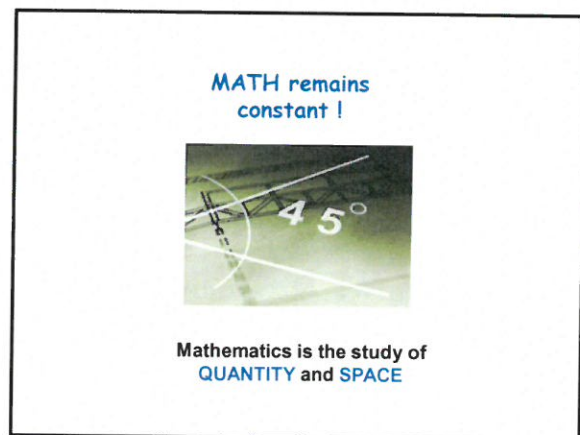
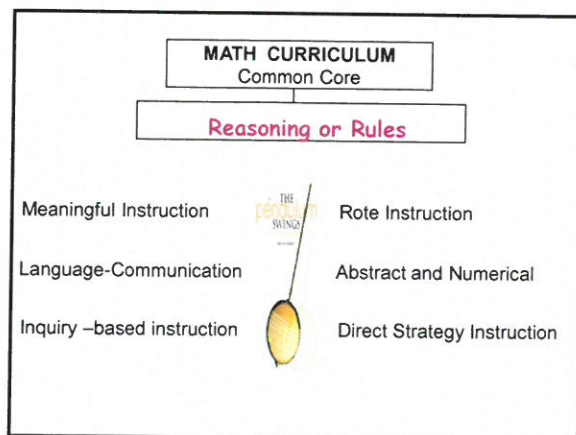
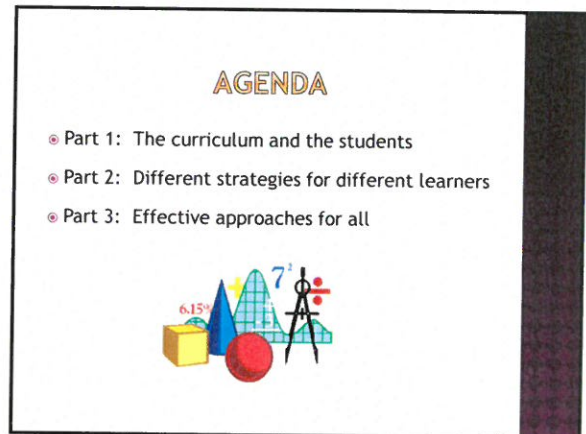
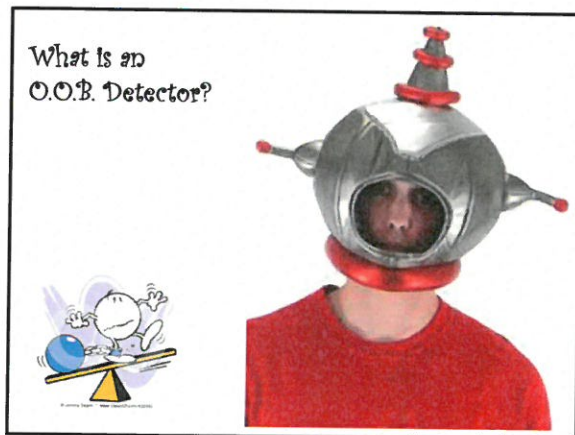
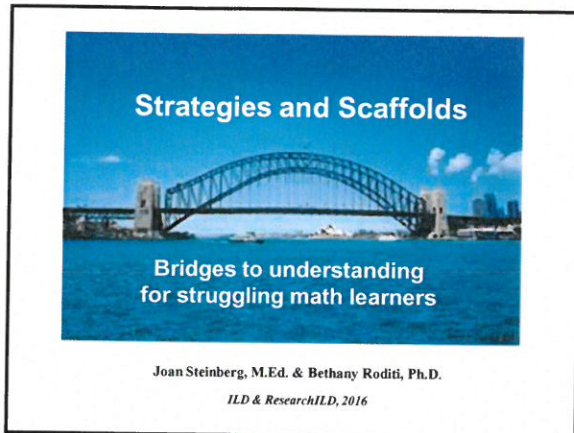


