Mathematics Interventions

Courage to Risk 1/24/09

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Advance Organizer



- Mathematics Education and a 3-Tier Model
- Mathematics Difficulties
- Tier 2 Intervention Booster Lessons



Warm-up

•Count by 10's, 5's, 2's

Count up/back (from a given point)

•Write your numbers (10 . . .)

Answer facts











Mathematics Education and a 3-Tier Model





Colorado Multi-Tiered Model of Instruction & Intervention



www.cde.state.co.us/Rtl/LearnAboutRtl.htm







NCTM *Curriculum Focal Points & Connections*, Sept. 2006

http://www.nctm.org/focalpoints/downloads.asp

Kindergarten:

Number & Operations: Representing, comparing, and ordering whole numbers and joining and separating sets (Geometry, Measurement)

First Grade:

Number & Operations & Algebra: Developing understanding of addition & subtraction and strategies for basic addition facts and related subtraction facts

Number & Operations: Developing an understanding of whole number relationships including grouping in tens & ones (Geometry)

Second Grade:

Number & Operations: Developing an understanding of the base-ten numeration system and place-value concepts

Number & Operations & Algebra: Developing quick recall of addition facts and related subtraction facts & fluency with multidigit addition and subtraction (Measurement)



Number Sense

- NCTM described number sense as "moving from the initial development of basic counting techniques to more sophisticated understandings of the size of numbers, number relationships, patterns, operations, and place value" (2000, p.79).
- . . . good number sense abilities as moving effortlessly between quantities and number (Case, 1998).
- . . . represent numbers in many ways, recognize numerical patterns [algebraic reasoning], and understand numerical quantities



Number Sense

- A strong relationship between number sense abilities and mathematics achievement has been found in the primary grades (Jordan, Kaplan, Oláh, & Locuniak, 2006; Locuniak & Jordan, 2008).
- Examples of skills that are related to number sense include counting, quantity comparison (Which group has more? Which number is greater?), arithmetic facts, and story problems Bryant et al., 2008).

What does it take

- To use the count-on strategy to add 9+3=?
- To use the doubles +1 strategy?
- To identify where to put the number 50 on a number line?
- To use a hundreds chart to count by 10s beginning with 32?
- To use the decomposition strategy to add 9+4=?
- To identify which number is greater: 49 or 62?
- To tell which number comes before 21?
- To subtract two numbers that require regrouping?





What does it take

- To use the count-on strategy to add 9+3=?
 (recognize +1, +2, +3 are count on strategies; min strategy: bigger # in head [9] count on 3 [keeping track of 3 while also counting consecutively tap fingers, hold up fingers]
- To use the doubles +1 strategy?
 (Doubles, know doubles +1 = two numbers next to each other on the number line)
- To identify where to put the number 50 on a number line? (recognize start & end point; distance between; where 50 belongs)
- To use a hundreds chart to count by 10s beginning with 32? (start with 32, recognize 42 is 10 more)



To use the decomposition strategy to add 9+4=?

(9 + 1 and 4 = 3 + 1, use the 1 to make 10, now 10 + 3 = 13).

- To identify which number is greater: 49 or 62? 68 or 61? (start with 10s; go to ones)
- To tell which number comes before 21? (vocabulary: before, 20)
- To subtract two numbers that require regrouping? (understands place value, checks ones place, knows top number should be bigger, subtracts-knows facts)



Mathematics Difficulties







What do we know about characteristics of students with math difficulties?

Procedural Difficulties

- Inefficient/ineffective strategy use - Errors in math problem execution (following the steps to solve the problem) - Doesn't use knowledge of properties

Fails to verify answers and settles for first answer

Takes a long time to complete calculations

Makes "borrowing" (i.e., regrouping, renaming) errors

Counts on fingers

Calculates poorly when the order of digit presentation is altered

Disregards decimals

Fails to carry (i.e., regroup) numbers when appropriate

(Bryant, Bryant, & Hammill, 2000; Geary, 2004) © 2008 Meadows Center

What do we know about characteristics of students with math difficulties?

