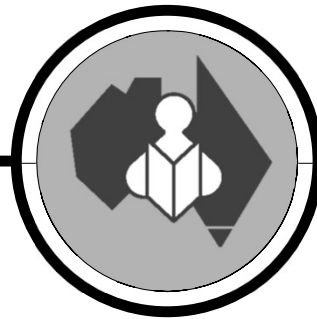


# Learning Difficulties Australia

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.



[www.ldaustralia.org](http://www.ldaustralia.org)



[enquiries@ldaustralia.org](mailto:enquiries@ldaustralia.org)



[@LearningDifficultiesAustralia](https://www.facebook.com/LearningDifficultiesAustralia)



[@LD\\_Australia](https://twitter.com/LD_Australia)

# Dr Anne Bellert

Master of Leadership: (with Distinction), Monash University, VIC. 2022

Doctor of Philosophy (PhD), University of New England, NSW. 2012  
*The Effects of Improved Automaticity in Basic Academic Skills: A Study of Learning Difficulties in the Middle-School Years.*

Bachelor of Education (Special Education), UNE, NSW. 1998

Bachelor of Teaching (Primary), UNE – Northern Rivers, NSW. 1994

I have worked as a classroom teacher, support teacher and school advisor in schools in regional NSW for 10+ years.

In 2014 I began working in the tertiary sector as a lecturer in inclusive education (Southern Cross University). In 2017 I was promoted to Senior Lecturer.

In August, 2022, I started working at Melbourne Graduate School of Education, in the Learning Intervention team. I am currently the Course Co-Ordinator for the Graduate Certificate in Education - Learning Difficulties

**Now co-convenor of LDA's Consultants Committee**



# Automaticity in basic number facts: Freeing up the load.

- automaticity in basic number facts
  - the cognitive advantages it offers
- strategies and approaches to support the development of basic academic skills
  - for students experiencing learning difficulties
- differences between rote learning and developing automaticity
  - out with the old, in with the new

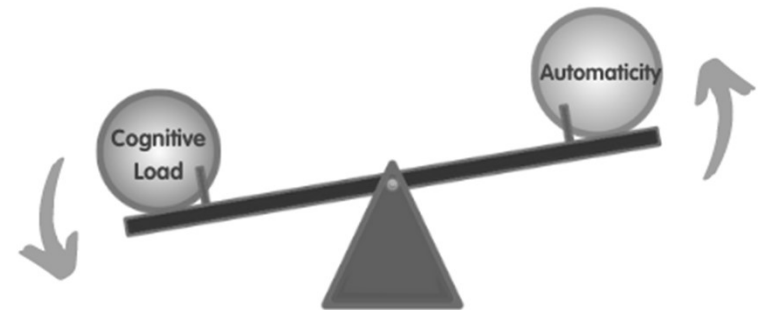
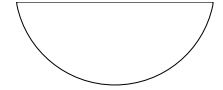


Image source: <https://phonicshero.com/wp-content/uploads/seesaw-graphic-e1622554159110.png>



