

Establishing a Multi-Tiered System of Support for Mathematics

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Ohio School Psychologists Association

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Overview

Content

- Mathematics Learning & Learning Challenges
- Tier 1: Screening & Evidence-based Instruction
- Tier 2 & 3: Refining the Problem, Selecting Treatments, & Monitoring Progress

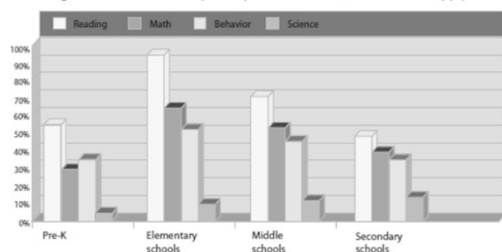
Learning Objectives

- Participants will evaluate their **school readiness** for MTSS in mathematics
- Participants will locate & select appropriate **screening & progress monitoring** tools
- Participants will know how to use **data to match** at-risk students with appropriate **treatments**
- Participants will be familiar with effective **intervention options according to research and evidence-based standards**

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2010 RTI Adoption Survey

For which grades and areas have you implemented RTI? (Check all that apply)

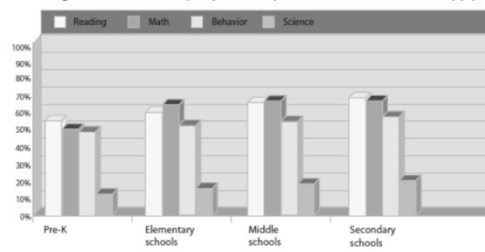


(Council of Administrators of Special Education; American Association of School Administrators; National Association of State Directors of Special Education, Inc.; www.spectrumk12.com)

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2010 RTI Adoption Survey

For which grades and areas do you plan to implement RTI? (Check all that apply)



(Council of Administrators of Special Education; American Association of School Administrators; National Association of State Directors of Special Education, Inc.; www.spectrumk12.com)

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MATHEMATICS LEARNING



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Math Matters

Growth of jobs in mathematics/science & engineering is outpacing general job growth 3:1

Mathematics skills are important for academic, occupational success & for daily living situations

Quantitative literacy = weakest area of adult literacy

Students who do not demonstrate proficiency in basic mathematic skills are at-risk for failure in higher-level material

(Duncan et al., 2007; Gersten & Chard, 1999; Patton, Cronin, Bassett, & Koppel, 1997; National Institute for Literacy, 2003; USDOE, 2008)

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U.S. Math Performance

National Performance (NAEP, 2015)

- 40% of 4th, 33% of 8th grade students perform at/above proficiency

International Performance Varies

- Program for International Student Assessment (PISA, 2012): *US mean score significantly below average*
- Trends in International Mathematics & Science Study (TIMSS, 2011): *4th & 8th grade scores were higher than TIMSS average*

Achievement Gaps Persists

- Race, Disability, & SES Status

Persistent Mathematics Difficulties

- 17% → 7% MLD; 5%-10% of School-Age Children Persistent Low Achievement

(Berch & Maizzone, 2007; Bryant et al., 2008; Chard, Ketterlin-Geller, & Mendoza, 2008; Fuchs, Compton et al., 2005; Fuchs, Fuchs, et al., 2008; Geary, 2007; Gersten et al., 2005; National Center for Education Statistics, 2013; 2015)

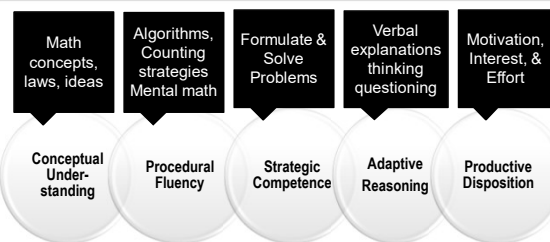
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Improving Mathematics Standards

- Common Core State Standards for Mathematics
 - Coherent Set of Curriculum Standards (2010)
- President & U.S. Department of Education
 - Convened National Mathematics Advisory Panel
 - Final Report (March 2008)
- National Council of Teachers of Mathematics
 - Generated Curriculum Focal Points (2006)
- National Research Council
 - Convened panel of mathematicians, psychologists & educators
 - Adding It Up* (2001)

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Number Proficiency



(National Research Council, 2001; National Mathematics Advisory Panel [NMAP] 2008)

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Standards for Student Mathematical Practice

A grid of eight standards for student mathematical practice, each with an icon and a brief description:

- 1 Make sense of problems and persevere in solving them.** (Icon: Person thinking)
- 2 Reason abstractly and quantitatively.** (Icon: Person with a number line)
- 3 Construct viable arguments and critique the reasoning of others.** (Icon: Two people talking)
- 4 Model with mathematics.** (Icon: Number line with points)
- 5 Use appropriate tools strategically.** (Icon: Person using a calculator)
- 6 Attend to precision.** (Icon: Person with a ruler)
- 7 Look for and make use of structure.** (Icon: Grid pattern)
- 8 Look for and express regularity in repeated reasoning.** (Icon: Circle with arrows)

Math Concepts, Laws, Ideas

Arithmetic Operation Laws
Commutative Property
 $2+5 = 5+2$

Place Value (Base-10)

Estimation

Composition
 $(7+8 = 7 + 7 + 1)$

Decomposition
 $(200+50+7 = 257)$

(National Research Council, 2001; NMAP, 2008; Wu, 2011)

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CCSSI-M Standards for Mathematical Practice

A grid showing two standards for mathematical practice from the CCSSI-M document:

- 7 Look for and make use of structure.** (Icon: Grid pattern)
- 8 Look for and express regularity in repeated reasoning.** (Icon: Circle with arrows)


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Procedures

Paper & Pencil	Mental
<ul style="list-style-type: none"> • Algorithms 	<ul style="list-style-type: none"> • Mnemonics • Automatic Retrieval • Skip Counting • Estimation

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CCSSI-M Standards for Mathematical Practice



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Linking Aspects of Whole Number Proficiency

Solve this Problem:

What Strategy did you Use?

$$\begin{array}{r} 54 \\ + 48 \\ \hline 102 \end{array}$$

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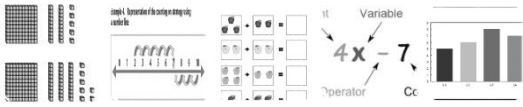
Linking Aspects of Whole Number Proficiency

1. $48 = 4 \times 10$ & 8 ones
2. Add 4 $\times 10$ to 54
 $64 \rightarrow 74 \rightarrow 84 \rightarrow 94$
3. 8 ones is also $6 + 2$
4. Add 6 to 94 = 100
5. $100 + 2 = 102$

$$\begin{array}{r} 1 \\ 48 \\ + 54 \\ \hline 102 \end{array}$$

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Strategic Competence



Manipulatives:
Chips
Base-10
Blocks

Models:
Number
lines
Strip
Diagrams
Ten
Frames

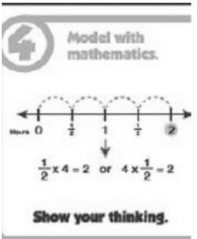
Drawings

Numbers
&
Symbols

Graphs

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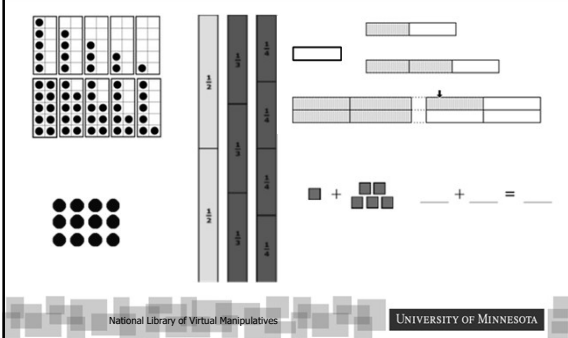
CCSSI-M Standards for Mathematical Practice



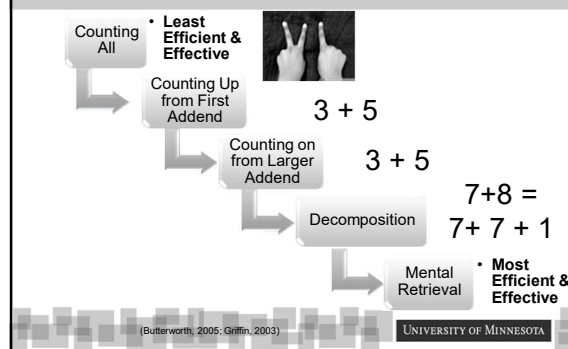
Show your thinking.

