

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

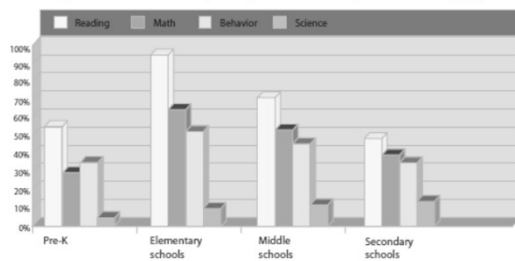
Learning Objectives

1. Participants will evaluate their **school readiness** for MTSS in mathematics
2. Participants will locate & select appropriate **screening & progress monitoring** tools
3. Participants will know how to use **data to match** at-risk students with appropriate **treatments**
4. 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)

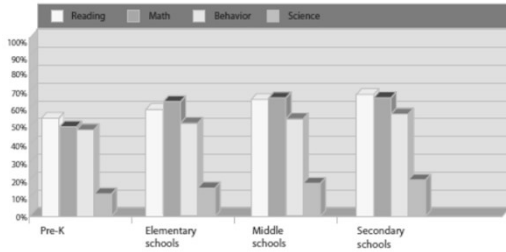


(Council of Administrators of Special Education; American Association of School Administrators; National Association of State Directors of Special Education, Inc.; www.spectrumK12.com)

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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; Gerson & Chard, 1999; Patton, Cronin, Bassett, & Koppel, 1997; National Institute for Literacy, 2003; IRDOE, 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

(Baruch & Mazocco, 2007; Bryant et al., 2008; Chard, Ketterlin-Geller, & Jitendra, 2008; Fuchs, Compton et al., 2010; Fuchs, Fuchs et al., 2008; Geary 2007; Gershon et al., 2005; National Center for Education Statistics, 2013, 2015)

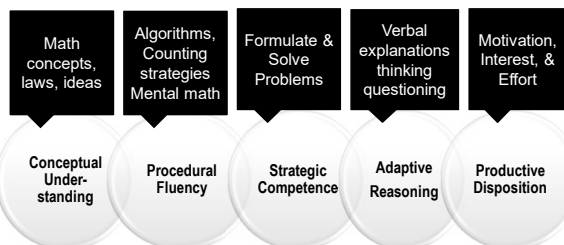
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Improving Mathematics Standards

- 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)

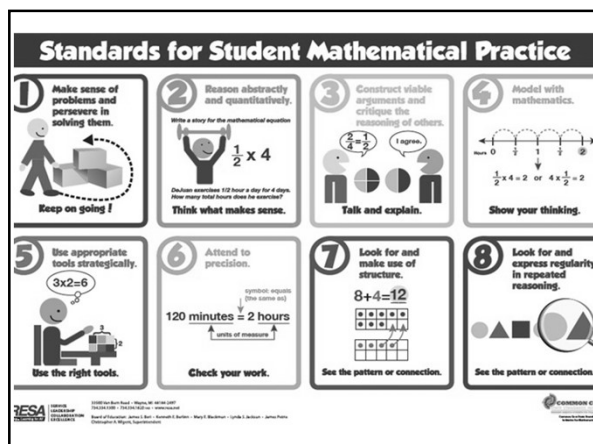
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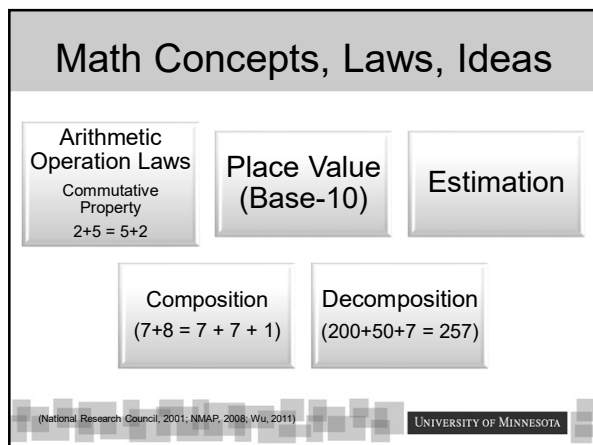
Number Proficiency

