An Emerging Model: Three-Tier Mathematics Intervention Model

Special Education Research Project (SERP)-Mathematics:

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This model is based on the 3-Tier Reading Model Vaughn Gross Center for Reading & Language Arts © University of Texas System/Texas Education Agency: www.texasreading.org

The Characteristics of Students with Mathematics Disabilities (MD)

- Procedural difficulties
 - Immature strategies use
 - Errors in math problem execution
- Memory problems
 - Poor long-term memory retrieval skills
 - Working memory deficits
- Visual/spatial deficits
 - Weak visual/spatial representations
- Low number sense
 - Number magnitude comparison confusion
 - Poor number naming and writing

Core Educational Problem: Assessment

- Limited availability of technically adequate measures for identification and to monitor response to intervention of Tier 2 students in the primary grades
- Need to develop technically adequate measures for early mathematics number, operation, and quantitative reasoning skills and concepts
- Measures can contribute to an understanding of predictors of early mathematics performance, inform mathematics instructional decisions, and change mathematics outcomes for students who are at risk for mathematics difficulties

(Chard, Clarke, Baker, Otterstedt, Braun, & Katz, 2005)

What is the 3-Tier Mathematics Intervention Model?

- Is an assessment & intervention model designed to meet the instructional needs of students in grades K -2 who are identified as struggling with mathematics
- Provides a framework for providing instruction and using assessment data to inform decision-making
- Is a response-to-intervention model (developing)
- Focuses on standards-based intervention (number & operation)

What are the Components of the 3-Tier Mathematics Intervention Model?

- Tier 1: Core classroom instruction for all students (45-60 minutes-observed in K-4)
- Tier 2: Intervention for approximately 10 30% of identified students (15-20 minutes-10 - 12 weeks - 3 to 4 days a week)
- Tier 3: Intensive intervention for approximately 5-8% of identified students (may include special education students; probably another 20 minutes?)

What are the Components of the 3-Tier Mathematics Intervention Model?

- Tier 1
 - Seems to be based on National Science Foundation instructional recommendations, teacher created lessons, basal based instruction, NCTM Standards (based on observations)
 - Focus on instructional adaptations (content, delivery, materials, activity): Tier 1 + adaptationskeep your eye on Tier 2

What are the Components of the 3-Tier Mathematics Intervention Model?

Tier 2 (probably Tier 3-developing)

- Includes differentiated instruction in number and operation (developing)
- Includes explicit instruction in small, homogeneous groupings
- Has levels of instructional need within Tier 2
- Includes intervention lessons on number and operation (developing)

■Tier 3

More intensive instruction; delivery, grouping, content

How is Assessment Conducted in the 3-Tier Mathematics Model?

Texas Early Mathematics Inventories (TEMI)

- Kindergarten: Quantitative Recognition (subitizing), Numeral Naming (1-20), Magnitude Comparisons (1-20; bigger/same), Number Sequences (1-20) (screening, midpoint)
- First Grade: Place Value (ones/tens), Magnitude Comparisons (1-99; smaller/same), Number Sequences (1-99), Add/Subtract Arithmetic Combinations (to 18) (screening, midpoint)
- Second Grade: Place Value (ones/tens/hundreds), Magnitude Comparisons (1-999; smaller/same), Number Sequences (1-999), Add/Subtract Arithmetic Combinations (to 18) (screening, midpoint)
- All Grades: SAT-10 (pre/post; outcome measure)

How is Assessment Conducted in the 3-Tier Mathematics Model?

- Diagnostic/Progress Monitoring (all students): individually administered/fluency (2nd grade screening-whole class) (group administration in development)
- Progress Monitoring of Lessons: Bi-weekly for Tier 2 & Weekly for Tier 3 (developing)
- Outcome: whole class (2 sessions for K) (in development)

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Numeral Naming (K Only) 0-20

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Quantity Recognition (K Only) 1-6





K: 0-20, bigger #, same 1: 0-99, smaller #, same 2: 0-999, less, equal



Numeral Sequences K: 0-20 1: 0-99 2: 0-999







Place Value







Results

Validity Concurrent Criterion-Prediction TEMI (Form A) Correlations w/SAT-10

	<u>SAT-10 [K], (1) & 2</u>					
	[Math]	(<u>Math)</u>	<u>MPS</u>	<u>MP</u>	<u>Total</u>	
QR:	.54					
NN:	.48					
MC:	.65	.64	.52	.43	.53	
NS:	.56	.58	.56	.56	.62	
PV:		.65	.51	.57	.59	
ASC:		.55	.53	.59	.62	