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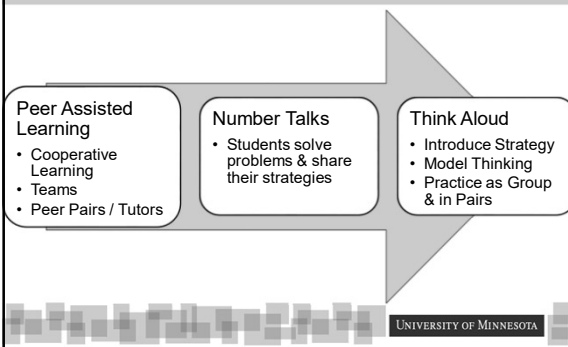
Visual Representation Examples



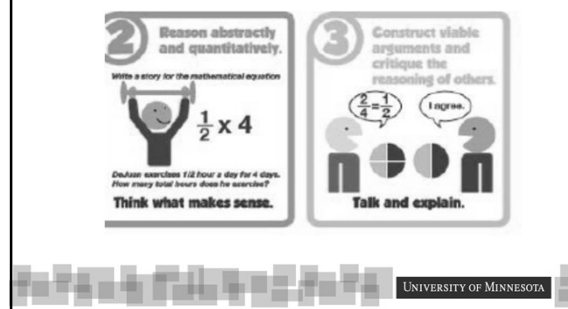
Pathway to Automaticity



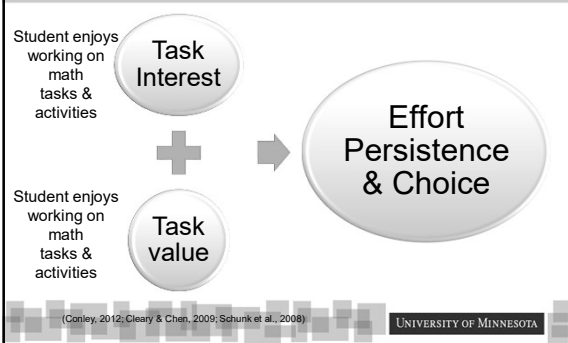
Adaptive Reasoning



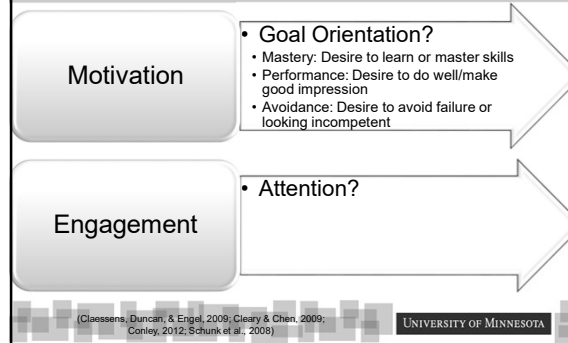
CCSSI-M Standards for Mathematical Practice



Productive Disposition



Productive Disposition



CCSSI-M Standards of Mathematical Practice



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Productive Disposition

Feedback on Effort or Performance

Self-Monitoring

Make Math Learning & Tasks Meaningful

Classroom Orientation

(Conley, 2012; Cleary & Chen, 2009; Schunk et al., 2008)

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MTSS BASICS

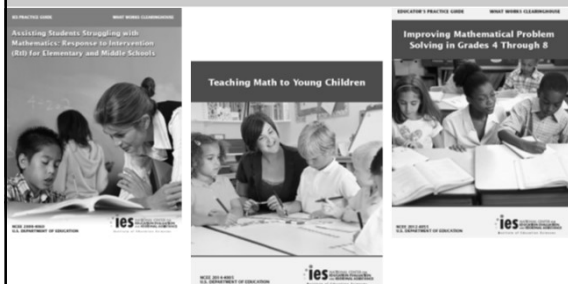
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Core Features of MTSS

- ✓ • School System Capacity & Support
- ✓ • Data-Based Decision Making
 - Screening, Progress Monitoring, Intervention Planning
- ✓ • Multi-tiered
 - Tier 1 → Core Instruction for ALL Students
 - Tier 2 → Small Group Instruction/Intervention
 - Tier 3 → Intensive, Individualized
- ✓ • Evidence-Based Instruction & Intervention
- ✓ • Identification of Sub-Group Representing LD

Increasing Intensity of Treatment, Resources, & Monitoring

Resources



U.S. Department of Education, Institute for Education Sciences,
National Center for Educational Evaluation & Regional Assistance

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MTSS Math Evaluation Scale



- School System Capacity & Support
- Data-Based Decisions
- Quality Instruction
- Tiered Interventions
- Professional Development

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MTSS Math Evaluation Scale

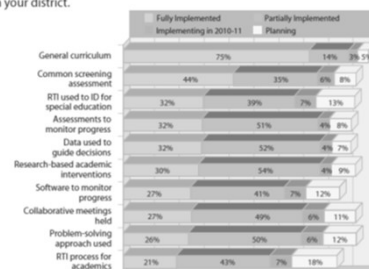
SHARE Findings

- School System Capacity & Support
- Data-Based Decisions
- Quality Instruction
- Tiered Interventions
- Professional Development

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2010 RTI Adoption Survey

Please indicate the academic implementation level(s) for the following RTI components in your district.



(Council of Administrators of Special Education; American Association of School Administrators; National Association of State Directors of Special Education, Inc.; www.spectrumk12.com)

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TIER 1

SCREENING & EVIDENCE-BASED INSTRUCTION

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Universal Screening + Instructional Practices

How are students and classes of students performing in CORE instructional environment?

Screening (2 to 3 Times Per Year)

- Early Numeracy
- Computation
- Concepts & Applications
- Computer-Adaptive Tests

Core Instruction

- Curriculum
- Supplemental Instruction
- Computer Assisted
- Peer-Assisted

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Core Mathematics Curricula

Problems

- Breadth at the expense of depth
- Weak conceptual emphasis
- Discovery-based curricula may be insufficient for students with or at-risk for mathematics disabilities

Solutions

- Adopt curricula that follow a coherent progression
- Focus on key foundational areas:
 - Proficiency w/whole numbers
 - Proficiency w/fractions
 - Some aspects of geometry
- Include instructional process elements with proven effectiveness

(National Governors' Association Center for Best Practices, Council of Chief State School Officers, 2010; National Mathematics Advisory Panel, 2008)

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Successful Curricula

FIGURE 1

A+ Composite: Mathematics topics intended at each grade by at least two-thirds of A+ countries.

Note that topics are introduced and sustained in a coherent fashion, producing a clear opportunity for mastery.