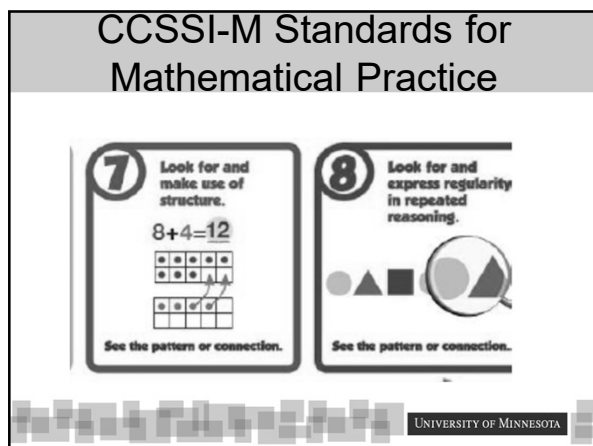


(National Research Council, 2001; National Mathematics Advisory Panel [NMAP] 2008)

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

1. $48 = \text{close to } 50 \text{ } (-2)$
2. $50 + 54 = 104$
3. $104 - 2 = 102$

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

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Strategic Competence

The diagram shows five categories of mathematical representations:

- Manipulatives:** Chips, Base-10 Blocks
- Models:** Number lines, Strip Diagrams, Ten Frames
- Drawings:** (represented by a drawing of a person)
- Numbers & Symbols:** Includes the expression $4x - 7$ with labels for 'Variable' (x), 'Operator' (-), and 'Constant' (7).
- Graphs:** A bar graph with three bars of increasing height.

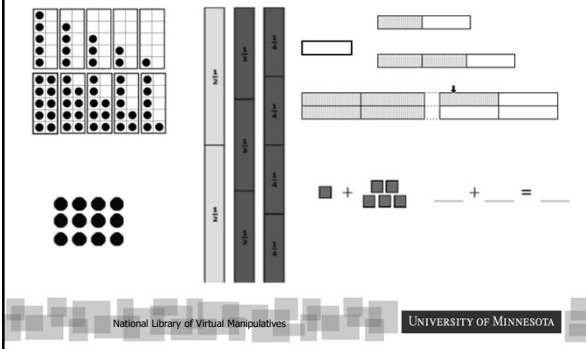
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CCSSI-M Standards for Mathematical Practice

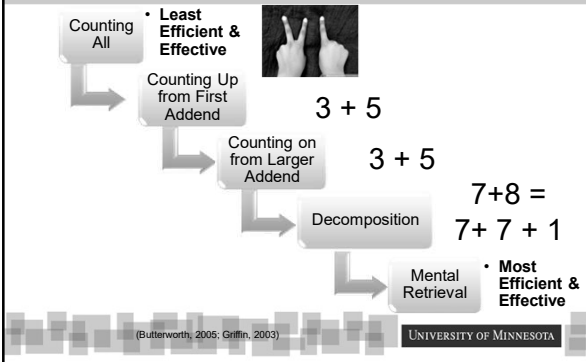
The diagram shows a number line from 0 to 2 with tick marks at $\frac{1}{2}$ and 1 . A dashed line connects $\frac{1}{2}$ to 1, and another dashed line connects 1 to 2. Below the number line, the equation $\frac{1}{2} \times 4 = 2$ or $4 \times \frac{1}{2} = 2$ is shown. The text "Show your thinking." is at the bottom.

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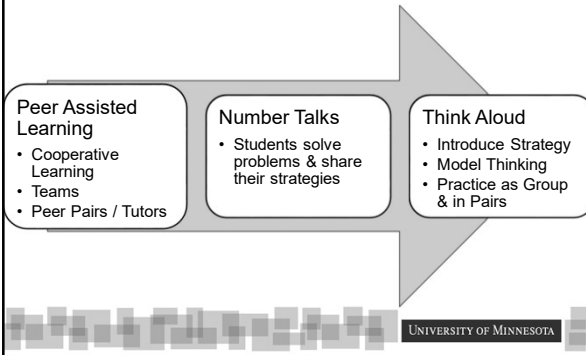
Visual Representation Examples



Pathway to Automaticity




Adaptive Reasoning



CCSSI-M Standards for Mathematical Practice

2 Reason abstractly and quantitatively.


Write a story for the mathematical equation

 $\frac{1}{2} \times 4$

On June exercises 1/2 hour a day for 4 days. How many total hours does he exercise?