# Automaticity

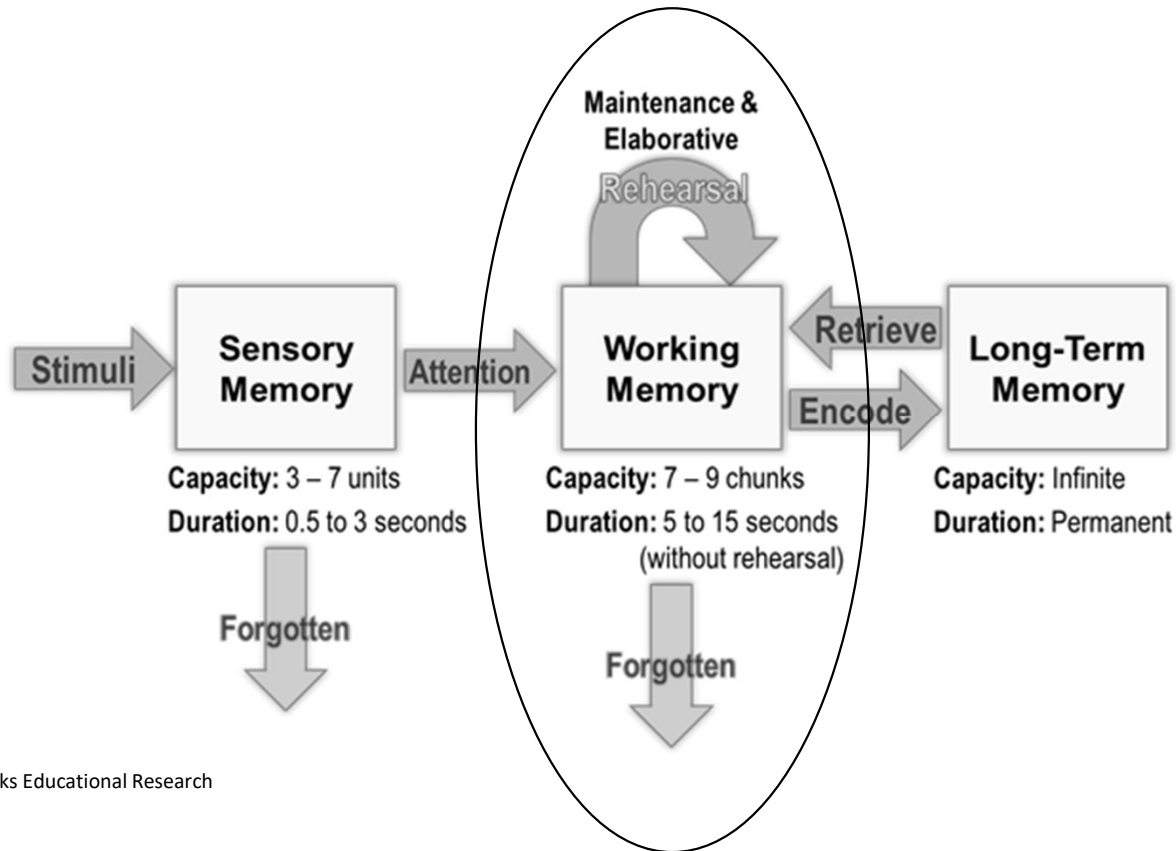
- Memory (encode/decode)
  - Long term memory (LTM)
- Working memory
  - Limited capacity
    - Lower order aspects of the task have priority
- Practice needed for effective retrieval from LTM
  - Spaced practice of the knowledge
  - Practice retrieving the knowledge



# Basic number facts

- Addition and subtraction facts to 10
- Multiplication and division facts to 12+
- Numeracy vocabulary
  - Vocabulary associated with basic facts
  - General mathematics vocabulary, e.g. geometry
- Problem-solving is the ultimate goal

# The Multi-Store Model of Memory

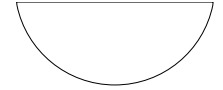


# Working Memory (WM)

- Working memory has been described as a theoretical construct used in cognitive psychology to characterise the system or mechanism underlying the maintenance of task-relevant information during the performance of a cognitive task (Miyake & Shah, 1999).
- Other definitions in the literature similarly describe working memory as a temporary, simultaneous storage mechanism in memory for incoming information required in the performance of a complex task (Baddeley, 1992; Hulme & McKenzie, 1992; Siegel & Ryan, 1989; Swanson & Keogh, 1990).



Image source: <https://cogbites.org/2019/02/18/what-is-working-memory-training-and-what-makes-it-work/>



# Working Memory & Learning Difficulties

- Students who experience learning difficulties (LD) may
  - have reduced WM capacity
    - for all of us, our WM capacity is limited
    - Capacity can be predictive of future achievement
  - Use their limited WM resources inefficiently
    - Shifting focus
    - Emotions take up WM space
  - Over-rely on WM
    - 'work it' constantly instead of retrieving from LTM
- Caution: WM training has limited evidence base for having an impact on learning outcomes
  - methodological issues
  - future prospects
    - (Nutley & Söderqvist, 2017)