TOPIC	GRADE	1	2	3	4	5	6	7	8
Whole Number Meaning		■	■	■	■	■	■	■	■
Whole Number Operations		■	■	■	■	■	■	■	■
Measurement Units		■	■	■	■	■	■	■	■
Common Fractions		■	■	■	■	■	■	■	■
Equations & Formulas		■	■	■	■	■	■	■	■
Data Representation & Analysis		■	■	■	■	■	■	■	■
2D Geometry: Basics		■	■	■	■	■	■	■	■
Polygons & Circles		■	■	■	■	■	■	■	■
Perimeter, Area & Volume		■	■	■	■	■	■	■	■
Rounding & Significant Figures		■	■	■	■	■	■	■	■
Estimating Computations		■	■	■	■	■	■	■	■
Properties of Whole Number Operations		■	■	■	■	■	■	■	■
Estimating Quantity & Size		■	■	■	■	■	■	■	■
Decimal Fractions		■	■	■	■	■	■	■	■
Relationship of Common & Decimal Fractions		■	■	■	■	■	■	■	■
Properties of Common & Decimal Fractions		■	■	■	■	■	■	■	■
Percentages		■	■	■	■	■	■	■	■
Proportionality Concepts		■	■	■	■	■	■	■	■
Proportionality Problems		■	■	■	■	■	■	■	■
2D Coordinate Geometry		■	■	■	■	■	■	■	■
Geometry: Transformations		■	■	■	■	■	■	■	■
Negative Numbers, Integers & Their Properties		■	■	■	■	■	■	■	■
Number Theory		■	■	■	■	■	■	■	■
Exponents, Roots & Radicals		■	■	■	■	■	■	■	■
Exponents & Orders of Magnitude		■	■	■	■	■	■	■	■
Measurement Estimation & Errors		■	■	■	■	■	■	■	■
Construction of Knowledge & Competence		■	■	■	■	■	■	■	■
3D Geometry		■	■	■	■	■	■	■	■
Congruence & Similarity		■	■	■	■	■	■	■	■
Rational Numbers & Their Properties		■	■	■	■	■	■	■	■
Patterns, Relations & Functions		■	■	■	■	■	■	■	■
Slope & Equations		■	■	■	■	■	■	■	■
Number of topics covered by at least 67% of the A+ countries		3	3	7	15	20	17	16	18
Number of additional topics intended by A+ countries to complete a typical curriculum at each grade level		2	6	5	1	1	3	6	3

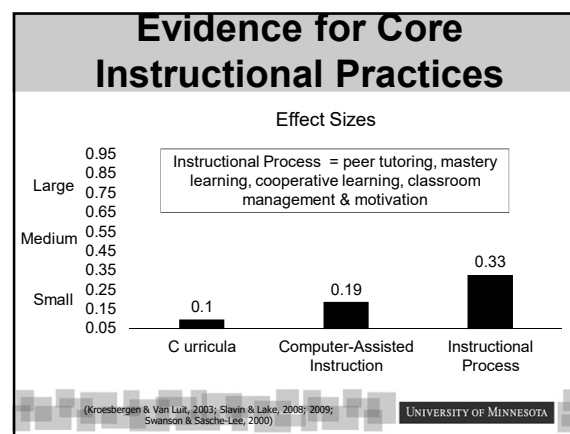
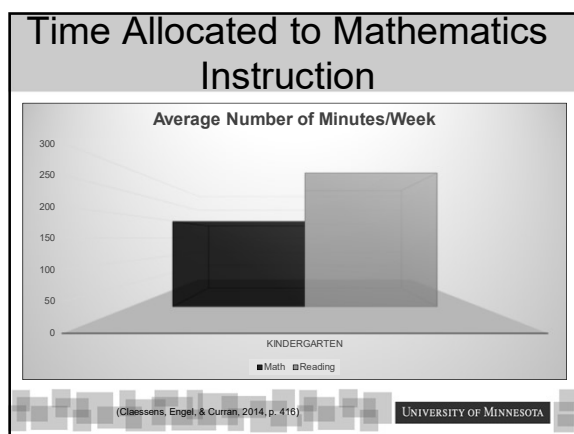
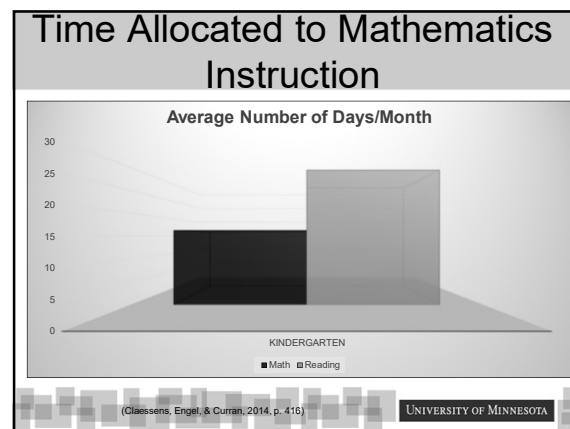
(Schmidt, Houang, & Cogan, 2002, p. 3)

FIGURE 2
State Composite: Mathematics topics intended at each grade by at least two-thirds of 21 U.S. states.
New-Art topics are introduced and sustained in a way that produces no visible structure.

Common U.S. Curricula

TOPIC	GRADE	1	2	3	4	5	6	7	8
Whole Number Meaning		■	■	■	■	■	■	■	■
Whole Number Operations		■	■	■	■	■	■	■	■
Measurement Units		■	■	■	■	■	■	■	■
Common Fractions		■	■	■	■	■	■	■	■
Equations & Formulas		■	■	■	■	■	■	■	■
Data Representation & Analysis		■	■	■	■	■	■	■	■
2D Geometry: Basics		■	■	■	■	■	■	■	■
Polynomials & Circles		■	■	■	■	■	■	■	■
Perimeter, Area & Volume		■	■	■	■	■	■	■	■
Rounding & Significant Figures		■	■	■	■	■	■	■	■
Estimating Computations		■	■	■	■	■	■	■	■
Properties of Whole Number Operations		■	■	■	■	■	■	■	■
Estimating Quantity & Size		■	■	■	■	■	■	■	■
Decimal Fractions		■	■	■	■	■	■	■	■
Relationship of Common & Decimal Fractions		■	■	■	■	■	■	■	■
Properties of Common & Decimal Fractions		■	■	■	■	■	■	■	■
Percentages		■	■	■	■	■	■	■	■
Proportionality Concepts		■	■	■	■	■	■	■	■
Proportionality Problems		■	■	■	■	■	■	■	■
2D Coordinate Geometry		■	■	■	■	■	■	■	■
Geometry: Transformations		■	■	■	■	■	■	■	■
Negative Numbers, Integers & Their Properties		■	■	■	■	■	■	■	■
Number Theory		■	■	■	■	■	■	■	■
Exponents, Roots & Radicals		■	■	■	■	■	■	■	■
Exponents & Orders of Magnitude		■	■	■	■	■	■	■	■
Measurement: Estimation & Error		■	■	■	■	■	■	■	■
Constructions w/ Straightedge & Compass		■	■	■	■	■	■	■	■
3D Geometry		■	■	■	■	■	■	■	■
Congruence & Similarity		■	■	■	■	■	■	■	■
Rational Numbers & Their Properties		■	■	■	■	■	■	■	■
Patterns, Relations & Functions		■	■	■	■	■	■	■	■
Scale & Proportionality		■	■	■	■	■	■	■	■
Number of topics covered by at least 67% of the states		14	15	18	18	20	25	23	22
Number of additional topics intended by states to complete a topical curriculum at each grade level		8	8	7	8	8	5	6	4
Intended by 67% of the states		■	■	■	■	■	■	■	■
Intended by 83% of the states		■	■	■	■	■	■	■	■
Intended by 100% of the states		■	■	■	■	■	■	■	■

(Schmidt, Houang, & Cogan, 2002, p. 5)



Pre-K to Kindergarten Level

Curricula/Program	What Works Clearinghouse	Best Evidence Encyclopedia
CURRICULA		
Building Blocks for Math (SRA Real Math)	Positive	NA
Pre-K Mathematics	Positive	Moderate
SUPPLEMENTAL PROGRAMS		
Peer Assisted Learning Strategies (PALS)	No Discernible Effect	Moderate
Classwide Peer Tutoring (CWPT)	NA	Strong

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Elementary Level

Curricula/Program	What Works Clearinghouse	Best Evidence Encyclopedia
CURRICULA		
Odyssey Math	Potentially Positive	NA
Everyday Mathematics	Potentially Positive	Limited Evidence
Saxon Math	Potentially Positive	NA
Singapore Math → Commonly Recommended b/c Match with Effective International Curricula (Primary Mathematics; New Elementary Mathematics; Math in Focus; My Pals are Here Math)		
SUPPLEMENTAL PROGRAMS		
Peer Assisted Learning Strategies (PALS)	NA	Strong
Class-wide Peer Tutoring (CWPT)	NA	Strong
Team Assisted Instruction (TAI)	NA	Strong
PowerTeaching: Mathematics	NA	Strong
Accelerated Mathematics	Potentially Positive	Limited Evidence

Practice....