Think what makes sense.

3 Construct viable arguments and critique the reasoning of others.



$\frac{2}{4} = \frac{1}{2}$

Talk and explain.

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Productive Disposition

Student enjoys working on math tasks & activities

Task Interest

+

Student enjoys working on math tasks & activities

Task value

→

Effort Persistence & Choice

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

Productive Disposition

Motivation

- Goal Orientation?
 - Mastery: Desire to learn or master skills
 - Performance: Desire to do well/make good impression
 - Avoidance: Desire to avoid failure or looking incompetent


Engagement

- Attention?

(Classens, Duncan, & Engel, 2009; Cleary & Chen, 2009; Conley, 2012; Schunk et al., 2008) UNIVERSITY OF MINNESOTA

CCSSI-M Standards of Mathematical Practice

1 Make sense of problems and persevere in solving them.



Keep on going!

6 Attend to precision.

symbol: equals (no same as)

120 minutes = 2 hours

units of measure

Check your work.

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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

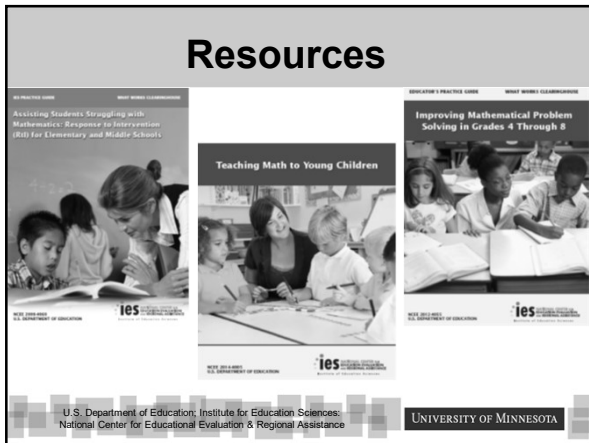
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Core Features of MTSS

- ✓ • 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



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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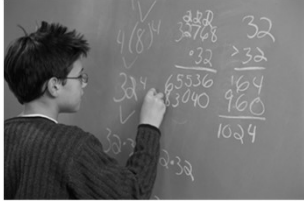
2010 RTI Adoption Survey

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

| | Fully Implemented Implementing in 2010-11 | Partially Implemented Planning |
|---------------------------------------|--|-----------------------------------|
| General curriculum | 73% | 14% 8% 15% |
| Common screening assessment | 44% | 33% 6% 8% |
| RTI used to ID for special education | 32% | 39% 7% 13% |
| Assessments to monitor progress | 32% | 51% 4% 8% |
| Data used to guide decisions | 32% | 52% 4% 7% |
| Research-based academic interventions | 30% | 54% 4% 9% |
| Software to monitor progress | 27% | 41% 7% 12% |
| Collaborative meetings held | 27% | 49% 6% 11% |
| Problem-solving approach used | 26% | 50% 8% 12% |
| RTI process for academics | 21% | 43% 7% 18% |

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

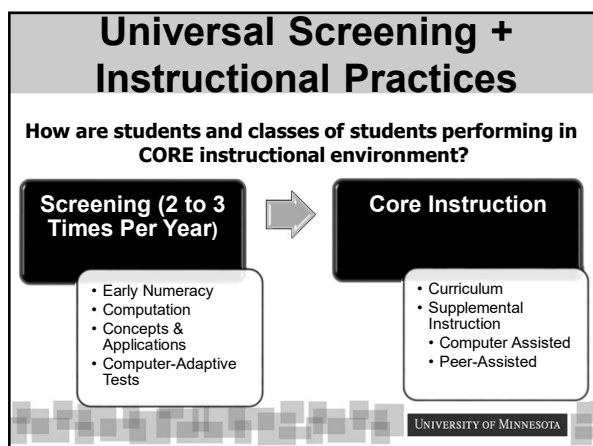
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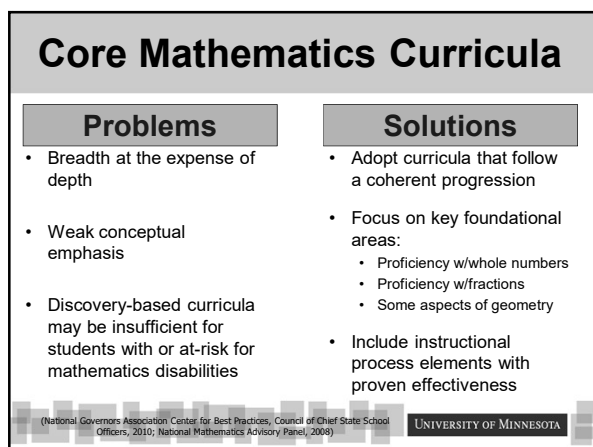


