APPLYING THE STRUCTURE OF O-G TO MATH LESSON PLANNING

Matthew Buchanan
Multisensory Math Instructor of Teaching
Key School Multisensory Math Instructor

J. Concha Wyatt
Fellow/AOGPE, CALT

Key School and Learning Center
at Carolina Day School, Asheville, NC

THE MULTISENSORY MATH APPROACH (MSM)

- Is evidence-based way of "thinking" about teaching mathematics
- Like O-G it is an APPROACH that adapts to any curriculum or program
- Meets the needs of all learners through differentiation
- Foundational roots are directly connected to O-G

MULTISENSORY MATHEMATICS

Using an Orton-Gillingham Approach to Teach Mathematics

Joyce Steeves, Ed.D
John's Hopkins University
Baltimore, MD 21218

MULTISENSORY MATHEMATICS

MAKE MATH MULTISENSORY

(A plea to math teachers)
By Joyce Steeves

"I hate it. I can't do it! I'm so dumb!"

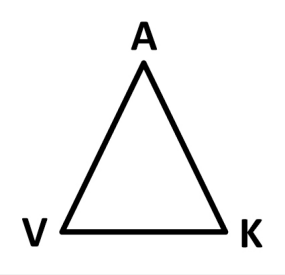
CORE MSM COMPONENTS

1. Multiple Sensory Experiences
2. Multiple Representations
3. Precise Instructional Language
4. Differentiation
5. Vertical Linkages
6. Explicit Concept-Based Instruction using the **CRA Sequence**

1. MULTIPLE SENSORY EXPERIENCES

Simultaneous Processing

- **Auditory**
  - Use of clear, concise, explicit language
  - Repetition to mastery
- **Visual**
  - Clear models
  - Near point references
- **Kinesthetic**
  - Gross motor movements
  - Student manipulation of quantity and understand why the math works



2. MULTIPLE REPRESENTATIONS

- Word problems, hands-on manipulation, algorithms
- Real life applicability
- Structured lesson which includes multiple strands of math

3. PRECISE INSTRUCTIONAL LANGUAGE

- Language has an enormous impact on math teaching and learning.
- The language of math is highly conceptual.
- Both receptive and expressive language skills are involved.
- MSM utilizes repetitive **concept-based language.**
- Let the manipulatives do the talking!

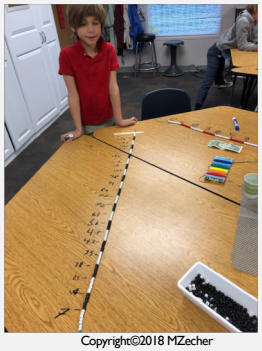
4. DIFFERENTIATION

Teach foundational skills for remediation

- Also for independent work

Use strategies to reduce the strains on Executive Function

- Restricted Number Facts
- Near Point References



5. VERTICAL LINKAGES

- Begin with the end in mind by teaching in the "simple to complex" fashion
- Explicitly teach from "what is known to what is new"
- Vertical linkages applies to vocabulary as well

Addition and Subtraction?

6. CRA SEQUENCE

Teach New Information Using **CRA**

- **Concrete** – Introduce the concept using manipulatives, gross motor movements, hands on experiences
- **Representational** – Draw a picture or diagram creating a portable memory
- **Abstract** – Apply the efficient use of numerals in algorithms for calculations

EVIDENCE-BASED PRACTICE

Universal Design for Learning (UDL)

Multiple Means of:

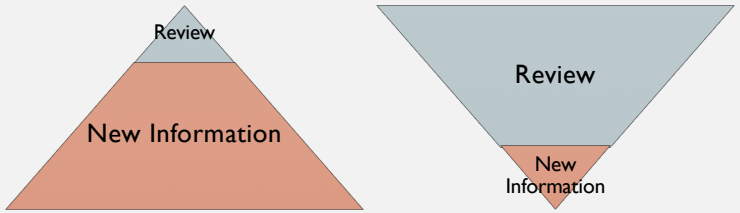
- Representation
- Action & Expression
- Engagement

The What Works Clearinghouse

- Explicit, systematic instruction
- Opportunities to work with visual representations
- Explicit instruction at representational level
- Practice w/ typical word problems
- 10 minutes of fact practice per day

http://ies.ed.gov/ncee/wwc/PracticeGuide.aspx?sid=2

THE MSM LESSON IS A MIRROR OF THE O-G LESSON



KEY SCHOOL MULTISENSORY MATH LESSON PLAN

- Problem of the Day
- Warm-Up
- Drill –Auditory/Visual/Kinesthetic
- Review and Reinforcement
- New Information
- Recap

