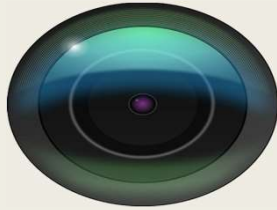


SUPPORTING STUDENTS WITH LEARNING DISABILITIES THROUGH A MATH LENS



Deborah Shore Reid and
Paul Cook
Learning Disabilities
Association
of London Region

Lynn-Marie Pearce
London District Catholic
School Board

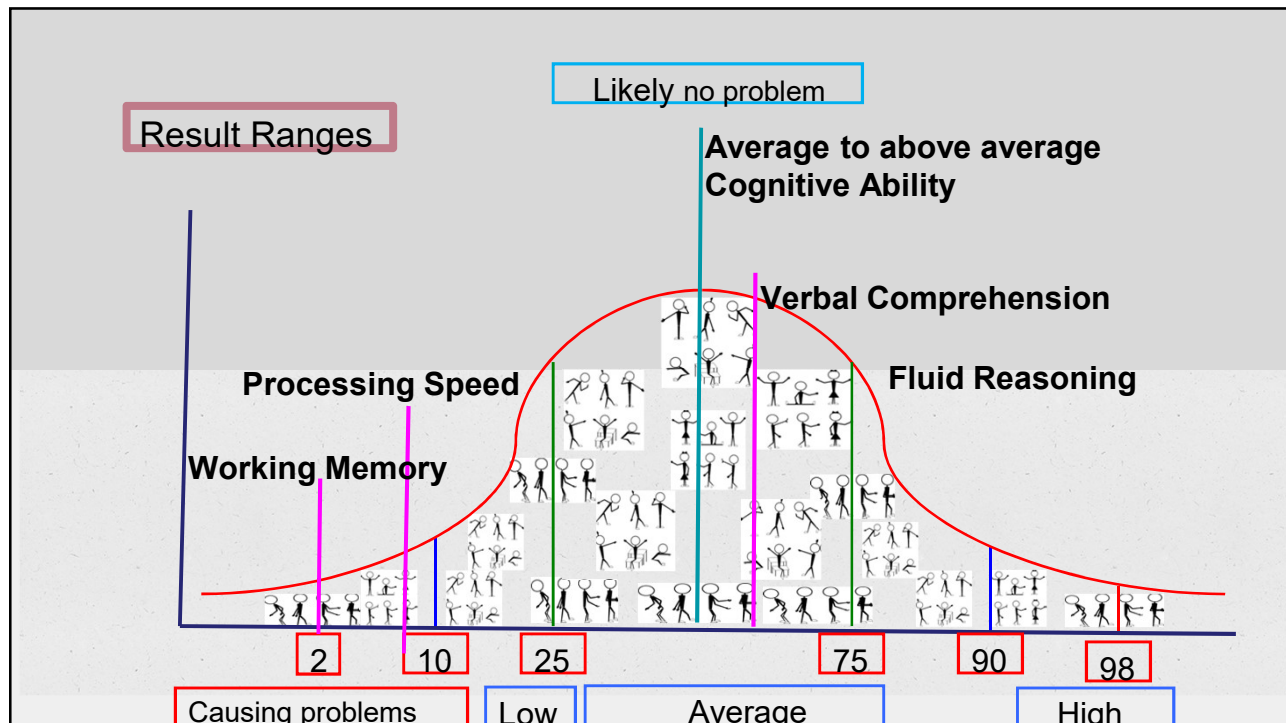
Acknowledgement of
some slides from Thames
Valley District School
Board



I Hate Math!

Barriers to success in math:

- Failed success
- Limited opportunities to use 3 senses during learning
- Lack of Grit and Growth mindset
- Math anxiety affecting performance
- Limited understanding of symbol-quantity relationship



LD's in Math

- Lots of different variations based on brain difficulties
- Difficulties similar to LDs in reading and writing, can overlap
- Can include problems with:
 - *Processing language – word problems, math questions*
 - *Visual-spatial relationships – organizing numbers and symbols on a page*
 - *Memory - remembering facts and sequence of steps in operations*

What Does LD look like in Math?