TIER 1

SCREENING & EVIDENCE-BASED INSTRUCTION

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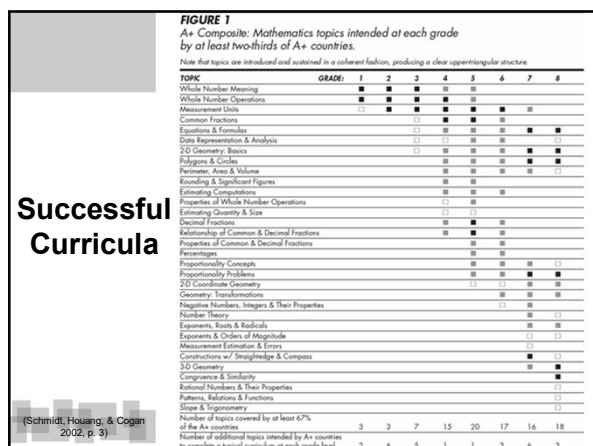


FIGURE 2
State Composite: Mathematics topics intended at each grade
by at least two-thirds of 21 U.S. states.

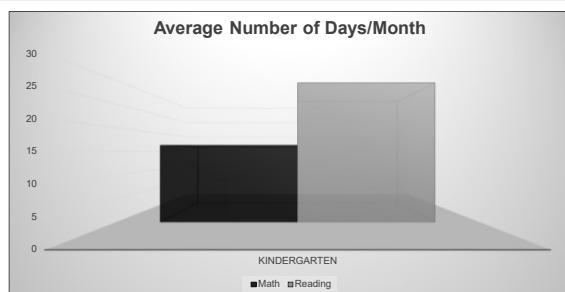
Note that topics are introduced and sustained in a way that produces no visible structure.

| 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 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 2-D 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 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Percentages | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Proportionality Concepts | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Proportionality Problems | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 2-D Coordinate Geometry | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Geometry: Transformations | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Negative Numbers, Integers & Their Properties | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Number Theory | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Exponents, Roots & Radicals | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Exponents & Orders of Magnitude | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Measurement: Estimation & Errors | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Constructions w/ Straightedge & Compass | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 3-D Geometry | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Congruence & Similarity | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Rational Numbers & Their Properties | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Patterns, Relations & Functions | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Slope & Trigonometry | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Number of topics covered by at least 67% | 14 | 15 | 18 | 18 | 20 | 25 | 23 | 22 |
| Number of additional topics intended by states to complete a typical curriculum at each grade level | 8 | 8 | 7 | 8 | 8 | 5 | 4 | 4 |
| Legend: ■ = intended by 67% of the states ■ = intended by 83% of the states ■ = intended by 100% of the states | | | | | | | | |

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

Common U.S. Curricula

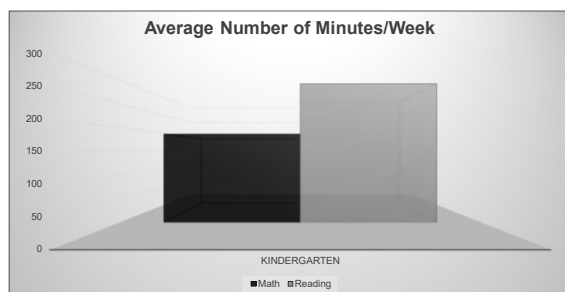
Time Allocated to Mathematics Instruction



(Clausson, Engel, & Curran, 2014, p. 416)