One of the best predictors of adult mathematics competency

Should consume a majority of instructional time (according to some experts)

Promotes automaticity

Is limited or not meaningful in many common textbook & curricular activities

(Barrick, Hall, & Baker, 2013; Binder, 1996; Burns, Ysseldyke, Nelson, & Karive, 2014; NMAP, 2008; Stickney et al., 2012).

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Promoting Productive Practice

Definition

- Materials match individual student's instructional level & are sequenced systematically
- Brief & frequent sessions
- Material is delivered in small sets

Activities

- Teacher Guided Practice
- Peer Practice
- Independent Practice
- Isolated Drill
- Practice in Context

(Baroody, Etland, et al., 2009; Burns et al., 2006; Coddling et al., 2011; Daly et al., 2007; Fuchs, Fuchs, Powell, et al., 2008; Martens & Eckert, 2007)

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Building Fluency Practice into Core Instruction

Identify Grade Skill Needs Via Screening & Standards

- Target Instructional Grade Level &/or Pre-Requisite Skills

Identify Time (10 minutes) & Practice Strategy

- Examples: peer tutoring, explicit timing, flash cards, computer assisted, cover-copy-compare
- Teach efficient counting strategies (K-2)
- Teach distributive, commutative, & associative properties (2-8)

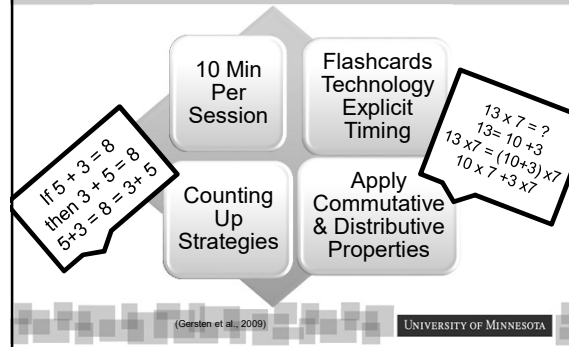
Students Set Goals & Receive Performance Feedback

Move up Skill Hierarchy with Mastery

(Coddling, Chan-Iannetta, George, & Ferreira, 2009; Gersten, Beckmann, Clarke, Fiegen, Marsh, Star, & Wintzall, 2009; VanDerHeyden & Burns, 2005)

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Building Fluent Retrieval of Basic Facts



(Gersten et al., 2009)

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Summary: Recommendations for Instructional Practices

1. Match Curriculum w/ Common Core Standards

2. Incorporate Differentiated & Explicit Instruction

3. Designate 45-60 Minutes for DAILY Instruction

- Assume additional 20-40 minutes for tiered activities

4. Supplement w/Instructional Process Strategies

- Peer-Assisted Learning, Small Groups, Cooperative Learning
- Classroom Management & Motivation
- Computer Assisted

5. Provide Targeted Practice to Promote Fluency

6. Conduct Universal Screening

(Coddling et al., 2009; Doehler & Fein, 2013; Fuchs et al., 2012; Gersten, Beckmann et al., 2009; Kilpatrick et al., 2001; Riccomini & Wittet, 2010; Slavin & Lake, 2008, 2009)

Tier 1

UNIVERSAL SCREENING

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Screening in Mathematics

Purpose & Psychometrics

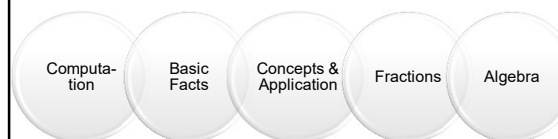
- Identify *all* students' current levels of performance
- Tools are:
 - **Efficient**,
 - **Reliable**,
 - **Valid** (predictive),
 - **Sensitive** (low rates of false negatives)

Resources & Types

- National Center on Intensive Intervention
www.intensiveintervention.org/chart/progress-monitoring
- CBM:** AIMSweb, EasyCBM, DIBELS Math, Monitoring Basic Skills Progress, STEEP
- Computer Adapted:** FASTBridge, STAR
- Norm- &/or Criterion-Referenced:** State Assessments

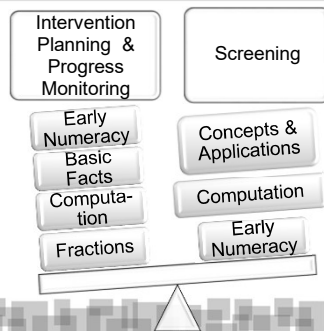
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Challenges Measuring Mathematics



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Challenges Measuring Mathematics



Measurement in math is a challenge due to its multi-topic nature & lack of capstone task

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Current Screening Recommendations

Grade	Early Numeracy	Computation	Concepts Application	State Testing
K	X			
1	X	X		
2		X	X	
3		X	X	
4		X?	X?	X
5		X?	X?	X

- Screening Measures require ≤ 20 min to administer
- Screening should occur at least 2 times per year (fall, winter)
- Content should reflect grade specific instructional objectives
- Monitor Progress of students scoring near the cut point

(Gersten et al., 2009; VanDerHeyden, Coddling, & Martin, 2016)

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Screening Tools

National Center on Intensive Intervention Academic Progress Monitoring
www.intensiveintervention.org/chart/progress-monitoring



Work with your neighbor(s) to identify tools

- With good psychometric properties
- Feasible for implementation

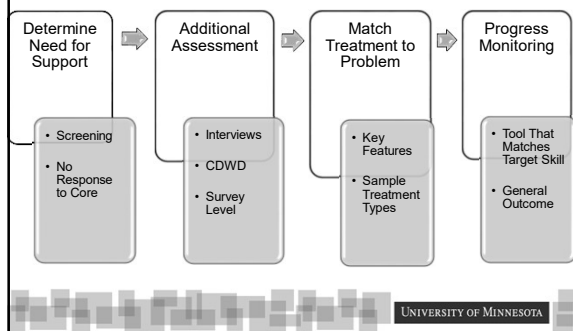
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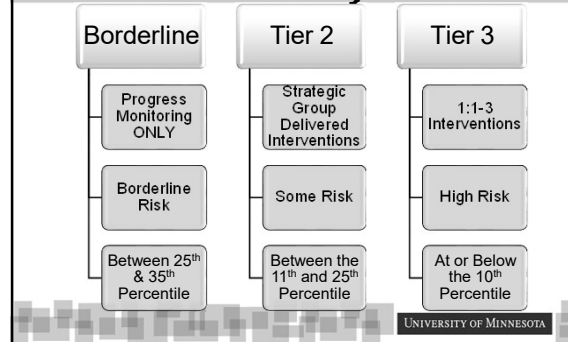
MTSS: TIERS 2 & 3

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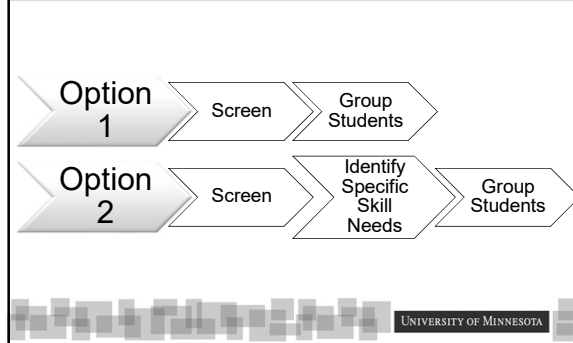
Tier 2 Process & Procedures