Developed through Key Learning Center's Orton-Gillingham Language Lesson Plan in combination with Using an Orton-Gillingham Approach to Teach Mathematics– Joyce Steeves, E.d.D, John's Hopkins University

PROBLEM OF THE DAY AND WARM-UP

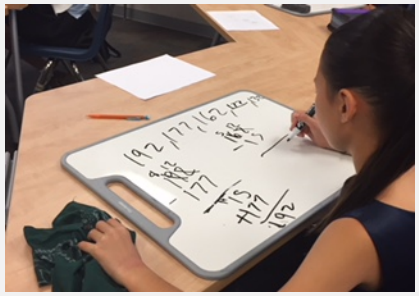
- Focusing Activities
  - Relatively easy task - About 5-10 minutes
  - Instills confidence through opening files for learning
  - Builds automaticity with fact families
  - Builds fluency with multistep algorithms
  - Develops mental agility with math thinking and problem solving

PROBLEM OF THE DAY

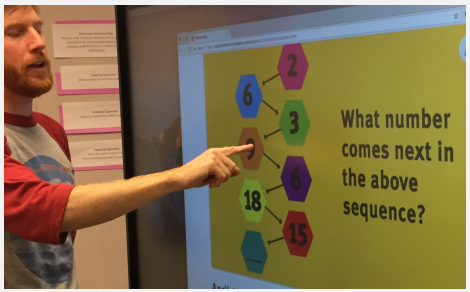
Example:

Completing Mathematical Patterns

192, 177, 162,____, 132



PROBLEM OF THE DAY



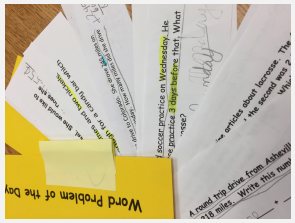
Example:

Completing Mathematical Sequences

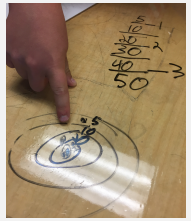
PROBLEM OF THE DAY

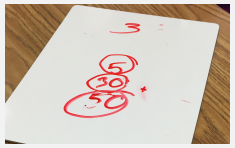
Single Word Problem

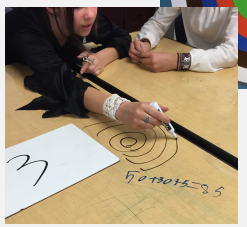
- Provides regular opportunities to apply strategies and practice procedures for word problems



PROBLEM OF THE DAY





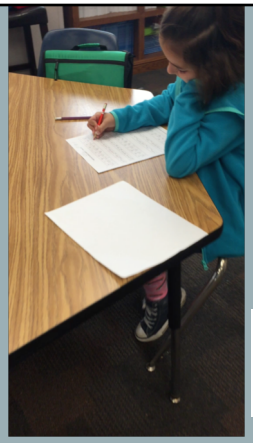


Single Word Problem

- Collaborative Problem Solving
- Strategic Thinking

FACT PRACTICE: FOCUS ON STRATEGY INSTRUCTION

- These short exercises provide variety and break up class time into meaningful chunks.
- With the strategy instruction approach, kids need multiple short opportunities to practice.



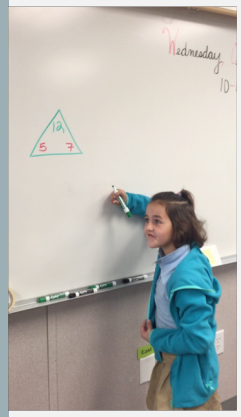
WARM-UP: FACT PRACTICE

- 1-minute timed exercise
- Noncompetitive, compared to self, personal goals are set

FACT PRACTICE: FOCUS ON STRATEGY INSTRUCTION

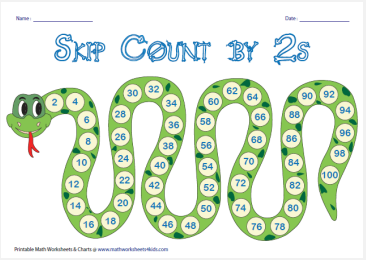
These short exercises provide variety and break up class time into meaningful chunks.

With the strategy instruction approach, kids need multiple short opportunities to practice.