Representative Memory Problems

-Poor long-term memory retrieval skills (permanent storage of information that is assisted by how information is stored) - Working memory deficits (processing and storing information simultaneously)

Cannot recall number facts automatically (declarative knowledge)

Cannot remember procedural steps

Representative Visual/spatial Deficits

-Weak visual/spatial representations

-Orders and spaces numbers inaccurately in multiplication and division

Misaligns vertical numbers in columns

Problems with place value that involves understanding base ten system

Trouble interpreting maps and understanding geometry

What do we know about characteristics of students with math difficulties?

Problems with Number Sense

Number magnitude comparison confusion

Poor number naming and writing

Understanding relative size of parts such as thirds, tenths, 25% and their relationship to a whole unit

Fails to see "unreasonable" answers

Disregards decimals

Fails to read accurately the correct value of multi-digit numbers because of their order and spacing



Problem Areas in children with MD, MD/RD and RD only*K, 1, 2, 3 (+ = problem - = not a problem)

Skill Counting	MD only +	MD/RD +	RD/only -		
Number Knowledge	+	+	-		
Rapid Fact Retrieval	+	+	-		
Number Naming	+	+	-		
Problem Solving	-	+	-		
Reliance on Fingers	+	+	-		
Digit Span	-	+	-		
Word Articulation Speed - + + + *From: Jordan, N.C. (2007). Do words count? Compilation of results from several studies.					
"D" refers to difficulties.	2000 Meedows Cost				
adows Center	2008 Meadows Center				

Early Predictors of Math Achievement*

Task	Areas Assessed				
Counting skills	Set enumeration; rote counting; 1-1				
	correspondence; stable order; cardinality				
Number knowledge	Relationships between numbers				
	(e.g., magnitude comparisons)				
Nonverbal calculation:					
Set transformations box	Adding or taking away objects hidden under a ("How many objects under the box?").				
Story problems	Single-digit addition and subtraction				
	problems embedded in stories				
Number combo	Single-digit addition and subtraction				
*From: Jo	problems ("How much is 2 + 1?) rdan, N.C. (2007). Do words count? Compilation of results from several studies.				



Tier 2 Intervention Booster Lessons







What content is important for Tier 2 based on the research?

Word Problem Solving: types of problems, extraneous information, multiple steps, contextualized

Number Knowledge and Relationships Counting: Rote, Rational, Counting Up/Back, Skip (2, 5, 10) Number Recognition & Writing: 0 - 99 (1st); 0 - 999 (2nd grade) Comparing & Grouping Numbers

Number Relationships of more, less, Relationships of one and two more than/less than Anchoring Numbers to 5 & 10 frames Part-part-whole Relationships (e.g., ways to represent numbers)

Numeric Sequencing



What content is important for Tier 2 based on the research?

Base 10 & Place Value

Making and counting: groups of tens and ones (1st grade); groups of hundreds, tens, and ones (2nd grade)

Using base-ten language (3 hundreds, 0 tens, 6 ones) and standard language (306) to describe place value

Reading and writing numbers to represent base ten models

Naming the place value held by digits in numbers

Addition & Subtraction Combinations

Identity Element and Properties Fact Families Counting & Decomposition Strategies (e.g., Addition: count on [+ 0, + 1, + 2], doubles, doubles +1, make 10 + more; Subtraction: count down [-0, -1, -2, -3], count on

Procedures & Features of Tier 2 Intervention*

•Groupings: homogeneous grouping with 3 - 5 students per group

•Duration: 4 times per week for 25 minutes; PM 5th day

•Lesson Design: mixed (instructional content-IC), scaffolded, scripted interventions; explicit, strategic, "think aloud;" error correction; factual, procedural, and strategic learning