# 80- Strategies and Scaffolds: Bridges to Understanding for Struggling Math Learners



**Research Findings: What works for students with learning disabilities**

**Direct Explicit Instruction  
Systematic Strategy Instruction**

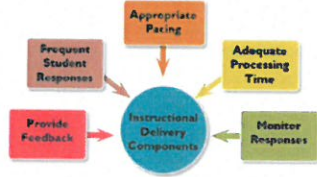


Figure 1. Standard instructional delivery components essential to all explicit instructional episodes (Fall, 2002).

Reported in Steedly et. al (Aug. 2012) *Effective Mathematics Instruction*

**Developmental Factors  
Underlying Math Learning**

- Language
- Visual Spatial Organization
- Executive Function
- Fine Motor
- Attention
- Memory
- Sequencing
- Math Anxiety
- Cognitive Flexibility
- Processing Speed

**Executive Function Paradigm**

- Initiating
- Planning
- Organizing
- Prioritizing
- Sustaining
- Shifting
- Self-monitoring

Meltzer, 2004

**PART 2  
MATH LEARNING AND EXECUTIVE FUNCTION**

**Different strategies for different learners**



What's getting in the way?

What does "circumference" mean? What is a "radius." I can never remember what the words mean!

**HOW DO LANGUAGE-BASED LEARNING DISABILITIES (LBLD) AFFECT MATH?**

- Difficulty with vocabulary and instructions
- Difficulty memorizing rote information because of working memory deficits.
- Struggle with "word problems."
- Miss the details.



### Strategies for Students with LBLD

- Visual/ hands-on-manipulatives
- Templates for problem-solving steps
- Vocabulary section, "triple note tote" in notebook
- Checking Strategies
- Big Picture Learners: Top-Down Approach



What's getting in the way?



I just don't get math. Especially geometry!

### HOW DOES A NON-VERBAL LEARNING DISABILITY (NVLD) AFFECT MATH LEARNING?

- Visual-spatial reasoning affects number sense
- Weak abstract reasoning
- Difficulty with cognitive flexibility makes math difficult.
- "Inchworm" learning style, makes it hard to "get the big picture".

### Nonverbal Learning Disability (NVLD) – Brief Summary

#### Strengths

- Early language development
- Rote memory
- Verbal expression
- Vocabulary
- Decoding
- Spelling
- Detail oriented

#### Weaknesses

- Visual-spatial reasoning  
(On WISC IV, Perceptual Reasoning lower than Verbal Comprehension)
- Sensory-motor skills
- Integration of information
- Executive Function
- Organization
- Social skills

**"Don't try to teach me what it means.**

**Give me lots of examples,**

**And show me the rule,**

**And eventually, I'll get what it means."**

**A 6th grade student**




### Strategies for Students with NVLD or Visual-spatial Difficulties

- Verbal Mediation
- "Recipes" – Procedure lists and rules
- From practice to meaning
- "Twist at a time"
- Address the "inchworm" learner




**What's getting in the way?**



This is boring.  
I don't know, what is the question you're asking me?  
Oh... this is not going to be fun  
I don't want to do this.  
You're not telling me what to do  
You're being a bad tutor.  
I wonder what's for dinner.

**ANXIETY REDUCTION**



**Addressing math anxiety**  
A.K.A.....


Fibromyalgebra      PI-GRAINE

Arithmia

Percentile Dysfunction

Add Nauseum      Digit-itis


**ANXIETY REDUCTION**



**Addressing math anxiety**

- Routines and structure
- Tests in a separate space
- Extended time
- Building “struggle muscle”
- Break problem or work into pieces
- Homework “jump start”
- “Anchor” instruction with road map or formula
- Charismatic adult or peer ally



**Building the “struggle” muscle**




- What is “struggle muscle?”
- Build a safe environment !
  - Reassure students that it's ok not to have “The Answer”
  - Encourage students to share their observations
  - Ask them to explain the question in their own words
  - Ask “What information do you know and need to know?”
  - Ask “Where can you find the information you need?”
- Encourage self-reflection!