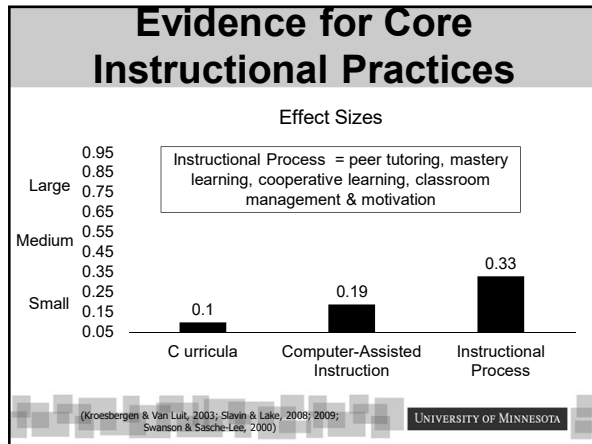
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Time Allocated to Mathematics Instruction



(Clausson, Engel, & Curran, 2014, p. 416)

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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 <small>(Primary Mathematics; New Elementary Mathematics; Math in Focus; My Pals are Here Math)</small> | | |
| 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

Bahrack, Hall, & Baker, 2013; Binder, 1990; Burns, Yesseldyke, 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, Eiland, et al., 2009; Burns et al., 2006; Codding 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

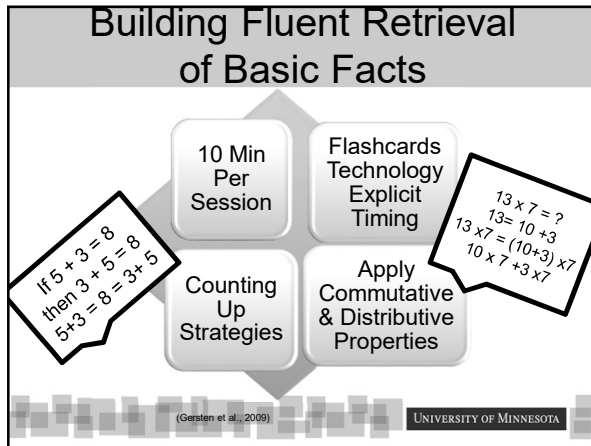
- Examples: peer tutoring, explicit timing, flash cards, computer assisted, cover-copy-compare
- Teach efficient counting strategies (K-2)
- Teach distributive, commutative, & associative properties (2-8)

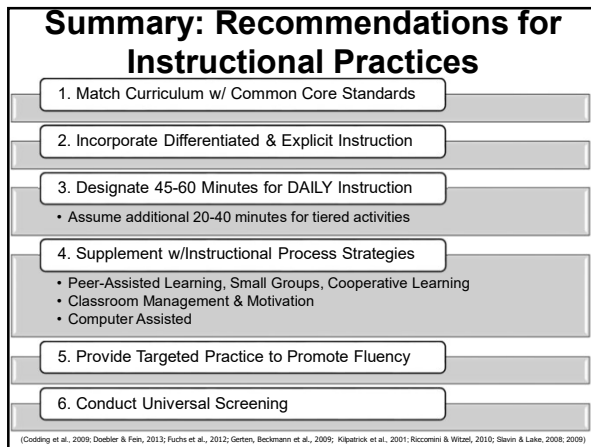
Students Set Goals & Receive Performance Feedback

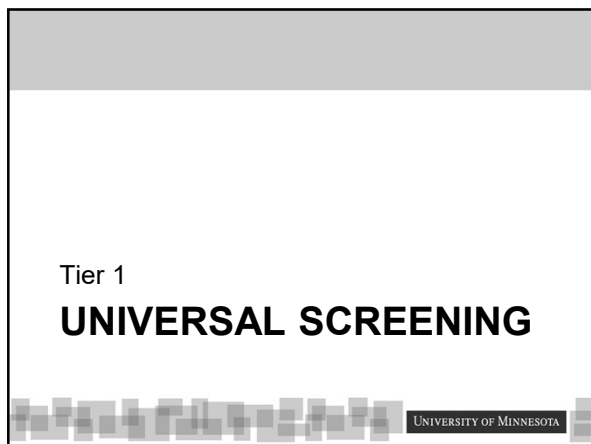
Move up Skill Hierarchy with Mastery

(Codding, Chan-Iannetta, George, & Ferreira, 2009; Gersten, Bechmann, Clarke, Foege, Marsh, Star, & Witzel, 2009; VanDerHeyden & Burns, 2005)