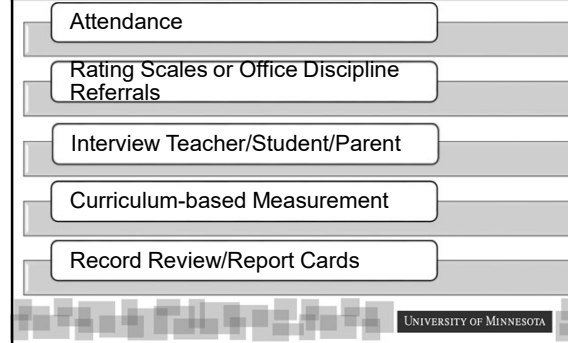
Guidelines for Service Delivery



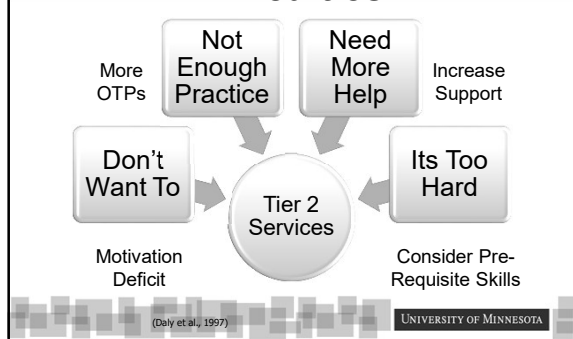
How to Use Screening Data



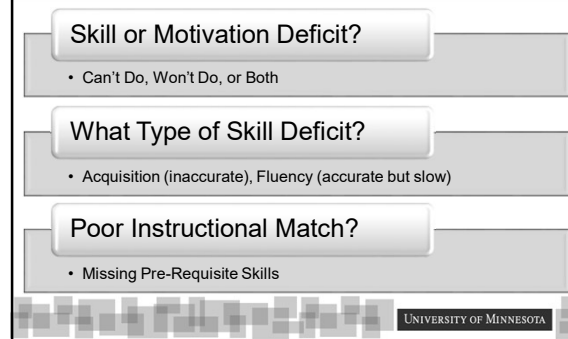
Refine Assessment

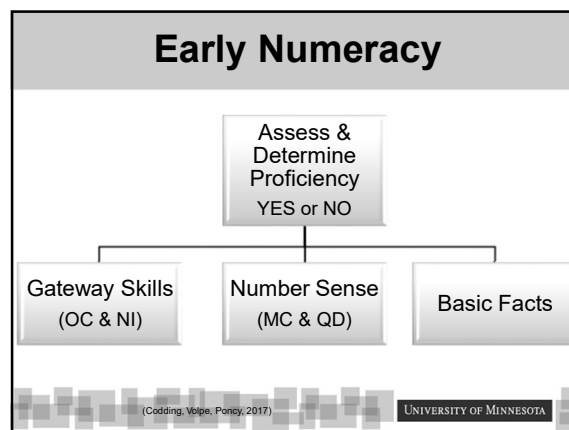
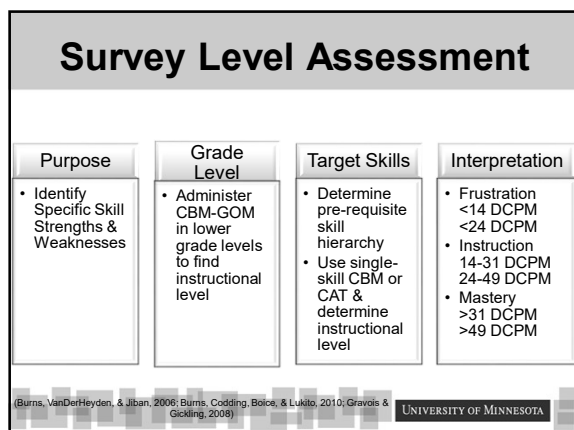
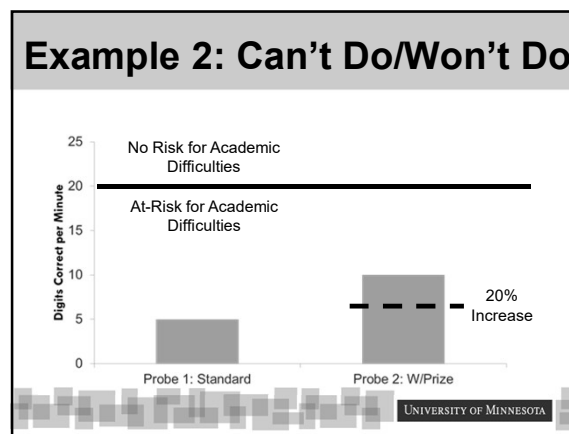
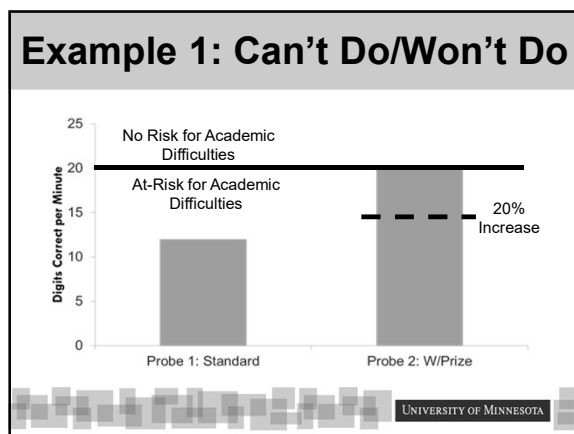
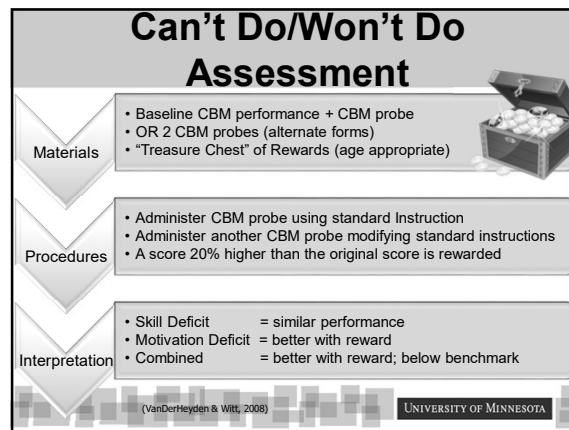
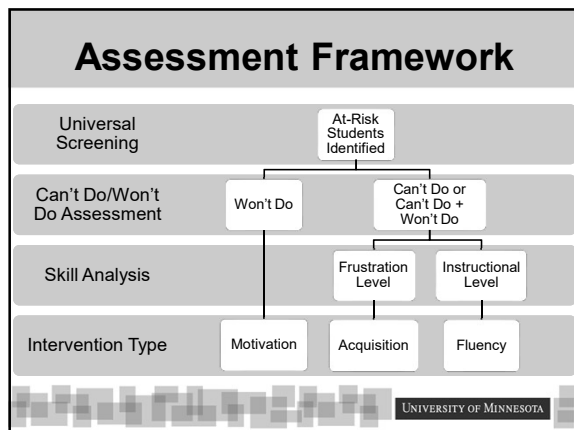