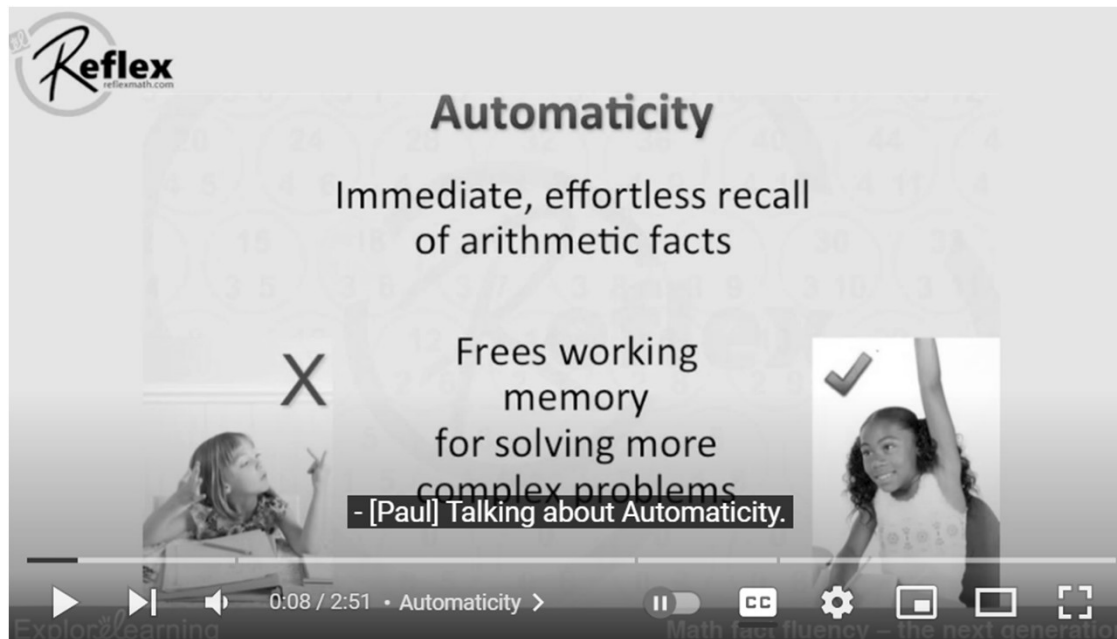


# WM & Mathematics

- Mathematics, arithmetic, numeracy
- WMC predicts measures of current and future mathematical abilities, dependent on
  - Developmental stage
  - Exposure to mathematics training (effective teaching)
- Different components of WM are related to mathematics performance at different ages, and between aspects of mathematics within the same age
- During early stages of learning arithmetic most children use counting strategies, before developing verbal counting and finally, the counting will gradually be replaced by forming categorical representations in long-term memory
- For the same task, the strategies used to solve it might differ between students
  - Students experiencing LD tend to over-rely on inefficient strategies

# Automaticity and arithmetic facts

- <https://youtu.be/l8JITqJYKUQ?t=8>



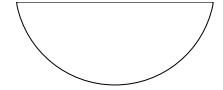
The video player shows a video from Reflex (reflexmath.com) titled "Automaticity". The video content includes the following text:

**Automaticity**  
Immediate, effortless recall  
of arithmetic facts

Frees working  
memory  
for solving more  
complex problems

- [Paul] Talking about Automaticity.

The video player interface shows a progress bar at 0:08 / 2:51, a play button, a volume icon, a closed captions icon, a settings icon, a full screen icon, and a share icon. The video player also displays the text "Explor Learning" and "Math fluency - the next generation" at the bottom.



# Reducing the Load

- **Increasing the use of efficient strategies**
  - Developmentally appropriate
- **Using the limited capacity of working memory effectively to solve a task**
  - Not 'using it all up' on the lower order aspects of a task
    - Instead, retrieve the key information from LTM, and
    - use the available resources (WM) to focus on higher order aspects of a task
- **Clara's story – fast fingers**
- **Rosemary's story – not enough practice**

# QuickSmart Numeracy

Yrs 3-8

- SiMERR Centre
  - Professor John Pegg
  - (Professor Lorraine Graham)
  - Anne Parnell
  - Dr Maree Lake
  - QuickSmart team
- 
- Average effect-size results for thousands of *QuickSmart* students (of 0.60 to 0.94)
  - translates into growth of two- to three-years in one year compared to the gains made by average-achieving students.