Students with LD may experience problems in math in any of the following areas:

- Learning number facts (number sense)
- Doing arithmetic and calculations (number sense)
- Using symbols in math (number sense, measurement)
- Understanding visual-spatial relationships (geometry, patterning and algebra)
- Problem solving (all strands)

Basic Number Processing

- Lack of understanding numerical magnitude
- Difficulties in learning numerical expressions and maintaining them in memory

It is deficits in processing the meaning of numbers

Look Fors

Don't Wait
for it to happen,
GO MAKE IT
HAPPEN.

May have excellent grasp of math concepts, but inconsistencies:

- calculating and paying attention to the operational sign
- borrowing or carrying appropriately
- comparing two lengths
- sequencing the steps in complex operations / keeping procedures in order

Difficulties in visual-spatial organization which may result in:

- confused arrangements of numerals and signs on the page
- poor 'number sense'
- specific difficulty with pictorial representations
- weak understanding of math concepts



Look Fors

Don't Wait
for it to happen,
GO MAKE IT
HAPPEN.



Early difficulties in:

- estimating quantities
- associating small quantities of items with printed numerals

Persistent trouble with:

- memorizing basic number facts
- developing efficient memory strategies on their own

Working memory difficulties:

- interfere with math problem-solving, where students must keep a number of items in mind at the same time

Hampered by the language aspects of math:

- confusion about terminology, difficulty following verbal explanations, and/or weak verbal skills for monitoring the steps of complex calculations

- **emotional blocks** so overwhelming as to preclude their ability to think responsibly and clearly when attempting math

Program Policy Memoranda- PPM 8

Instructional, environmental, and assessment accommodations

should be provided, as appropriate, so that the student is able to access grade-level curriculum expectations and to demonstrate learning.

(MOE, 2014)

EQUALITY VERSUS EQUITY



In the first image, it is assumed that everyone will benefit from the same supports. They are being treated equally.

In the second image, individuals are given different supports to make it possible for them to have equal access to the game. They are being treated

In the third image, all three can see the game without any supports or accommodations because the cause of the inequity was addressed. The systemic barrier

Let's Take A Quiz

Informal Mathematics Teacher Competency Inventory

Directions: Solve the following basic facts. You have 1 minute to complete this quiz. Please remember that the: + symbol means multiply, the - symbol means divide, the ÷ symbol means add, and the x symbol means subtract.

$8 + 2 =$	$10 - 5 =$	$8 \times 7 =$
$14 \div 7 =$	$17 \times 2 =$	$2 \times 1 =$
$12 \times 2 =$	$8 \div 4 =$	$14 - 7 =$
$10 - 2 =$	$4 \times 3 =$	$6 \times 2 =$
$6 \times 5 =$	$15 - 3 =$	$8 + 5 =$
$9 \div 9 =$	$9 \div 2 =$	$9 - 1 =$
$9 + 6 =$	$15 \times 3 =$	$6 + 6 =$
$12 \div 2 =$	$9 - 3 =$	$8 - 4 =$
$5 + 6 =$	$4 + 4 =$	$20 - 1 =$
$16 - 4 =$	$6 \div 6 =$	$8 + 2 =$
$6 \div 6 =$	$8 + 3 =$	$6 \div 2 =$

Mind Set

- *Encourage positive attitudes and work habits*
- *Be positive to reduce math anxiety*
- *View mistakes as learning opportunities*
- *Be patient*
- *Build confidence*
- *Praise effort*
- *Growth mindset*



Multisensory Learning

Multisensory learning involves the simultaneous use of:

- **Visual**

Mindmaps, number lines, pictures, posters, anchor charts, videos



sight

- **Auditory**

Clapping, group dialogue, speech-to-text, problem-solving out loud, videos



hearing



touch

- **Kinesthetic-Tactile**

Making manipulatives, tiles, dominoes, coins, 2 and 3-D forms, sand, air writing

The CRA approach is a research-based sequence of instruction with three key stages:

1) Concrete

2) Representational

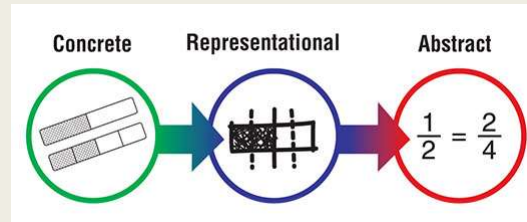
3) Abstract

Concrete	Representational	Abstract
Students manipulate hands-on, concrete materials	Students draw and observe diagrams, or watch the teacher touching and moving hands-on materials	Numbers and mathematical symbols

**Research shows that the CRA approach is especially effective in teaching students with learning disabilities

(Mercer & Miller 2003; Witzel 2005; Witzel, Riccomini & Schneider, 2008; Lockwood & Medina 2012)

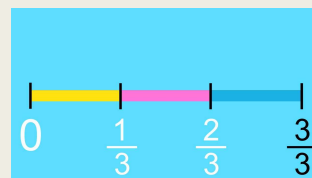
C-R-A



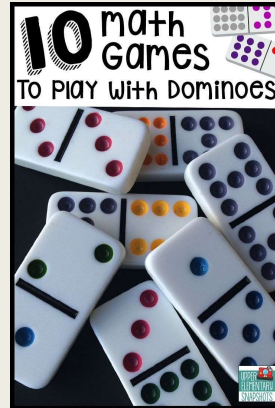
How can I help?

- Visual representation must be explicitly explained to students
- Teachers - model, model, model
- Parents - practise, practise, practise

- Work on visualizing math concepts so students can create a mental image and refer to that mental image when it is needed



Understanding Number through Play



Consider playing games like this one.

Try an abacus too.

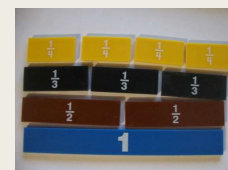
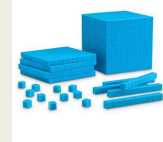
Adapt by using side by side representations of symbol and quantity by adding that variation to:

- Dominoes
- Tenzi
- Yahtzee



Math Tool Kit

- Place Value blocks and paper decimal grids
- Fraction Circles and Paper Fraction Circles
- Fraction Strips and Paper Fraction Strips
- Coloured Tiles and Math Linkcubes
- Hundred's Chart
- Multiplication Matrix
- Number Lines



Summary of Effective Practices for Math Intervention

- Positive Mind Set
- Multisensory Approach (Think aloud)
- Use Concrete and Representational models
- Teach strategies and use of math tools

- Explicit and systematic instruction based on diagnostic assessment
- Balance work on number operations with strategies for solving problems that are more complex

Moving Up Math at LDA

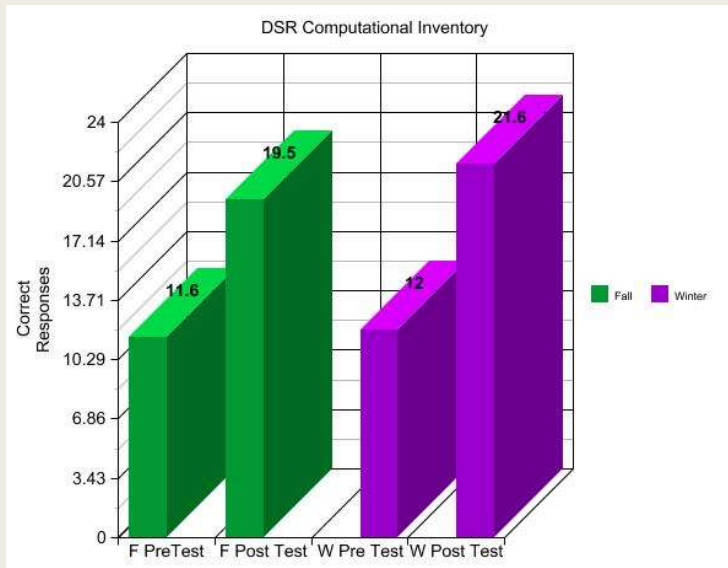
- Grades 4-8
- Pre-assessment (computations and understanding)