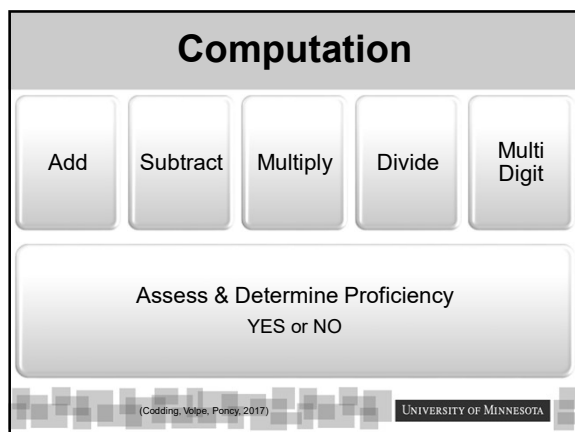
Reasons For Students' Math Difficulties



Skill X Treatment Interaction

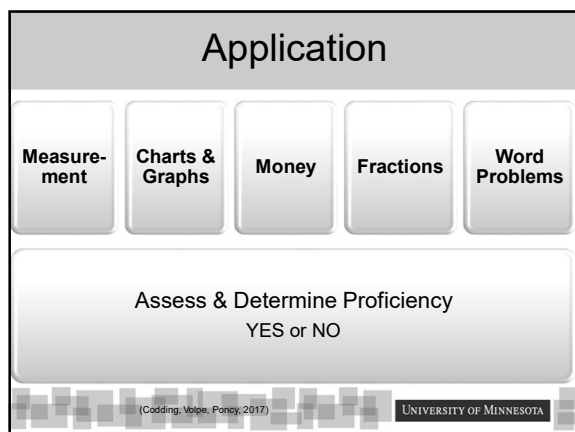






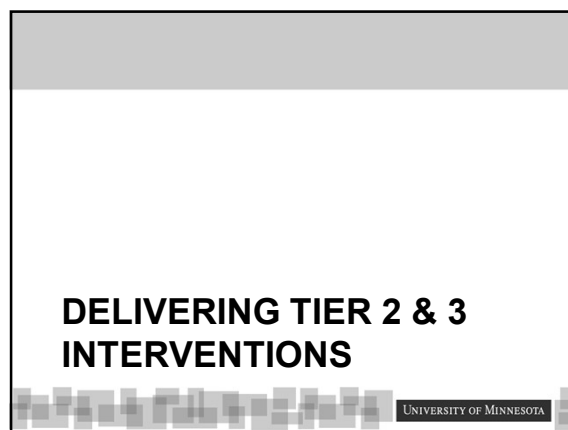
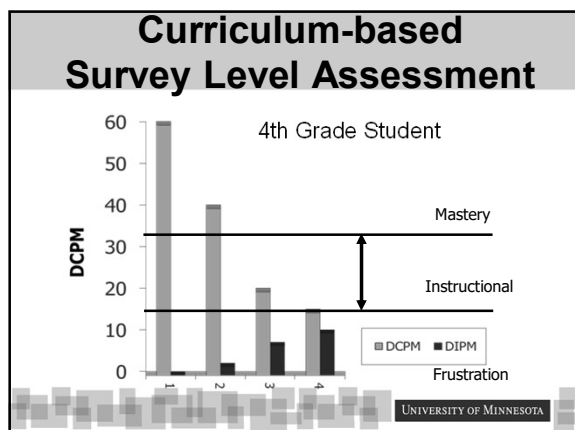
Operation	Skill
Addition	<ul style="list-style-type: none"> One-digit facts to 10 One-digit facts to 20 Two-digit, no regrouping Two-digit, regrouping
Subtraction	<ul style="list-style-type: none"> One-digit facts to 10 One-digit facts to 20 Two-digit, no regrouping Two-digit, regrouping
Multiplication	<ul style="list-style-type: none"> One-digit facts 0-2, 5 One-digit facts 3-4, 6-12 1 x 2 digit Multiple digits (w/ & w/o regrouping)
Division	<ul style="list-style-type: none"> One-digit facts 0-2, 5 One-digit facts 3-4, 6-12 Long division, no remainder Long division, remainder

(Common Core, 2010; Shapiro, 2010)



Grade	Fractions	Geometry & Measurement
4	<ul style="list-style-type: none"> Identify & Represent Fractions & Decimals Compare Fractions & Decimals on Number Line 	<ul style="list-style-type: none"> Understand Concepts of Angle & Measurement Angles
5	<ul style="list-style-type: none"> Compare Fractions, Decimals, & Common Percent Add/Subtract Fractions & Decimals 	<ul style="list-style-type: none"> Solve Perimeter & Area Problems for Triangles and Quadrilaterals
6	<ul style="list-style-type: none"> Multiplication & Division of Fractions & Decimals All Operations w/Positive & Negative Integers 	<ul style="list-style-type: none"> Analyze Properties of 2D Shapes Solve Perimeter & Area Problems for 2D Shapes Analyze Properties of 3D Shapes Solve Surface Area & Volume Problems for 3D Shapes

(Common Core, 2010; Shapiro, 2011)



Structuring Tier 2 & 3 Services

Determine At-Risk Group of Students

Establish List of Interventions for Different Areas

- Whole Numbers, Rational Numbers, Word Problem Solving

Schedule Time for Interventions

- End of Math Block (walk for math); Study/Free Class; Content Class

Identify Interventionists

- Teaching Assistant, Para Professional, Volunteers, Librarian, Practicum Students/Interns, Special Education Teachers, Math Specialists

Identify Progress Monitoring Tools & Schedule

Evaluate Progress & Make Adjustments Accordingly

Behaviors of Students With Mathematics Problems

Poor Recall of Number Combinations (Facts)
 Not Understanding Commutative Property
 Ineffective Counting Strategies
 Regrouping Errors
 Misaligns Numbers
 Trouble with Meaning of Signs (+, -, <, %)
 Difficulty Solving Word Problems
 Problems Implementing a Plan to Solve Word Problems
 Trouble Identifying Tangential Information
 Not Understanding the ? Asked
 Math Language
 Failing to Check Work

(Bryant, Bryant, & Hammill, 2000)

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Frequently Cited Math Difficulties

Solving word problems

Multi-step procedural calculations

Mathematics language

Checking work and answers

Automatic recall of basic facts

Fractions

(Bryant et al., 2000; National Mathematics Advisory Panel, 2008)

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Key Content Areas for Intervention

Kindergarten to Grade 5

- Strategic Counting
- Number Composition
- Number Decomposition
- Place Value
- Operations (add, subtract, multiply, divide)
- Explicit Teaching of Word Problems

In Depth Knowledge of Whole Numbers

Grades 4 to 8

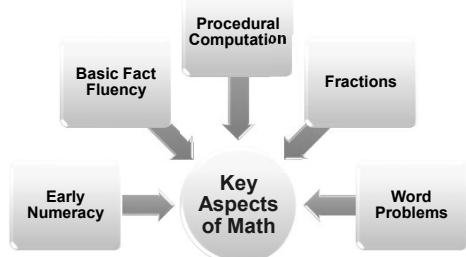
- Operations (fractions, decimals, ratios, percentages)
- Complex Operations (e.g., long division)
- Explicit Teaching of Word Problems

In Depth Knowledge of Rational Numbers

(Gersten et al., 2009; USDOE, 2008)

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Target Areas for Intervention



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Locating Intervention Programs: Resources

Best Evidence Encyclopedia: Center For Data Driven Reform

- John Hopkins University; <http://www.bestevidence.org>

Center on Response to Intervention

- <http://www.rti4success.org/>

National Center on Intensive Interventions

- <http://www.intensiveintervention.org>

RTI Action Network

- www.rtinetwork.org

What Works Clearinghouse

- <http://ies.ed.gov/ncee/www/findwhatworks.aspx>

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Key Active Ingredients

1. Use of Explicit & Strategy Instruction
2. Sequence Instruction: *Foundational pre-requisite skills 1st*
3. Provide Opportunities for Student Verbalization
4. Visually Represent Concepts
5. Build Fluent Retrieval of Basic Facts
6. Incorporate Motivation Strategies
7. Monitor Progress & Provide Feedback

(Burns, Coddling, Boice, & Lukito, 2010; Coddling, Burns & Lukito, 2011; Fuchs, Fuchs, Powell et al., 2008; Baker et al., 2002; Gersten et al., 2009; Swanson, 2009)

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Finding Treatment Matches By Examining Skill Needs

