calculation errors	Correctly carries out processes	Answer makes sense to question
YES		NO	NO	NO	NO	NO
YES		YES	NO - Conversion	NO	NO	NO
YES		YES- some prompting	NO	NO	NO	NO
YES		YES	NO	NO	NO	NO
YES		YES	NO	NO	NO	NO
YES		YES	NO	NO	NO	NO
YES		YES		NO	NO	NO
YES		YES	YES	NO - calcul	NO	NO
YES		YES	YES	NO		NO
YES		YES	YES	NO		
YES		YES	YES	NO		YES
YES		YES	YES	NO		YES
YES		YES	YES	NO	YES	YES
YES		YES	YES	YES - calculator		YES
YES		YES	YES	YES	YES	YES
YES		YES	YES	YES	YES	YES
YES		YES	YES	YES	YES	YES
YES		YES	YES	YES	YES	YES
YES		YES	YES	YES	YES	YES
YES		YES	YES	YES	YES	YES
YES		YES	YES	YES	YES	YES
YES		YES	YES	YES	YES	YES
YES		YES	YES	YES	YES- calculator	YES
YES		YES	YES	YES	YES	YES
YES		YES	YES	YES	YES	YES
YES		YES	YES	YES	YES	YES
YES		YES	YES	YES	YES	YES
YES		YES	YES	YES	YES	YES

#### Resources

#### Newman Analysis:

- brief overview
- NSW teacher support and PPT
- planning document

The Newman Procedure for Analysing Errors on Written Mathematical Tasks (1996)

Numberless word problems homepage and introduction & outline of process

Other problems and ideas from Brian Bushart's <u>blog/newsletters</u>

Similar to the concept of numberless word problems - Slow reveal graphs

http://ntimages.weebly.com/photos.html (images for Number Talks)

### Feedback & accessing a copy of this PPT

We would welcome your thoughts on today's session.

This QR code will take you to a very short feedback form.

If you'd like a copy of the PPT for this session, you can either:

- include your email address when completing the feedback form, or
- email Antje or Kris directly: antje@leighlancasterconsulting.com.au kristen.westcott@det.nsw.edu.au

Then we'll share a link over the next few days.





### **Feedback MAV**

## Please also complete the MAV feedback survey within the conference app.

### Any quick questions?

Thank you