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Screening in Mathematics

Purpose & Psychometrics

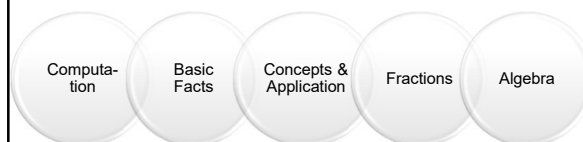
- Identify **all** students' current levels of performance
- Tools are:
 - **Efficient**,
 - **Reliable**,
 - **Valid** (predictive),
 - **Sensitive** (low rates of false negatives)

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

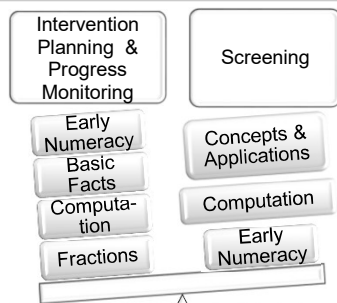
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Challenges Measuring Mathematics



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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

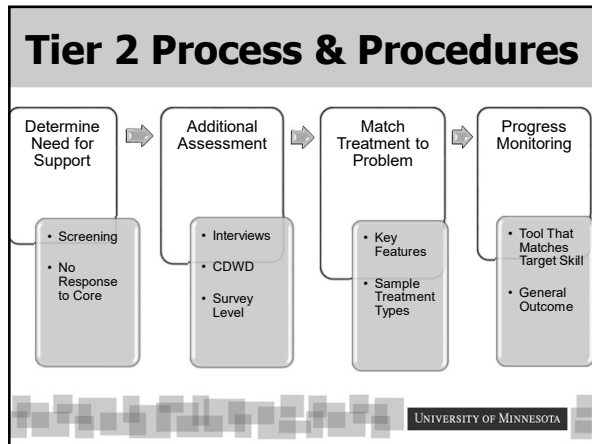
- With good psychometric properties
- Feasible for implementation

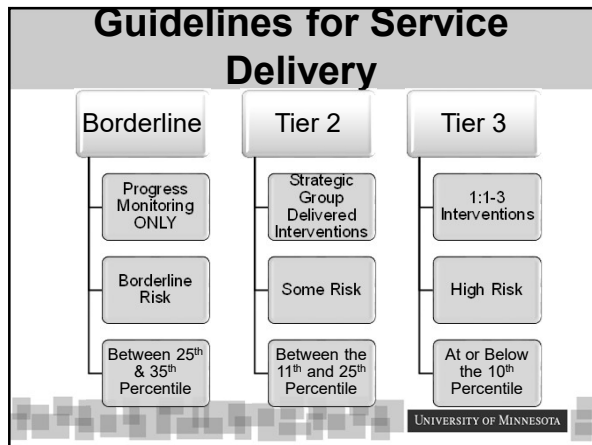
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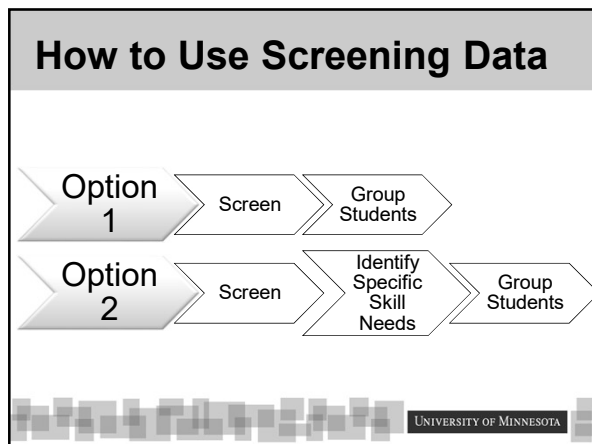