Acquisition	Acquisition/Fluency	Fluency
<ul style="list-style-type: none"> < 10 DCPM 60% Accuracy Explicit & Strategy Instruction Modeling & Concrete Examples Guided Practice Frequent Feedback on Accuracy 	<ul style="list-style-type: none"> 0-20 DCPM 60-90% Accuracy Guided Practice & Modeling Isolated Practice Concrete + Visual Representation Frequent Feedback 	<ul style="list-style-type: none"> 20+ DCPM 90% Accuracy Novel & Frequent Practice Feedback on Fluency Goal Attainment & Reinforcement Self-Monitoring

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EARLY NUMERACY INTERVENTIONS

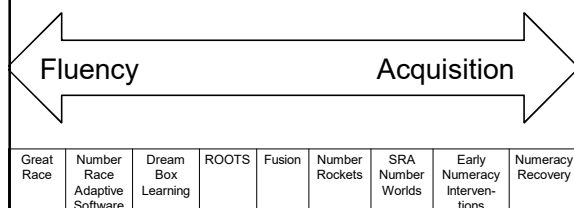
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Early Numeracy Interventions

	Grade	Details	Topics	Length
DreamBox Learning® http://www.dreambox.com/	K-2	Online; Tailors Activities to Instructional Level	Subitizing, Counting, Magnitude	90 Min Weekly
Early Numeracy Interventions Psychoeducational Services	1	Small Group Intervention Program 3-4 Times Weekly	Comparison, # Line,	25-30 Min
focusMath Intensive Intervention® http://www.pearsonschool.com/focusmath	K-6	Small Group or Individual Administration	# Identification, # Writing, Part-Whole Relations, Place Value, Basic Facts, Problem Solving	45-60 Min
Fusion https://dlibels.uoregon.edu/market/movingup/first/foundation	1	Small Groups of 3-5 Students; 4-5 Days Weekly		30 Min
Number Rockets http://kvc.mic.vanderbilt.edu/numberrockets/	1	Small Group Tutoring; 3 Times Weekly		40 Min
Number Sense Interventions Brookes Publishing	K	Small Group; 3 Times Weekly		30 Min
Roots https://dlibels.uoregon.edu/market/movingup/kfou	K	Small Group; 2-3 Times Weekly		20 Min
SRA Number Worlds® http://www.sranumberworlds.com/	PK-8	Curricula w/ Intervention Element		15-60 Min

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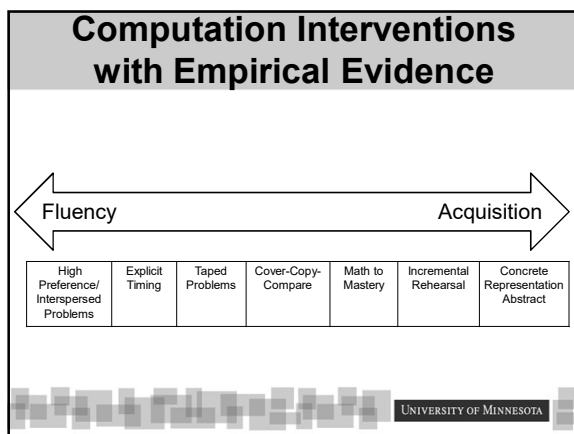
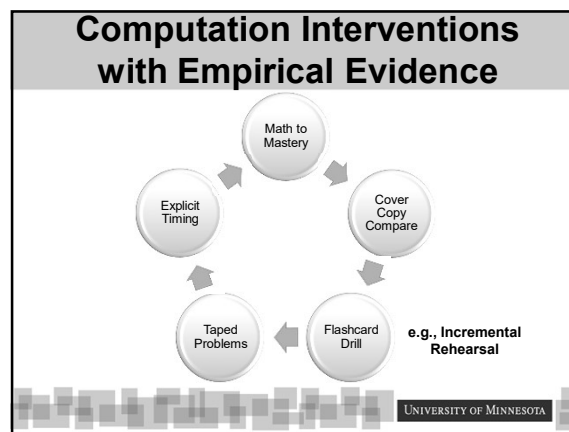
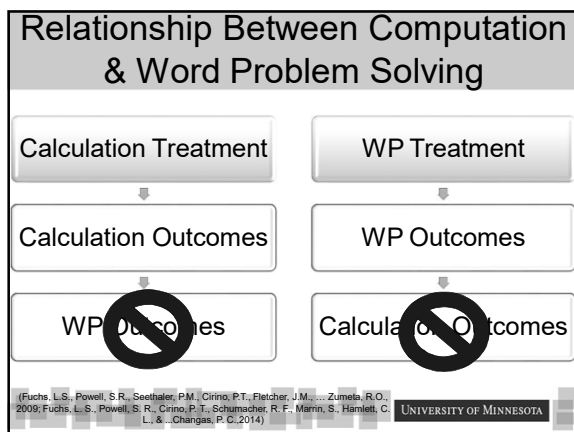
Early Numeracy Interventions



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COMPUTATION INTERVENTIONS

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Commercially Available Computation Interventions

	Grade	Details	Length
Academy of MATH® EPS/School Specialty Literacy and Intervention	2-12	Online tool; Small Groups; 3 Times Weekly	30 Min
Accelerated Math Renaissance Learning	1-12	Supplement; Computer Program; Comprehensive Topics	Varies
Odyssey Math Compass Learning®	K-8	Supplement; Web-Based; Comprehensive Topics	Varies
FASTT Math (Scholastic)	2-12	Independent Computer Practice	Daily
Mastery Math Facts (Curriculum Associates)	1-8	Curriculum Supplement	Daily

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Procedural Computation (Multi-Digit)

Students need to compose and decompose large numbers by place value

- $358 \rightarrow 300 + 50 + 8$

Students should be able to use number line knowledge to estimate an answer

- $358 + 421$

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Conceptual Understanding & Visual Representation

54
+ 48

Concrete
Base-10 Blocks

Representation
Pictures of Objects
Tallies
Number lines

Abstract
Symbolic

RENAME

48 + 54 = 102
48 + 54 = 102
48 + 54 = 102
48 + 54 = 102
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WORD PROBLEM SOLVING INTERVENTIONS

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Visual Representation & Schema-Based Instruction

Organize Problems on Structural Features
Change (join/separate), Group (part-part-whole), & Compare

Explicit Modeling of Strategy Steps, Explanations, & Elaborations
Using "Think-Alouds"

Strategy Checklists

4-Step Strategy (FOPS)

Find the Problem Type
Organize Using Diagram
Plan to Solve the Problem
Solve the Problem

3-Step Strategy (RUN)

Read the Problem
Underline Question
Name Problem Type

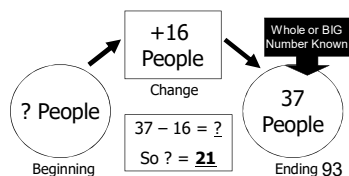
(Chard et al., 2008; Fuchs, Fuchs, Powell et al., 2008; Jindra, 2007)

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Sample Change Schema

CHANGE: The MBTA Number 9 bus is pulling into the Boylston Street stop. 16 people get on the bus. Now there are 37 people on the bus. How many people were on the bus before the Boylston Street stop?