quicksmart



University of New England

<https://simerr.une.edu.au/quicksmart/numeracy-pr...>

## Numeracy Program – QuickSmart - SiMERR - UNE

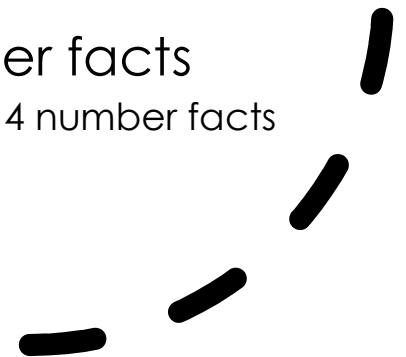
Overview: The **QuickSmart Numeracy** intervention program focuses on understanding and recall of basic number facts, performance of elementary calculations, ...

*QuickSmart* is an evidence-based basic skills intervention program designed for middle-school students who experience persistent difficulties in literacy and/or numeracy. The **award-winning programs** provide a framework with short and targeted lesson components for educators to work through with their students.

The aim of *QuickSmart* is to enable students to become automatic (quick) in their basic skills in order to move onto more complex problem-solving skills (smart). Over **67,000 students** have benefited from the programs since 2001.

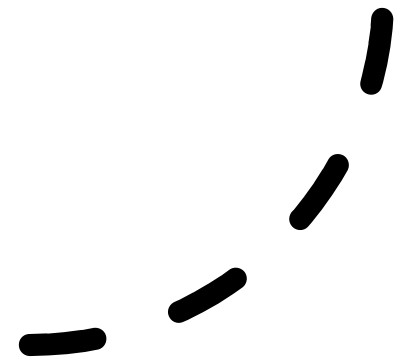
# How to achieve automaticity in basic maths facts

- Start with the known
  - Explore current understandings
- Needs more than a singular focus on recall
  - Not rote learning
- Spaced (distributed) practice
- Enough practice opportunity
- Confidence ....
- 'Trust your head' (replace old cognitive habits)
- The relationship between number facts
  - If you know one number fact, you know 4 number facts



**How to  
achieve  
automaticity  
in basic  
maths facts**

- Your suggestions .....



# Automaticity Activities 1 (Yr 3-8 & beyond)

- **Always start with review – tap into prior knowledge**
  - Establish that conceptual understanding exists
- **Speed sheets**
  - NOT maths mental
  - Retrieval practice of known facts, with a limited range (e.g. number facts to 10, +3, '3 times tables')
  - Teach strategies for doing the task
    - jump down the page, do like 'sums' at the same time
- **Flash cards**
  - Limited range in a known domain

# Automaticity Activities 2

- **Games**

- Memory, 3-in-a-row,
- Online games BUT carefully selected

- **Self-record progress**

- Graph rates each time
- Expect/ explain variance

- **Embedded knowledge activities**

- Problem solving
- Include geometry, algebra, measurement etc.
- TRANSFER AND GENERALISATION



# How is teaching for automaticity in basic number facts different from rote learning?

- Discussion

# Implications for your practice

- Discussion

# References

Bergman Nutley, S., & Söderqvist, S. (2017). How Is Working Memory Training Likely to Influence Academic Performance? Current Evidence and Methodological Considerations. *Frontiers in psychology*, 8, 69. <https://doi.org/10.3389/fpsyg.2017.00069>

Graham, L., Bellert, A. & Pegg, J. (2007). Supporting students in the middle school years with learning difficulties in mathematics: Research into classroom practice. *Australasian Journal of Special Education*, 31 (2), 171-182

Pegg, J. & Graham, L. (2013). A three-level intervention pedagogy to enhance the academic achievement of Indigenous students: Evidence from *QuickSmart* Mathematics research relevant to Indigenous populations: Evidence-based practice (123-138). In R. Jorgenson, P. Sullivan & P. Grootenboer (Eds.), *Pedagogies to enhance learning for Indigenous students*. Singapore: Springer. ISBN 9789814021838

# Dr Anne Bellert

Senior Lecturer  
Melbourne Graduate School of  
Education at the University of  
Melbourne

Email:  
[anne.bellert@unimelb.edu.au](mailto:anne.bellert@unimelb.edu.au)

[abellert@ldaustralia.org](mailto:abellert@ldaustralia.org)