**What's getting in the way?**

Wait, What?

**Many students need More TIME**

 **Slow Processors**

- Extended time for tests
- Sufficient “wait time”
- Preview
- Differentiating homework – fewer, but not less difficult, problems

Many students need to **SLOW DOWN**



- Write out each step
- Check your work
- Take medicine if appropriate
- Any other ideas?

What's getting in the way?



What happens to her during small group problem solving activity?

Then, what happens during homework?

### How does ADHD affect Math?

- Inattentive to details
- Distracted/ over-stimulated in lab situations
- Reluctant to write down information
- Test performance is inconsistent
- Need extended time for tests
- Hard time paying attention to classroom instruction- must relearn at home.
- Forget to write down assignments and to bring the right materials home.
- Easily distracted during homework time.

### Strategies to Address ADHD



- Checking strategies
- Checklist for problem-solving
- Models of a similar problem
- Fidget toys or "wiggly" cushions
- Assignments posted online
- Fewer number of hw problems
- Test corrections for credit



What's getting in the way?

I have no idea where to even start!



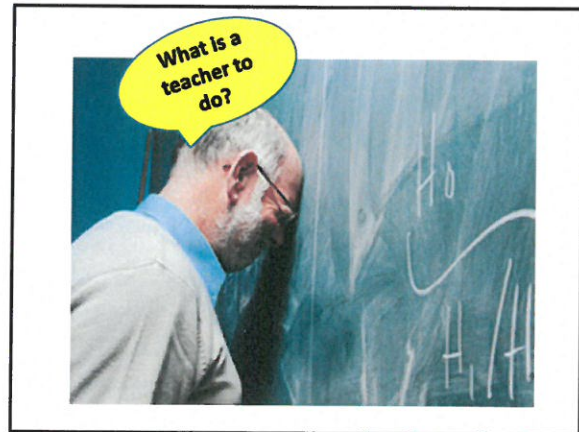
### HOW DO Executive Function Difficulties Affect Math?

- Don't adopt a planful approach
- Disorganized
- Have difficulty getting started
- Don't record assignments
- Don't internalize the "process" and the steps in order
- Can't hold information in working memory



### Strategies to Address Executive Function

- Visual schedule/ structured classroom
- Leave a large supply of pens/pencils in the classroom
- Assignments available on the web consistently
- "Study Buddy"
- E-mail communication with parents
- Study guides
- Road maps for problem solving
- Color code materials
- Strategy cards, strategy notebooks, reference sheets
- Use of calculators



### Part 3

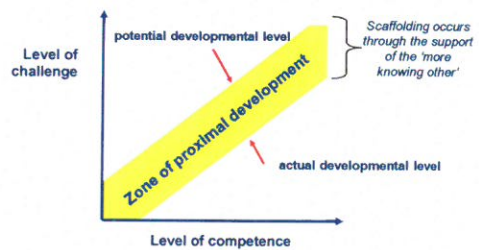
Math Learning and Executive function

### Effective Approaches for All Learners



### Zone of Proximal Development

The distance between the individual's actual and potential development level



Source: Vygotsky, 1978

### Scaffolded Help

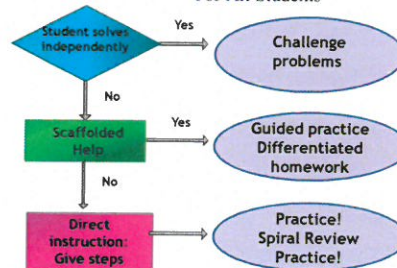
### A Twist at a Time

1. Scaffold instruction
2. Start with an example based on prior knowledge
3. "Twist" #1
4. "Twist" #2

Sufficient practice of prior examples before adding a "twist"



### Moving Toward Independent Learning For All Students



"just enough" of a lifeline"