MTSS: TIERS 2 & 3

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Refine Assessment

Attendance

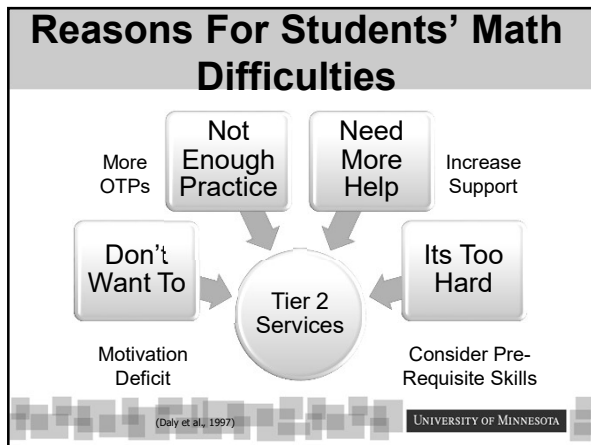
Rating Scales or Office Discipline Referrals

Interview Teacher/Student/Parent

Curriculum-based Measurement

Record Review/Report Cards

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Skill X Treatment Interaction

Skill or Motivation Deficit?

- Can't Do, Won't Do, or Both

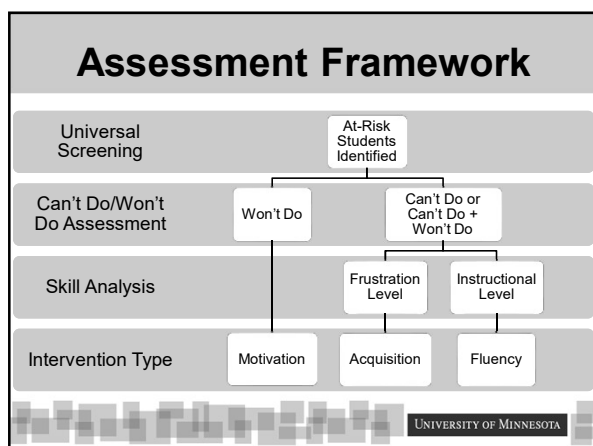
What Type of Skill Deficit?

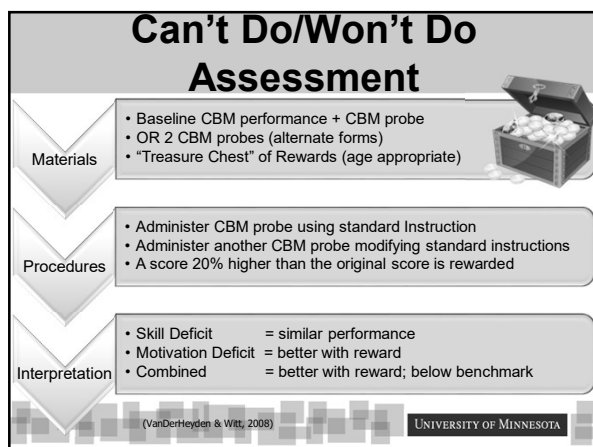
- Acquisition (inaccurate), Fluency (accurate but slow)

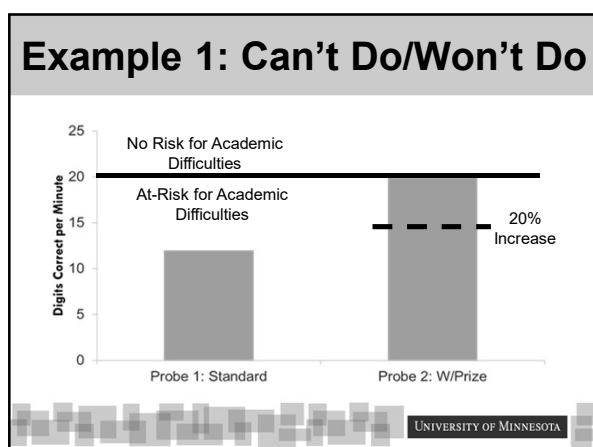
Poor Instructional Match?

- Missing Pre-Requisite Skills

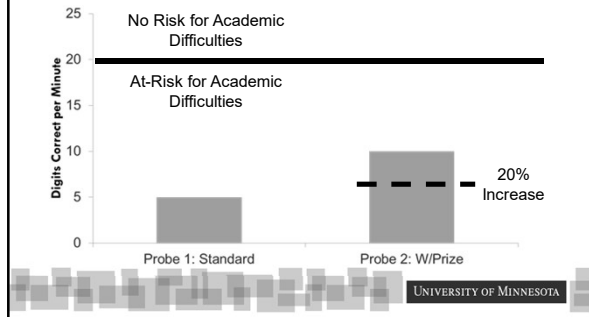
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Example 2: Can't Do/Won't Do



