A FRAMEWORK FOR EFFECTIVELY INTEGRATING STUDENTS WITH HIGH INCIDENCE DISABILITIES INTO MATHEMATICS CCSS

MOVING FROM STANDARDS TO PRACTICE: LEADING TOMORROW’S MATHEMATICS AND SCIENCE EDUCATION IN SOUTH CAROLINA

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OVERVIEW

• The Need
• The Developing Mathematical Literacy Initiative (DML-I): A Framework for Effectively Engaging Students with HID in the CCSSM
• Potential for the DML-I and the CCSSM
• Research and Development Activities
THE NEED
Math Reality for Many Students with LD

- Well below peers without disabilities
  - e.g., 40-42% at or below 20\textsuperscript{th} percentile; only 11-16% at or above 61\textsuperscript{st} percentile (IES, 2007)

- Historical and consistent difficulties with mathematics including algebra
  - e.g., Bryant, Bryant, & Hammill, 2000; Cawley, Parmar, Yan, & Miller, 1998; Maccini, McHaughton, & Rule, 1999; Witzel, Mercer, & Miller, 2003

- Failure to pass secondary end of course exams (Algebra 1 & Algebra 2)
  - e.g., Urquhart, 2000; Witzel, Smith, & Brownell, 2001

- Math requirements necessary at postsecondary level
  - e.g., Minskoff & Allsopp, 2003
Characteristics
- Strength
- General Learning
- Cognitive-based

Effective Teaching Practices for Characteristics
- Authentic contexts
- Strategy instruction
- Graphic organizers
- Multisensory methods
- C-R-A Instruction
- multiple opportunities
- Systematic, explicit instruction
- Scaffolding, guided practice
- Self-regulation
- Self-awareness

CCSS & Students with HID
- Achieve rigorous content and skills
- Master higher-order thinking skills
- Gain knowledge and skills needed for college and work
- Learn content area literacy
- Gain depth & breadth
THE DEVELOPING MATHEMATICAL THINKING INITIATIVE (DML-I)

A Framework for Integrating Students with HID in the Mathematics CCSS
WHAT IS THE DML-I PROCESS? – QUICK OVERVIEW

- A structured but flexible instructional process that integrates research supported practices
- Initially developed for Tier 2 and Tier 3 type intervention
- Emphasis on developing mathematics literacy
- Number sense, Number Operations, & Algebraic Thinking concepts/skills
- 30-45 minute sessions
- Use of continuous student performance data collection to make instructional decisions
A Closer Look

The Developing Mathematical Literacy Initiative

Instructional Components

1. Measure Progress and Make Decisions
2a. Communicate Mathematical Ideas
2b. Make Connections
3. Problem Solve the New
4. Build Fluency

The Developing Mathematical Literacy Initiative

The Foundation

- Research-Supported Practices
- NCTM Processes
- Context
- Data-based Instructional Decision-making
Research Supported Effective Practices & Related NCTM Processes Emphasized

- Explicit Instruction
- Meaningful Context
- C-R-A Teaching/Assessment Sequence (Representation)
- Teaching Math Strategies (Problem Solving)
- Visuals/Graphic Organizers (Representation/Connections)
- Communicating/Verbalizing Mathematics (Communication/Rationale & Proof)
- Multiple Response Opportunities with Corrective Feedback & Positive Reinforcement
- Continuous Monitoring/Data-based Decision-making
Problem solving and development of mathematics strategies are situated within narrative contexts.
ANCHOR #4: DATA BASED DECISION MAKING

Pre/Post Assessment
number sense
number operations
algebraic thinking

Continuous Progress Monitoring (during intervention)
C-R-A
Students respond to screening instruments/probes that address important K-8 number sense, number operations, & algebraic thinking skills.

Examples: K-6 Algebraic Thinking Scope & Sequence (Allsopp, Kyger, & Lovin, 2006); The Number Knowledge Test (Okamoto & Case, 1996); ; Number Sense Brief (Jordan, Glutting, and Ramineni, 2008)

Student responses are analyzed to determine concepts/skills needed for intervention
7. Using words, tables, graphs and rules to describe relationships

7a. Given situations that illustrate change, the student with identify and describe the change.
K-2:
Qualitative change
Quantitative change

3-5:
Varying and constant rates

Sue planted a sunflower. Once it sprouted, she watched it grow. Look at the chart and tell me what happened using words and numbers:

<table>
<thead>
<tr>
<th>Weeks in June</th>
<th>Inches grown each week</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

Two runners decided to race for 4 miles. Look at the table and describe how fast each runner ran.

<table>
<thead>
<tr>
<th></th>
<th>Mile 1</th>
<th>Mile 2</th>
<th>Mile 3</th>
<th>Mile 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Runner 1</td>
<td>10 minutes</td>
<td>10 minutes</td>
<td>10 minutes</td>
<td>10 minutes</td>
</tr>
<tr>
<td>Runner 2</td>
<td>8 minutes</td>
<td>12 minutes</td>
<td>12 minutes</td>
<td>10 minutes</td>
</tr>
</tbody>
</table>
During Intervention Sessions

Measuring Progress Phase:

Teacher evaluates students’ abilities to Read, Represent, Solve, & Justify during problem solving (i.e., word problem)

Building Fluency/Proficiency Phase:

C-R-A probe (Discrete Trial – “C” & “R;” or, Timing – “A”)
FOCUS: Measure Student’s Understandings of Newly Introduced Algebraic Thinking Concepts/Skills (10 minutes)

- Embedded in narrative/story problem
- Four aspects of problem solving
  - Read
  - Represent
  - Solve
  - Justify
- Make Instructional Decisions
  - Level of understanding (C-R-A)
  - Appropriateness of Concept/Skill
GAME DAY! – FOOTBALL

David’s favorite team, the Gators are playing a football game this weekend and he is excited because he gets to go with his mom and dad. When they go to the games, they enjoy eating lots of good food, dancing along with the cheerleaders and doing the Gator chomp when the Gators score a touch down.