Core Educational Problem: Intervention

•Limited evidenced-based interventions demonstrating efficacy for improving mathematics performance in early mathematics skills and concepts

•Need to develop, refine, and evaluate interventions to teach students in kindergarten, first, and second grades who have been identified as Tier 2 for mathematics difficulties

•Number and operations is cited as the most important area of NCTM's (2000) *Principles and Standards for School Mathematics* (Clements & Sarama, 2004)

•Automaticity is identified as "desirable" at an early stage of formal mathematics education (Cumming & Elkins, 1999)



Effective Instruction for Booster Sessions

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

Procedures & Features of Tier 2 Intervention

- (1) Groupings: homogeneous grouping with 2 4 students per group; 3 levels within in grade level
- (2) Duration: 4 5 times per week for 15-20 minutes
- (3) Lesson Design: sequential, scaffolded, stacked, scripted interventions; explicit, strategic, "think aloud;" error correction
- (4) Instructional Content: See Framework handout; mathematics vocabulary (e.g., greater than/less than)
- (5) Representations: physical (concrete), visual (pictorial), abstract (numbers)
- (6) Materials: number charts, 5- and 10-frames, counters, cubes, number lines (horizontal/vertical), base-ten materials, dot cards
- (7) Progress monitoring

Levels* of Progress Monitoring

Progress progress monitoring: a set of techniques for assessing student performance on a regular and frequent basis (<i>R.</i> <i>Quenemoen, M. Thurlow, R.</i> <i>Moen, S. Thompson, A.</i> <i>Blount Morse</i>)	What was learned this week; was it maintained and can it generalize to a testing format? Booster Probes	learned this month, and can it generalize to the larger instructional content? Monthly testing using Forms B, C, and D of Content Measures Content I	learned this trimester? Pre-, Mid-, and Post-testing using Form A of Content Measures Content II Level
What was learned today? <i>Independent</i> <i>Practice</i>	Maintenance/ Generalization Level		
Activity Level	© 2005 UT	* © 2005 System/TEA	Psycho-Educational Services 23

What was

What was

How Can Your District Get Started?

Tier 1

- Ensure that core instruction includes effective practices for struggling students
- Help teachers identify ways to adapt instruction and to monitor performance
- Identify an amount of time to require mathematics instruction (60+ minutes)
- Help teachers balance instruction
- Examine textbooks for the presence of practices that support struggling students' needs (practice, scaffolds, grouping)

How Can Your District Get Started?

Tier 2 & 3

- Identify the standards you wish to emphasize as part of Tier 2 instruction (number & operation)
- Identify the assessment measures to be used and when they will be administered; include fluency; include how to interpret assessments and plan instruction accordingly
- · Identify who will provide Tier 2 & 3 instruction & how often
- · Identify the interventions to be used
- Help teachers integrate Tier 2 into their day (amount of time, practices: student work stations)
- Elevate the importance of math instruction
- Provide coaching assistance

Implementation Questions

- How do you know if Tier 1 (core) instruction is not working? Assess all students 3 times a year; students not showing appropriate progress may qualify for Tier 2 instruction (cut score < 16th percentile)
- What should Tier 2 instruction look like? See previous Tier 2/3 instruction slide for example
- How do we know if Tier 2/3 instruction is working (are students responding to instruction)?
 Progress monitor students regularly

Implementation Questions

- How long is Tier 2 instruction implemented? 10-12 weeks; reassess if progress move to Tier 1; if limited progress conduct another 10-12 weeks of Tier 2; if no progress consider Tier 3
- How often should we progress monitor students? Tier 2, biweekly; Tier 3 - weekly - recommendation
- How do I assess fidelity? Use a checklist containing expectations for Tier 2 to decide if intervention practices are being used with fidelity; see Instructional Decision Making booklet - administrator's pages

http://www.texasreading.org/utcrla/materials/serp_preref erral_booklet.asp

What Are Helpful Resources?

- Baker, S., Gersten, R., & Lee, D. (2002). A synthesis of empirical research on teaching mathematics to low-achieving students. *The Elementary School Journal, 103,* 51-73.
- Chard, D., Clarke, B., Baker, B., Otterstedt, J., Braun, D., & Katz, R. (in press). Using measures of number sense to screen for difficulties in mathematics: Preliminary findings. Assessment Issues in Special Education.
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- National Council of Teachers of Mathematics. (2000). Principles and standards for school mathematics. Reston, VA: Author.
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- Special issue of JLD-July issue-Gersten & Jordan