- 1:1 instruction with Tutor on specific computational skills
- Small Group- Explicit Instruction on Math concepts / Big Ideas
- Blended Learning- Prodigy (targeted assignments)
- Targeted practice through games...fun!!!
- Weekly monitoring of progress
- Embed SEL (Social / Emotional Learning)
- [Financial Literacy](#)

- Post-assessment



Our program and data

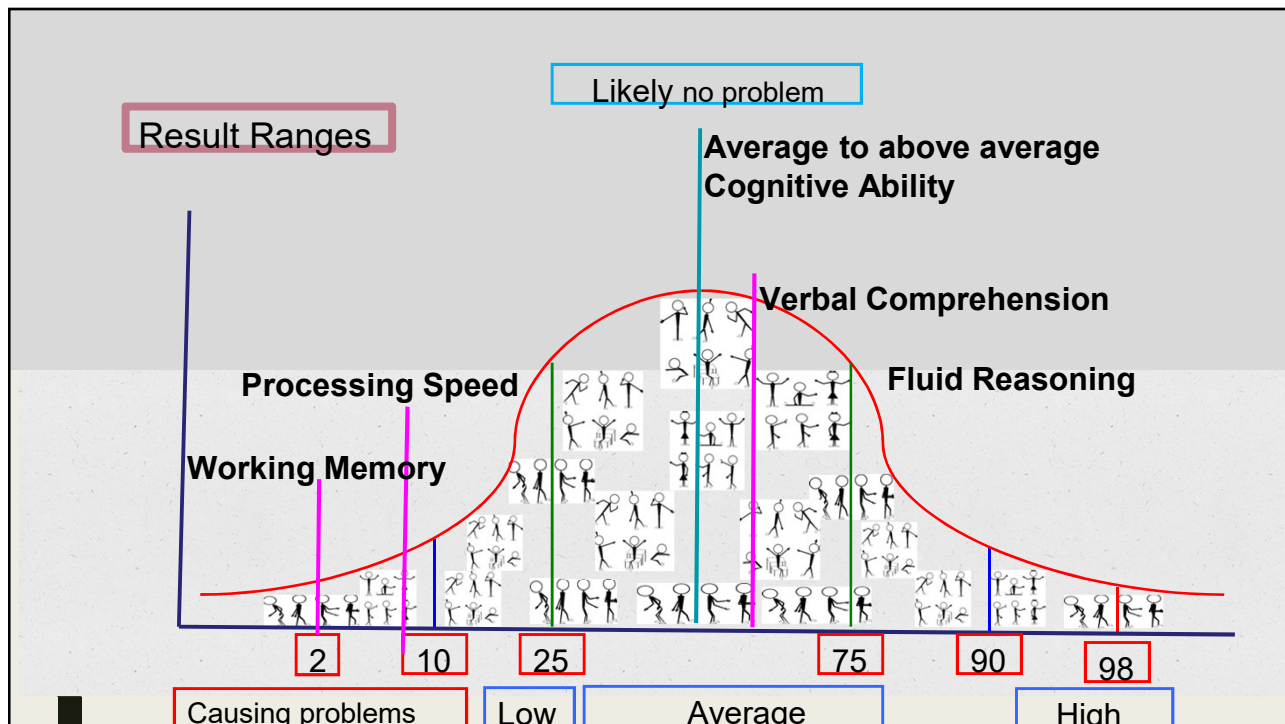


I am really proud of my kids, its amazing what they are doing, and you guys are doing a great job supporting them, and teaching good strategies to be successful at school.

This has been the first time getting him to attend wasn't like pulling out my hair. I am so happy. The tutor has really elevated my son's confidence and everytime I picked him up he was happy and was in no hurry to leave.