![Gator player]

![Gator shirt]

![Cheerleader]

During the first quarter the Gators 7 points. In the second quarter, the Gators scored 7 points. In the third quarter, the Gators also scored 7 points. With little time remaining in the fourth quarter, the Gators scored 7 more points to win the game! When the game was over David and his parents were very happy because their team had won.

PROBLEM SOLVING PROMPTS:

1. Can you show an addition number statement that shows the points scored by the Gators in the game?
2. Can you show a multiplication number statement that shows the points scored by the Gators in the game?
3. Because the Gators scored the last touchdown in the fourth quarter to win the game, how many total points could the other time have had?
4. If the Gators had scored 14 points in the fourth quarter instead of 7 points, how could you show a number statement showing their total points using both addition and multiplication?
INTERVENTION SESSIONS NOTES

FOCUS: Support Students to Apply Math Strategies and Thinking to New Problems (14-20 minutes)
Embedded in narrative/story problem

1) Set the Stage for Learning (1 minute)
   - Link
   - Identify
   - Provide Rationale

2) Problem Solve (5-9 minutes)
   - Read
   - Represent
   - Solve
   - Justify

3) Communicate Mathematical Ideas (4-5 minutes)
   - Math Language Notebook
   - Associate Language to Math Representations

4) Connect Mathematical Ideas (4-5 minutes)
   - Graphic Organizers
Math Language Notebook (Example)

- \(3 \times 7 = 21\)
- \(3 \times 7\) is equivalent to 21
- 3 groups of seven is twenty-one

\[3 \times 7 = 21\]
Four times five is twenty!

Four groups of five is twenty.

$5 + 5 + 5 + 5 = 20$

$4 \times 5 = 20$
FOCUS: Familiar Mathematics Concepts/Skills (12-15 minutes)

- Math Literacy Practice (10 minutes)
- Measure Level of Proficiency (2-5 minutes)

Some difficulty with confusing + and x signs. Most errors occur with division (treats like communicative property).
<table>
<thead>
<tr>
<th>CRA Level of Understanding</th>
<th>Method</th>
<th>Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>1-5 minute timings (depends on nature of target concept)</td>
<td>Fluency (Rate &amp; Accuracy)</td>
</tr>
<tr>
<td>Drawing</td>
<td>8-10 tasks</td>
<td>Accuracy 90-100% 3 times</td>
</tr>
<tr>
<td>Concrete</td>
<td>3 tasks</td>
<td>Accuracy 100% 3 times</td>
</tr>
</tbody>
</table>
Examples of Concrete and Representational/Drawing Probe Tasks

Concrete

Use circle pieces and string to solve the following equations.

Representational/Drawing

1. Below each item, draw a fraction that shows the first fraction and then draw a fraction that makes each statement true. You can use any of the fractional parts listed in the parentheses for each item.

1a. (Use halves, thirds, sixths, eighths, tenths, or twelfths)

\[
\frac{1}{4} \quad \text{is greater than} \quad \frac{1}{8}
\]
**Algebraic Thinking Domain:** The Notion of Variables (and Equality)  
**Objective:** Write number sentences to represent equivalent mathematical relationships  
**Level of Understanding:** Abstract  
**Response Task:** Read number sentence/Write a different number sentence that is equivalent

<table>
<thead>
<tr>
<th>Number Sentence</th>
<th>Equivalent Sentence</th>
<th>Cumulative Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>$5 + 4$</td>
<td>$6\times 2$</td>
<td>$6 - 1$</td>
</tr>
<tr>
<td>$4 \times 3$</td>
<td>$7 + 4$</td>
<td>$4 \div 2$</td>
</tr>
<tr>
<td>$4 - 3$</td>
<td>$5 \times 2$</td>
<td>$6 - 3$</td>
</tr>
<tr>
<td>$4 \times 5$</td>
<td>$0 + 0$</td>
<td>$1 \times 9$</td>
</tr>
<tr>
<td>$7 - 7$</td>
<td>$2 - 1$</td>
<td>$3 \times 3$</td>
</tr>
<tr>
<td>$9 \div 3$</td>
<td>$5 + 0$</td>
<td>$3 \times 4$</td>
</tr>
<tr>
<td>$10 - 6$</td>
<td>$6 \times 2$</td>
<td>$8 + 8$</td>
</tr>
<tr>
<td>$2 - 0$</td>
<td>$0 + 4$</td>
<td>$5 \times 0$</td>
</tr>
<tr>
<td>$3 + 7$</td>
<td>$8 \times 3$</td>
<td>$15 \div 3$</td>
</tr>
<tr>
<td>$12 \div 12$</td>
<td>$13 + 2$</td>
<td>$6 \times 6$</td>
</tr>
</tbody>
</table>
POTENTIAL FOR THE CCSS
Characteristics

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DML-I

- Special & math education research
- Foundational and higher-order skills
- Mathematics literacy
- Provides a process that can be adapted
- Resists the “dumbing down” of the mathematics curriculum by providing a viable structure to master CCSSM and meet students’ needs

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OBSERVATIONS & QUESTIONS