Doubles Facts for Compensation Strategy

WARM-UP: SKIP COUNTING



- Builds the foundation of multiplication through number sense
- Focus on two to three facts a week
- Incorporate weekly facts into other parts of the daily lesson when possible

AUDITORY & VISUAL DRILLS

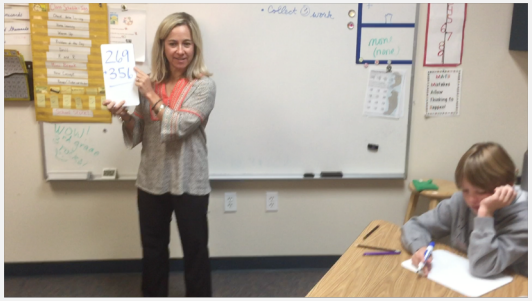
AUDITORY/VISUAL/KINESTHETIC (AVK)

"Opening the Files"

"Priming the Pump"

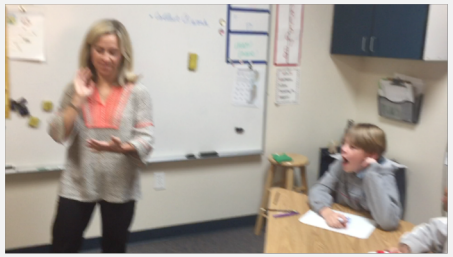
VISUAL DRILL

- Students respond to a primarily visual input.
- Goal: Simultaneous AVK response by students to a visual prompt by teacher



Just a few minutes in length

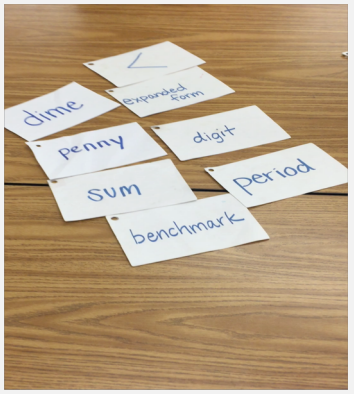
AUDITORY DRILL



- Students respond to a primarily auditory input.
- Students echo, write, and solve.
- Goal: Simultaneous AVK response by students to an auditory prompt by teacher

Just a few minutes in length

MATH VOCABULARY PRACTICE



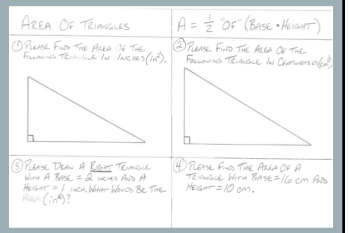
Just a few minutes in length

REVIEW AND REINFORCEMENT (R & R)

Reviews recent or challenging concepts

Incorporate Mixed Review to keep multiple skills sharp

Takes about ½ of lesson time



USING TECH FOR R & R

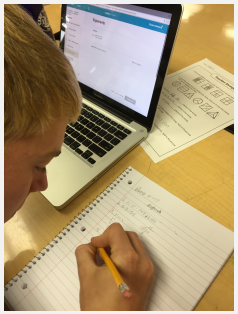
- Solidifies prior knowledge
- Builds automaticity
- Extends recently taught concepts
- Differentiated instructional levels

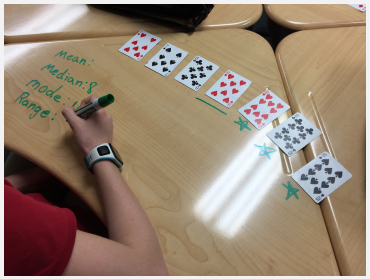
Quick Math

desmos

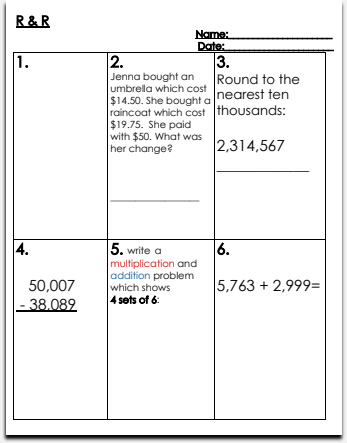
KHAN ACADEMY

REVIEW AND REINFORCEMENT AT VARIOUS GRADE LEVELS





REVIEW AND REINFORCEMENT AT VARIOUS GRADE LEVELS



R & R

Name: _____
Date: _____

1.	**2.** Jenna bought an umbrella which cost $14.50. She bought a raincoat which cost $19.75. She paid with $50. What was her change? _____	**3.** Round to the nearest ten thousands: 2,314,567 _____
4. 50,007 - 38,089	**5.** write a multiplication and addition problem which shows **4 sets of 6**:	**6.** 5,763 + 2,999=