ACCOMMODATIONS

Slides from TVDSB



Accommodations to Enable Verbal comprehension in Mathematics		
Check for understanding (including comprehension)	Support Input of Information	Support output of Knowledge and Understanding
<ul style="list-style-type: none"> Use strategies that support students in identifying most and least important information(i.e within whole group,engage students in unpacking problems using a template of your choice) Turn and talk to with a partner: What do you know about the problem? What is the problem asking you to find? How might you model this information? 	<p>Provide access to manipulatives (or interactive electronic tools/supports), models, and concrete objects to support instruction (verbal) and group math talk.</p> <p>During instruction, provide opportunities for students to explore and connect a variety of visual representations (i.e concrete/pictorial, numeric, graphical,algebraic) with oral/written.</p>	<p>Engage students in a partner strategy (i.e Think-Pair-share, A coach B, Stay and Stray) to provide opportunities for articulation of thinking</p>
<ul style="list-style-type: none"> Use strategies that support students in paraphrasing their understanding of a problem/instructions, ensuring sufficient wait time Have students generate clarifying questions Turn and Talk: What questions do you have about this problem/task? 	<p>Enhance understanding of terminology by:</p> <ul style="list-style-type: none"> Highlighting key words with key features of different representations, using colour-coding Pairing terminology with alternate and familiar language (i.e constant-stays the same) Using a concept/word wall or having a students maintain a personalized dictionary, pairing mathematical terminology with visual representations Linking specific mathematical key words to mathematical operations 	<p>Provide choice of demonstrating learning:</p> <ul style="list-style-type: none"> Allow for oral explanation of solutions (scribe, assistive technology/recording device) Allow for demonstration of concepts and skills using learning tools (i.e manipulatives, interactive electronic tools) paying attention to student gestures and mathematical actions with tools Encourage solutions that use a variety of representations (i.e concrete/pictorial,numeric,graphic al,table of values, algebraic)

Accommodations to Enable Perceptual Reasoning in Mathematics

Support Visual Representations with Oral and/or written	Provide Access to Tools (concrete and models) to make connections between visual and verbal (oral and written)	Support Visual Access to Content
<ul style="list-style-type: none"> ❖ Pair visual representations with oral and written when teaching 	<ul style="list-style-type: none"> ❖ Use manipulatives and technology in combination with language 	<ul style="list-style-type: none"> ❖ Avoid presenting too many visuals and/or excessive text at a time (decrease clutter)
<p>Use a think aloud strategy when presented with a visual representation and required to:</p> <ul style="list-style-type: none"> ❖ Make a conjecture ❖ Solve a problem ❖ Make inferences, conclusions and justifications ❖ Make connections between representations 	<ul style="list-style-type: none"> ❖ Connect abstract mathematical concepts to concrete models and experiences (i.e find the area-tile the desk with unit tiles) 	<ul style="list-style-type: none"> ❖ Use colour-scaffolding to identify key characteristics/terms/symbols
<p>Provide access to Assistive technology (i.e mathies, interactive electronic tools) during lessons and assessments</p>	<ul style="list-style-type: none"> ❖ Provide access to manipulatives and technology to enable communication of math thinking 	<ul style="list-style-type: none"> ❖ Provide visual and tactile experiences with representations (i.e use ten frames to represent 28)

Accommodations to Enable Memory in Mathematics

Explicitly Teach Memory Strategies	Provide Opportunities for Making Connections	Provide Memory Supports without Modification of Curriculum Expectations
<ul style="list-style-type: none"> ❖ Use a think aloud strategy to verbalize mathematics ideas/concepts/procedures (i.e Think-Pair-Share, A Coach B) 	<ul style="list-style-type: none"> ❖ Support students in connecting concepts with corresponding terminology to concrete/visual images 	<ul style="list-style-type: none"> ❖ Provide access to manipulatives/interactive electronic tools (with post-it notes if needed) or
<ul style="list-style-type: none"> ❖ Use mnemonics (i.e visualization, compare and contrast, repetition) following learning experiences that develop conceptual understanding of mathematical concepts with related procedures, problem solving strategies etc) 	<ul style="list-style-type: none"> ❖ Use real life situations/contexts to present problems or illustrate concepts 	<ul style="list-style-type: none"> ❖ Use colour-scaffolding to identify key characteristics/terms/symbols
<ul style="list-style-type: none"> ❖ Use rhythm/music/patterns to support recall of concepts and related procedures 		<ul style="list-style-type: none"> ❖ Provide visual and tactile experiences with representations (i.e use ten frames to represent 28)
<ul style="list-style-type: none"> ❖ Convert concepts, models, notes, etc., into abbreviated form or use visual cues/representations to recall information 		