•Instructional Content: IC ranges focusing on difficult numbers; vocabulary; (e.g., greater than/less than); number, operation, quantitative reasoning; patterns/relationships/algebraic thinking; problem solving; other TEKS (implicit)

*Based on Research for Students with Difficulties/Disabilities



Procedures & Features of Tier 2 Intervention

•Representations: physical (concrete), visual (pictorial), abstract (numbers/symbols)

•Materials: number charts (100s), 5- and 10-frames, counters, cubes, number lines, base-ten materials, dot cards, fact cards, place value cards

Progress monitoring: daily checks (independent practice); aim checks

- Stretch Your Skills
- Bubble answers
- •Fidelity Checks



Sample Fidelity of Implementation Rating Scale

Teacher Behavior	Most of the time	Some of the time	Rare- ly	Not at all
	3	2	1	0
Intervention				
Teacher follows script				
sufficiently to ensure fidelity of				
implementation.				
Teacher implements each step				
(modeling, GP, IP) sufficiently				
to ensure fidelity of				
implementation.				
Teacher implements self-				
correct/EC following IP to				
ensure students learn IC.				
Instruction				
Teacher maintains brisk pace.				
Teacher provides corrective				
feedback immediately as				
needed.				
Teacher talk is kept to a				
minimum and is characterized				
with short requests "What				
answer?" "How many?"				
Teacher engages students				
throughout lesson with a				
response that is verbal, written,				
or hands-on.				
Teacher models using "think				
aloud."				



Instructional Routine for Tier 2 Intervention Booster Lessons*

Framing the lesson **Previewing** Modeling w/think alouds or Modeled **Practice Guided practice Independent** practice **Checking for understanding Error correction and feedback Progress monitoring**

*Based on Research for Students with Difficulties/Disabilities



What we know....

 Multiple opportunities to practice within the lessons

- Good pacing
- Error correction
- Opportunities to make, show, write number concepts; problem solving
- Regular, consistent intervention 4-5 days per week
- Strategies to procedural knowledge
 Progress Monitoring/Data

*Based on Research for Students with Difficulties/Disabilities



You can create your intervention to include

 Warm-up: 2 minutes, previous facts, number recognition, number writing Look & Say or Look & Write
 Specific strategies for facts: min strategy (bigger number +); fact families +/-1, +/-2, +/-3; doubles; doubles +1; harder facts (decomposition + 10)

*Based on Research for Students with Difficulties/Disabilities



You can create your intervention to include

3.Place Value: C-P-A; Language: How many groups? How many altogether? 10, 20, 30, switch; place value mat 4. Ordering and comparing numbers: connect to place value, omit beginning number mostly (____, 16, 17; ____, 203, 204); greater than/less than-start with tens or hundreds place if same go to next place

*Based on Research for Students with Difficulties/Disabilities

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You can create your intervention to include

5.Cool down: more facts-Look & Say and Look & Write
6. Application: games, Stretch Your Skills

*Based on Research for Students with Difficulties/Disabilities



Unit: 7	Futor :	:				Group:		Time :
Student Tin	me	Day 1	Time	Day 2	Time	Day 3	Time	Day 4
	D	Date:		Date:		Date:		Date:
5/2	2 A	ASC:	8/2	PV:	5/2	ASC:	8/2	PV:
7/2	2 W	VPS:	6/2	MC:	7/2	WPS:	6/2	MC:
2/2	2 N	IS:	2	FF:	2/2	NS:	2	FF:
5/2	2 A	ASC:	8/2	PV:	5/2	ASC:	8/2	PV:
7/2	2 W	VPS:	6/2	MC:	7/2	WPS:	6/2	MC:
2/2	2 N	IS:	2	FF:	2/2	NS:	2	FF:
	-		0.40		z / 2	4.9.9	0./0	
5/2	$\begin{array}{c c} 2 & A \\ 2 & U \end{array}$	ASC:	8/2	PV:	5/2	ASC:	8/2	PV:
		VPS:	6/2	MC:	1/2	WPS:	6/2	MC:
	2 N	15:	2	FF:	2/2	NS:	2	FF:
	-		0.40	DI	5 / 0	4.0.0	0.10	DI
5/2	2 A	ASC:	8/2	PV:	5/2	ASC:	8/2	PV:
	2 W	VPS:	6/2	MC:	7/2	WPS:	6/2	MC:
272	2 N	NS:	2	FF:	2/2	NS:	2	FF:
5/2	2 A	ASC:	8/2	PV:	5/2	ASC:	8/2	PV:
7/2	2 W	VPS:	6/2	MC:	7/2	WPS:	6/2	MC:
2/2	2 N	IS:	2	FF:	2/2	NS:	2	FF:

Daily Activity Check Progress Monitoring- First and Second Grade

Behavior:



Graphing Unit Checks



From: Bryant, B. R., & Bryant, D. P. (2008). Monitoring progress to determine RtI. Manuscript in preparation adows Center for preventing educational risk

Student 2 Progress Monitoring Data

TEMI-PM&TEMI-AC

■ASC ■PV ■NS ■MC





Units

Validating the Interventions: Results Tier 2 Intervention

- 2007-2008 [3-Tier Schools]: Based on <u>Spring TEMI-PM</u> results with below the 25th percentile as the cut score for Tier 2
 - Kindergarten:
 - 41% qualified to exit Tier 2
 - 25% qualified for Tier 2
 - 34% qualified for Tier 3 (below the 10th percentile)
 - First Grade:
 - 52% qualified to exit Tier 2
 - 24% qualified for Tier 2
 - 24% qualified for Tier 3
 - Second Grade:
 - 49% qualified to exit Tier 2
 - 24% qualified for Tier 2
 - 27% qualified for Tier 3



Tier 3: Tertiary Intensive Intervention: Essential Features

Instructional Explicitness

Instructional Design to Minimize the Learning Challenge

Conceptual Basis

•Drill & Practice

Cumulative Review



Motivators to Monitor/Regulate Attention & Behavior

Progress Monitoring

Fuchs et al. upcoming special series in LDQ



What Works Clearinghouse

• WWC Evidence Standards:

- identify studies that provide the strongest evidence of effects
- randomized controlled trials and regression discontinuity studies, and secondarily quasi-experimental studies of especially strong design
- "Meets Evidence Standards"
- "Meets Evidence Standards with Reservations"
- "Does Not Meet Evidence Screens"

http://ies.ed.gov/ncee/wwc/

http://ies.ed.gov/ncee/wwc/reports/topic.as
px?tid=04 (reports)



WWC: Under Review

Programs under review

- Accelerated Math
- Bridges in Mathematics
- Compass Learning Odyssey
- Investigations in Number, Data, and Space
- Kumon Mathematics Program

The Access Center

- <u>http://www.k8accesscenter.org/training_resou</u> <u>rces/math.asp</u>
 - Mathematics Strategy Instruction (SI) for Middle School Students with Learning Disabilities
 - Using Mnemonic Instruction to Teach Math
 - Using Peer Tutoring for Math
 - Computer-Assisted Instruction and Math
 - Direct/Explicit Instruction and Math
 - Learning Strategies and Math
 - Concrete-Representational-Abstract Instructional Approach
 - Learner Accommodations and Instructional Modifications for Students with Learning Disabilities



More Resources

- Math Differentiation Brief
- Math Graphic Organizers
- Math Problem Solving for Primary Elementary Students with Disabilities
- Math Problem Solving for Upper Elementary Students with Disabilities
- Illuminations
 http://illuminations.nctm.org/
- MathTools
 http://www.mathforum.org/mathtools/
- Meadows Center for Preventing Educational Risk: Mathematics Institute for Learning Disabilities and Difficulties

http://www.meadowscenter.org/

www.earlymathintervention.org



Sample Lessons

Lets look at some sample lessons.