NEW INFORMATION

Builds on prior knowledge

Taught at 3 levels:

Concrete – Introduce the concept using manipulatives, gross motor movements, hands on experiences

Representational – Draw a picture or diagram creating a portable memory

Abstract – Apply the efficient use of numerals in algorithms for calculations

NEW CONCEPT: MULTIPLICATION

Concrete

- Strings with Wings
- Circle Groups
- Arrays

Example: 3 x 4 = 12

Key School at Carolina Day - Asheville, NC

NEW CONCEPT: MULTIPLICATION

Representational

Write word problems and draw pictures

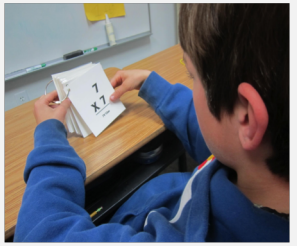
Multiply (*x*) means "groups of"
- 3 x 4 reads "3 groups of 4"

The Key School at Carolina Day - Asheville, NC

NEW CONCEPT: MULTIPLICATION

Abstract

Use multiplication facts and clues to solve equations or answer word problems



The Key School at Carolina Day - Asheville, NC

Homework (Home Learning)

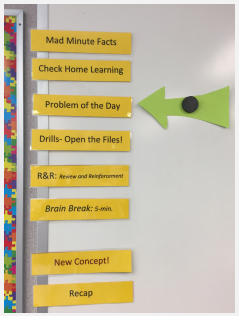
- Fosters independence
- Is short and successful
- Builds in practice with following procedures or class notes (for older students)

END OF CLASS REVIEW/RECAP

- Solidifies learning
- "Locks in" information
- Ticket out the door

TO RECAP. . . THE MULTISENSORY MATH LESSON PLAN

- Problem of the Day
- Warm-Up
- Drill – Auditory/Visual/Kinesthetic
- Review and Reinforcement
- New Information
- Recap



USING THE MSM LESSON IN A DIAGNOSTIC-PRESCRIPTIVE PROCESS

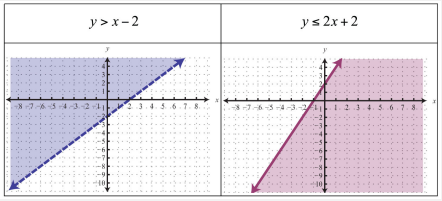
- Identify necessary subskills by task analysis to find gaps
- Identify prerequisite vocabulary and solidify understanding
- Work from simple to complex to address weaknesses
- ***Work from what is known into what is new***

LET'S CONSIDER AN EXAMPLE. . .

<u>Graphing Inequalities:</u>

What subskills are necessary?

What vocabulary should a student be familiar with?



EQUALITY VS. INEQUALITY

Can a student identify the correct symbol for greater than vs. less than?

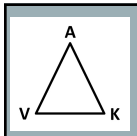
Can a student distinguish between greater than vs. greater than or equal to?

- Let's consider how we might use a component of the multisensory math lesson plan to answer these questions

VISUAL DRILL

Students respond to a primarily visual input

Student is shown greater than and less than symbols via note cards or through technology (e.g.: SmartBoard) and asked to identify



AUDITORY DRILL

Students respond to a primarily auditory input

Student is given a blank number line and asked to graph basic inequalities, which are dictated to them, including both greater than and greater than or equal to (this will help diagnose if closed vs. open circles can be used to make the connection to solid vs. dotted lines when graphing)

COORDINATE GRIDS AND QUADRANTS

Can a student identify the x and y axis?

Can a student name the four quadrants?

- Let's consider how we might use a component of the multisensory math lesson plan to answer these questions

REVIEW AND REINFORCEMENT (R & R)

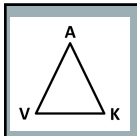
Reviews recent or challenging concepts

Student is given blank coordinate grids and asked over multiple examples to label the x and y axis and plot points, recording each time in which quadrant they are working

SLOPE

Can a student consistently prove understanding of positive, negative, zero, and undefined slope?

- Let's consider how we might use a component of the multisensory math lesson plan to answer these questions



AUDITORY DRILL

Students respond to a primarily auditory input

Student is asked to stand and using either their hands and arms (younger kids are more agreeable to this) or a manipulative (such as a pipe cleaner) to show each slope dictated

SLOPE INTERCEPT

Can a student consistently graph a line using the slope intercept form?