**Penny Circle Problem**  
 Dan Meyers: Math in Three Acts  
 Act 1

**What observations can you make?**

**What math question(s) might you ask?**

**The Question is.....**  
**How many pennies will fit in the whole circle?**

**Estimate**

**What information do you need?**

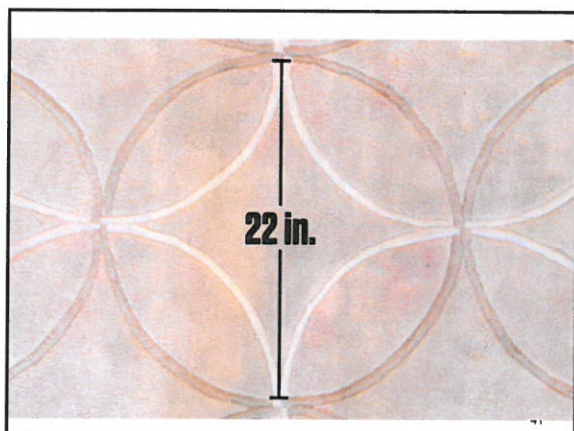
**Coming Soon-Act 2, the information you will need.....**

**1-2-3**  
**Penny Problem**  
**"Drop an Anchor"**

- List everything you know about the problem**  
 Circles, Pennies, Radius, Diameter
- What math do you know that may be related?**  
 Area formula:  $A = \pi r^2$     Proportion  $\frac{2}{6} = \frac{10}{x}$
- What information would be helpful to have?**  
 Diameter of the big circle  
 Number of pennies in small circle  
 Dimensions of small circle

**"Triple Note Tote"**  
**Circles**

Term	Definition	Diagram/Formula
Diameter	The distance across the circle 2x the radius	
Radius	The distance from the center of a circle to a point on the circle $\frac{1}{2}$ the diameter	
Area	the area of the region enclosed by the circle	
Circumference	distance around the circle	



**How can we use smaller circles to figure out how many pennies are in the big circle?**

## Let's Share Solutions!

About how many pennies?

5 inch diameter (radius is 2.5) has 35 pennies  
 $\text{Area of 5in. circle} = \pi r^2 = \pi(2.5)^2 \approx 20$

Large circle has 22 inch diameter (11 in radius):  
 $\text{Area} = \pi r^2 = \pi(11)^2 = 380.13 \approx 380$

Use a proportion

$$\frac{20 \text{ (area of small)}}{35 \text{ (pennies in small)}} = \frac{380 \text{ (area of big)}}{x \text{ (pennies in big)}}$$

44

## Proportion Strategy

- $20x = 380 \cdot 35$
- $20x = 13,300$
- Divide both sides by 20:
- $x = 13,300 \div 20 = 665$

## Act 3: The Big Reveal

46

## Math Strategy Notebooks

1. Class notes:  
Possible formats: "Triple Note Tote"  
Procedure List
2. Rules
3. Strategies that work for ME.
4. Math Rings
5. Math Road Maps - Templates for Problem Solving
6. Typical errors- "Top Three Hits"
7. Templates - Drop and Anchor
8. Strategy Reflection Sheets
9. My Best Work

## Sample RULES List Integers

RULES FOR INTEGERS (SIGNED NUMBERS)			
ADDITION		SUBTRACTION	
+ and + = +	- and - = -	<b>ADD THE OPPOSITE!</b>	
+ and - = -	- and + = +	<small>(Change the subtraction sign to an addition sign)            Change the sign of the second number.            Now follow the Addition rules!</small>	
MULTIPLICATION AND DIVISION			
+ and + = +	+ and - = -	- and + = -	- and - = +
<small>Copyright © All Rights Reserved. www.khanacademy.com</small>			

FOR SUBTRACTION: KEEP CHANGE CHANGE

KEEP the sign of the first number  
 CHANGE the operation  
 CHANGE the sign of the second number  
 Use the rules above for addition