(Note: based on Chard et al., 2008, p. 239)



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Word Problem Solving Interventions

	Grade	Details	Topics	Length
Hot Math Tutoring http://www.kc.vanderbilt.edu/pals/	3-6	Supplement to Curricula; Small Group	Addition & Subtraction Word Problems	30 Minutes
Pirate Math http://www.kc.vanderbilt.edu/pals/	2-3	Individual; Small Group Tutoring	Addition & Subtraction Word Problems; Computation	25-30 Minutes
Solving Math Word Problems http://www.proedinc.com/	1-8	Small Group Tutoring & Computer Practice	Complex Word Problems: Add, Subtract, Multiply, Divide	30-60 Minutes
Solve It! Exceptional Innovations: http://www.ednm.net/solve-it.html http://sites.education.miami.edu/solveit/	5-12	Curriculum Supplement	Applying Cognitive Strategy Instruction to Word Problem Solving	3 Times Weekly

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FRACTIONS

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Recommendations for Fractions

Table 2. Recommendations and corresponding levels of evidence

Recommendation	Levels of Evidence		
	Minimal Evidence	Moderate Evidence	Strong Evidence
1. Build on students' informal understanding of sharing and proportionality to develop initial fraction concepts.	♦		
2. Help students recognize that fractions are numbers and that they expand the number system beyond whole numbers. Use number lines as a central representational tool in teaching this and other fraction concepts from the early grades onward.		♦	
3. Help students understand why procedures for computations with fractions make sense.		♦	
4. Develop students' conceptual understanding of strategies for solving ratio, rate, and proportion problems before exposing them to cross-multiplication as a procedure to use to solve such problems.	♦		
5. Professional development programs should place a high priority on improving teachers' understanding of fractions and of how to teach them.	♦		

(Siegler, Carpenter, Fennell, Geary, Lewis, Okamoto, Thompson, & Wray, 2010, p.11)

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1. Equal Sharing Activities

Problems Require Equal Sharing of Objects



Problems Divide 1 Object into Equal Parts (e.g., $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{9}$, etc.)

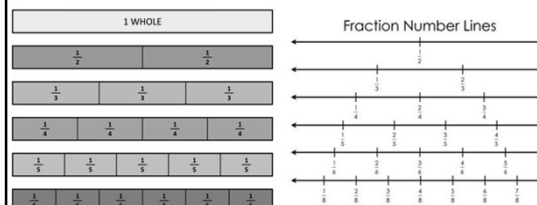


Problems Require Sharing a Set of Objects among Multiple People (e.g., $\frac{3}{4}$)



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2. Fractions are Numbers with Magnitudes



$$\frac{3}{4} = \frac{6}{8} = \frac{9}{12} = 0.75 = 75\%$$

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3. Procedures for Computation with Fractions

Use Visual Representations

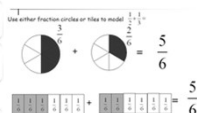
Use Estimation

Address Common Misconceptions

- e.g., failing to find the common denominator

Use Real World Measuring Contexts

- Rulers, Pizza, Carton of Eggs



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PROGRESS MONITORING

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Progress Monitoring Basics

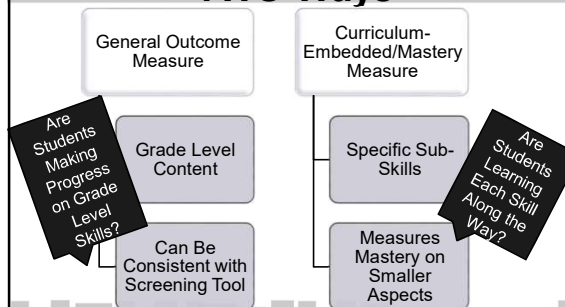
- Scientifically based practice used to assess academic performance & evaluate effectiveness of instruction
- Tools need to be: **efficient, valid, reliable, sensitive to growth, have multiple forms**
- Progress toward meeting the student's goals is measured by comparing expected and actual rates of learning

	General Outcome Measure	Mastery or Curriculum-Embedded Measures
Borderline Risk	Monthly	----
Tier 2	Bi-Weekly or Monthly	Daily, Weekly
Tier 3	Bi-Weekly or Monthly	Daily, Weekly

(Gershon et al., 2009; Salvia, Ysseldyke, & Bolt, 2007)

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Monitor Student Progress TWO Ways



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Progress Monitoring Tools

• Curriculum-Based Measurement (CBM)

- AIMSweb
- DIBELS Math
- EASYcbm
- mCLASS: Math
- Monitoring Basic Skills Progress
- iSTEAP
- Yearly Progress Pro

• Computer Adaptive Tests (CAT)

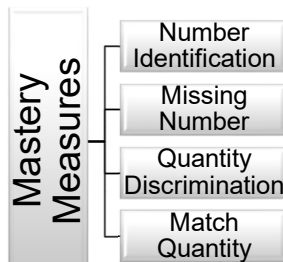
- FAST/FAST BRIDGE
- STAR



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Early Numeracy Options



- FASTBridge earlyMath
- AIMSweb TEN
- mCLASS: Math
- DIBELS Math

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Computation Options

Mastery Measures

M-CBM for Each Operation

2x1/2 Digit

2x3 Digit

- Accelerated Math
- AIMSweb M-CBM

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Online CBM Progress Monitoring Tools

Content Available

- Single Skill Computation
- Multi-digit Computation
- Fractions
- Decimals
- Word Problems

Free Resources

- Intervention Central
– www.interventioncentral.org
- Math Fact Café
– <http://www.mathfactcafe.com>
- The Math Worksheet Site
– <http://theworksheetsite.com/>
- SuperKids Math Worksheet Creator
– <http://superkids.com/aweb/tools/math/>
- Facts on Fire
– www.factsonfire.com

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Progress Monitoring & Mastery Tools

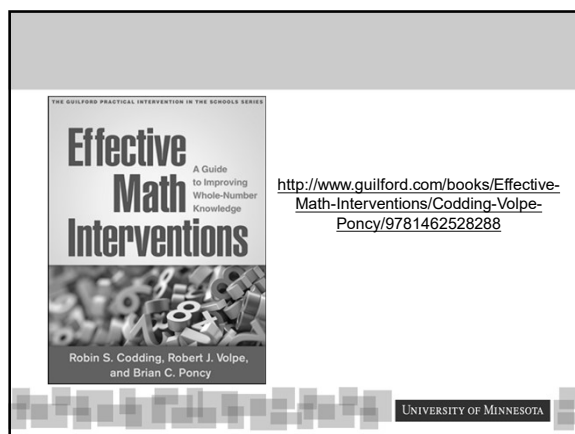
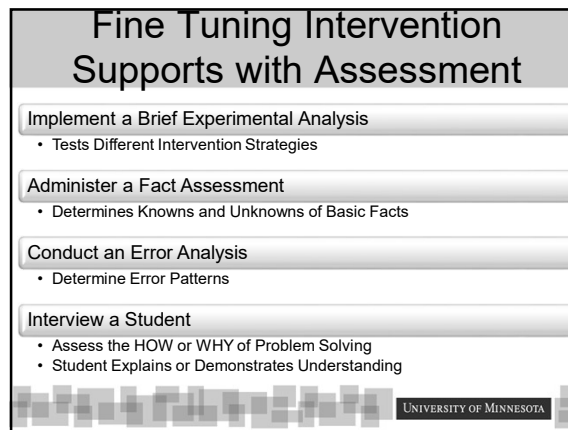
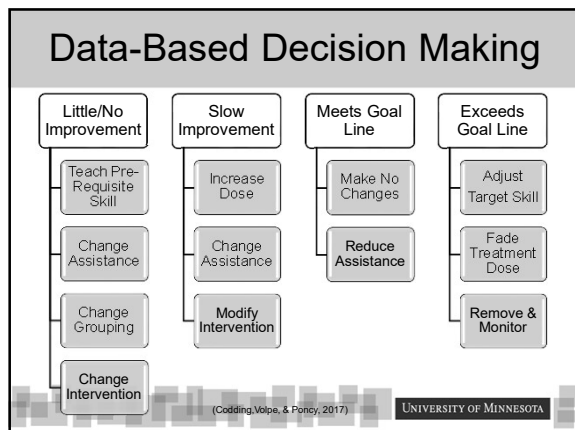


- Work with your neighbor(s) to identify tools
 - With good psychometric properties
 - Feasible for implementation

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EVALUATING RESPONSIVENESS

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Establishing a Multi-Tiered System of Support for Mathematics

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Ohio School Psychologists Association

Friday, November 11, 2016
Columbus, Ohio

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