Accommodations to Enable Processing Speed and Visual Motor Integration in Mathematics

Provide students with tools to assist them with processing of information	Provide students with strategies for processing information (i.e one task, one step at a time)	Provide time for mathematical thinking, and minimize time and fatigue for students
<ul style="list-style-type: none"> ❖ As an alternative to writing, provide access to manipulatives for learning and demonstrating understanding of concepts 	<ul style="list-style-type: none"> ❖ Provide a structure that assists students in identifying similarities and differences (i.e graphic organizer) 	<ul style="list-style-type: none"> ❖ Provide access to manipulatives/interactive electronic tools , to support think time and enable alternate ways for students to demonstrate learning
<ul style="list-style-type: none"> ❖ Use assistive technology (interactive electronic tools, recording devices) 	<ul style="list-style-type: none"> ❖ Cover up all but one line at a time 	<ul style="list-style-type: none"> ❖ Provide students with more time to process information (i.e wait time, slow down speed when presenting information, turn and talk with a partner, provide a task/problem in advance)
	<ul style="list-style-type: none"> ❖ Support students in developing strategies to chunk (break down or group to support thinking process while preserving the cognition demand of the task 	<ul style="list-style-type: none"> ❖ Reduce time spent copying notes and solutions (i.e provide copy of notes/solutions in class, post lesson materials on webpage, have students capture their thinking using recording devices)
		<ul style="list-style-type: none"> ❖ Reduce the number of homework/test questions

Accommodations to Enable Executive Functioning in Mathematics

Use strategies to support planning, focusing attention	Provide students with strategies for organizing, managing and using information (i.e one task, one concept at a time)	Use of assessment strategies
<ul style="list-style-type: none"> ❖ Activate prior knowledge in preparation for (new) learning task 	<ul style="list-style-type: none"> ❖ Scaffold information/task/learning into manageable and meaningful "units", while preserving the cognitive demand 	<ul style="list-style-type: none"> ❖ Provide exemplars for tasks to support students in understanding assessment tasks
<ul style="list-style-type: none"> ❖ Provide access to manipulatives and technology (i.e e-tools, spreadsheet software, mathies, equatio, Read and Write for Google) 	<ul style="list-style-type: none"> ❖ Make explicit connections to real life applications of mathematics 	<ul style="list-style-type: none"> ❖ Provide rubric/marking scheme to students to guide task completion
<ul style="list-style-type: none"> ❖ Use graphic organizers, anchor charts for multi-step problem solving ❖ Post class agenda, timelines and lessons in classroom and on webpage 	<ul style="list-style-type: none"> ❖ Co-create anchor charts for consolidation of math thinking/problem solving strategies/word wall 	<ul style="list-style-type: none"> ❖ Use frequent check ins and feedback to support organization and task completion
<ul style="list-style-type: none"> ❖ Provide checklist of tasks/timelines 	<ul style="list-style-type: none"> ❖ Provide predictable classroom routines (whole class to group work to independent) 	<ul style="list-style-type: none"> ❖ Provide options/choices for students to demonstrate learning

WHERE TO FIND HELP 😊

- Today's slides will be posted on LDA-LR website:

<http://www.ldalondon.ca/>

- LDA Ontario

<http://www.ldao.ca/>

<https://www.ldathome.ca/2018/06/video-building-math-skills-at-home/>

(Video and Parent Resource Kit)

[LDs in Mathematics: Evidence-Based Interventions, Strategies, and Resources](#)

<https://www.ldatschool.ca/math-york-waterfall-chart/>

(Links assessment information with recommended accommodations)

- Center on Instruction Research Group

<https://www.centeroninstruction.org/files/Mathematics%20Instruction%20LD%20Guide%20for%20Teachers.pdf>

(MATHEMATICS INSTRUCTION FOR STUDENTS WITH LEARNING DISABILITIES OR DIFFICULTY LEARNING MATHEMATICS – A Guide for Teachers)