**"Real life" examples: fractions and percents**  
Halves and quarters

Fraction/Percent	Example	Answer
Model: $\frac{1}{2}$ of 100	100 people were rafting down the river. $\frac{1}{2}$ fell in. How many people fell in?	50 people fell in.
$\frac{1}{2}$ of 1000	1000 people were eating in the park and $\frac{1}{2}$ of them were stung by wasps.	500
50% of 10	There were 10 questions on the test. Bob got 50% right. How many did Bob get right?	5
50% of 10	There were 10 mountains in Snowmass Colorado and Trevor and Meg skied 50% of them.	5
$\frac{1}{2}$ of 30	Rancatore's in Lexington has 30 flavors of ice cream. I have tried $\frac{1}{2}$ of them.	15
$\frac{1}{2}$ of 100	On our hot air balloon ride we saw $\frac{1}{2}$ of the Snowmass skyline. If the skyline was 100 yards wide, how much did we see.	75
$\frac{1}{2}$ of 1000	1000 people were in the audience for the Shakespeare play. $\frac{1}{2}$ of them were in line for	250

**Strategies That Work For Me**  
Automatic recall of addition facts

**"Rhymes for times"**

**4x4**  
A 4x4 is a mean machine  
I'm gonna get one when I'm sixteen  
*Multisensory: plastic cars w/ 4 wheels each*

**7x7**  
7x7 made out of lines  
Bend them around to make 49  
*Multisensory: Use pipe cleaners*

\* Schroeder & Washington, Math in Bloom, Linguistics, 1989

**Road Maps for Problem Solving**

Name \_\_\_\_\_  
Date \_\_\_\_\_

**RAPS**

**R**ead and Rephrase

**A**n

**P**lan and Predict

**S**olve

Developed by REASONHOLD, 2005

**CHECKING STRATEGY**  
**Top 3 Hits**

*My personal checklist of typical errors*

- 1.
- 2.
- 3.

Tips to remember:  
- Write these down on top of my test  
- Change pens to shift mindset  
- Search for TOP 3 Errors and correct them!

<p>TEMPLATE or</p> <p>SCHEMA</p> <p>Slope Intercept</p>   <p>Slope Formula</p>	<p><math>Y = mx + b</math></p> <p><math>Y = -3x + 2</math></p> <p><math>m =</math> <input type="text"/></p> <p><math>b =</math> <input type="text"/></p> <p><math>(0, b) = (0, \underline{\quad})</math></p> <p>Graph</p> <p><math>m = \frac{y_2 - y_1}{x_2 - x_1}</math></p>
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### Strategy Reflection Sheet

To solve the problem, what strategies did I/we use?  
Check off the ones you used.

Visual strategy (e.g. draw a diagram/graph) \_\_\_\_\_

Verbal Strategy (mnemonic; write out steps, talk it out)

Template/Schema

Road Map for problem solving (Step-by-step method)

Prior knowledge

Formula reference

Technology reference

Which one(s) worked best for you?  
\_\_\_\_\_



$(x+3)(x+2)$

1.  $(x+3)(x+2) \rightarrow$  FOIL- First, Outer, Inner, Last  
 $x^2 + 2x + 3x + 6 = x^2 + 5x + 6$

2.  $(x+3)(x+2) \rightarrow$  Face

### Virtual or Hands-On Manipulatives: Algebra Tiles

$x^2 + 2x + 3x + 6 = x^2 + 5x + 6$

### THINK BOARD

*Meaningful Instruction*

*Direct strategy Instruction*

Foster a classroom culture that values BOTH !!

- ◆ Math Strategy Notebooks
- ◆ Strategy Bulletin Boards
- ◆ Student Strategy Shares
- ◆ Strategy Labs
- ◆ Talk "strategy" in class
- ◆ Make it count!!!
- ◆ Classroom website
- ◆ Accommodations

**Reflections on my teaching:**  
*What works for all learners?*

Support the positive side of challenge

Scaffold questioning

Provide multiple representations

Adjust for slow/fast processors

Build math strategy notebooks

Teach reasoning AND rules!



What is an  
O.O.B. Detector?