- Let's consider how we might use a component of the multisensory math lesson plan to answer these questions

REVIEW AND REINFORCEMENT (R & R)

Reviews recent or challenging concepts

Student is given blank coordinate grids and asked over several examples to label the x and y axis and graph given lines in slope intercept form including shading "above" or "below" the line

PUTTING IT ALL TOGETHER WITH NEW INFORMATION

After solidifying the previously taught skills by working from simple to complex, diagnosing through task analysis any areas of weakness, we are ready to transition from:

What is Known into What is New

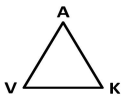
YOUR "YOU DO" OPPORTUNITY…

- Take a look at the "You Do" Handout– choose a math concept
- Work collaboratively with someone else in the room
- Identify subskills and vocabulary of the concept
- Pair the subskill or vocabulary with a component of the Key Multisensory Math Lesson Plan

TAKE-AWAYS
MSM COMPONENTS – MSM LESSON PLAN

1. Multiple Sensory Experiences
2. Multiple Representations
3. Precise Instructional Language
4. Differentiation
5. Vertical Linkages
6. Explicit Concept-Based Instruction using the **CRA Sequence**

- Problem of the Day
- Warm-Up
- Drill – Auditory/Visual/Kinesthetic
- Review and Reinforcement
- New Information
- Recap



Key School Multisensory Math Lesson Plan Outline

AVK strategies woven in all parts.

85 Minute Lesson Plan Outline	Your Notes
Problem of the Day/Warm Up - 5 to 10 minutes ● Focusing Activity, 5-10 minutes - A relatively easy task that instills confidence, opens the files for learning, and builds mental agility, and mathematical strategy thinking and problem solving. ● Builds automaticity with fact families and fluency with multi-step algorithms ● Repetition to build patterns and sequences	
Visual Drill - 5 minutes total for both drills *Simultaneous AVK - Students respond to visual input giving auditory, visual, kinesthetic response* Visual Drill Ideas: ● Teacher shows vocabulary word flashcards and asks for definition (A and V). ● Teacher shows fact families with missing components on flashcards (A and V). Fact family triangles practice to increase automaticity with multiplication and division facts or addition and subtraction facts. ● Teacher shows quantity card and asks for corresponding numeral representation (A and V). ● Teacher shows flashcard with missing components of a sequence or pattern on flashcards (A and V). ● Sorting exercises. "Show me the quantity of" the number on the card using beads, unifix cubes, counting animals, etc	
Auditory Drill - 5 minutes total for both drills *Simultaneous AVK - Students respond to auditory input giving visual, auditory, kinesthetic response* Auditory Drill Ideas: ● Teacher and/or students call out fact families. ● Teacher dictates problems to be practiced (students should echo, write, solve). ● Teacher asks for vocabulary definitions or reads definitions and asks for corresponding vocabulary words.	
Review and Reinforcement (R & R) Section of the Lesson - ½ of total lesson time ● The heart of MSM - this is the time the students practice skills to mastery. ● Ample opportunity to gain confidence and agility with recently taught information while weaving in previously taught concepts ● Provides opportunity for deep learning ● Can be a wide variety of activities and types of opportunities to practice skills and concepts that are recent and areas that students have gaps in their knowledge / learning ● Vocabulary and math language modeled and practiced	
New Information - ¼ of total lesson time *New concepts are taught at the 3 levels of Concrete, Representational, Abstract (CRA) targeting the appropriate level for the students* ● Connects to and builds on prior knowledge ● Introduced at concrete level, then moves to representational then to abstract. ● CRA can be taught over multiple days ● Vocabulary is explicitly taught for each concept	
Homework (Home Learning) - Assigned and Reviewed *Confirmation of understanding of previous day's homework can be done at different points during the lesson (at start of class or during R&R)* ● Short opportunity to practice with built-in success ● Can be individualized to assure independent success	
Recap of New Concept - 2 - 4 minutes to close the file *File the big concept for the day away into the correct mental file. Seal the deal with a quick confirmation through "ticket out the door" approach.*	

“You Do” Opportunity

With your group consider one (or more) of the following concepts:

Addition with Regrouping	Multiplying Multi-digit Factors	Creating Equivalent Fractions
Subtraction with Regrouping	Dividing with Single Digit Divisors	Adding Fractions with Unlike Denominators

Subskills and/or Vocabulary Required	**Areas of MSM Lesson Plan Components to Address these Subskills**
Skill or Vocab	Part of the Lesson
Skill or Vocab	Part of the Lesson
Skill or Vocab	Part of the Lesson