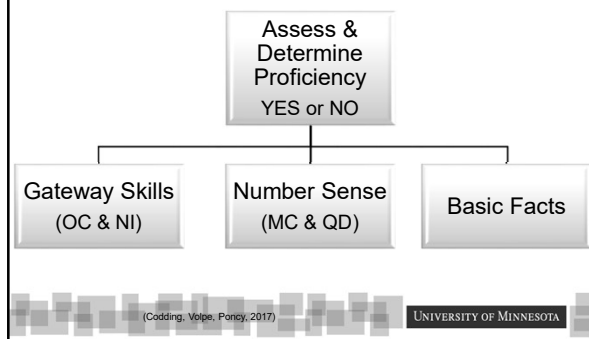
Survey Level Assessment

| Purpose | Grade Level | Target Skills | Interpretation |
|--|--|--|--|
| <ul style="list-style-type: none"> Identify Specific Skill Strengths & Weaknesses | <ul style="list-style-type: none"> Administer CBM-GOM in lower grade levels to find instructional level | <ul style="list-style-type: none"> Determine pre-requisite skill hierarchy Use single-skill CBM or CAT & determine instructional level | <ul style="list-style-type: none"> Frustration <14 DCPM <24 DCPM Instruction 14-31 DCPM 24-49 DCPM Mastery >31 DCPM >49 DCPM |

(Burns, VanDerHeyden, & Jiban, 2006; Burns, Coddling, Bolice, & Lukito, 2010; Gravels & Gickling, 2008)

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Early Numeracy



Computation

Add

Subtract

Multiply

Divide

Multi Digit

Assess & Determine Proficiency
 YES or NO

(Coddling, Volpe, Pancy, 2017)
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| Computation Skill Hierarchy | |
|-----------------------------|---|
| 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; Sharlin, 2010)

Application

Measure-
ment

Charts &
Graphs

Money

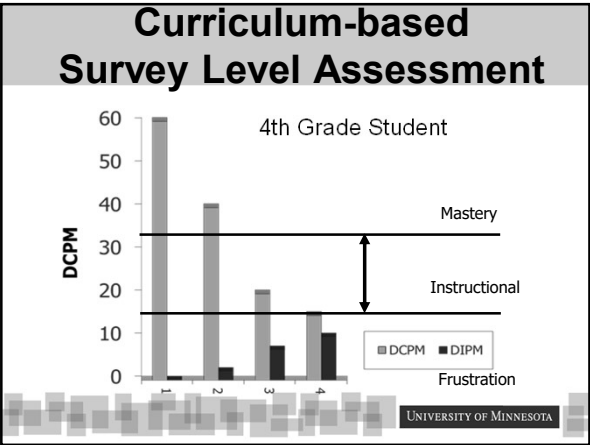
Fractions

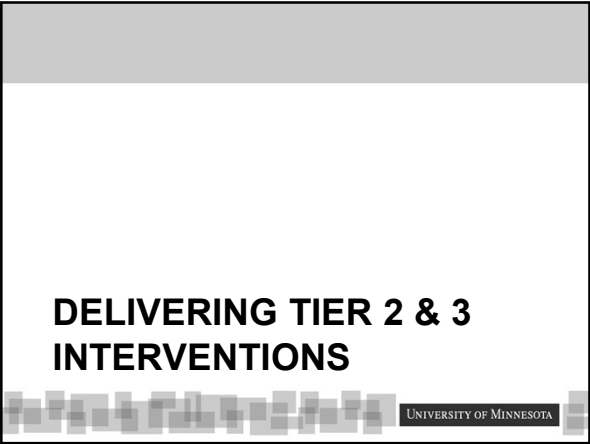
Word Problems

Assess & Determine Proficiency
 YES or NO

(Coddling, Volpe, Pancy, 2017)
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| Skill Benchmarks By Grade | | |
|------------------------------------|---|--|
| Grade | Fractions | Geometry & Measurement |
| 4 | <ul style="list-style-type: none">Identify & Represent Fractions & DecimalsCompare 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 PercentAdd/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 & DecimalsAll Operations w/Positive & Negative Integers | <ul style="list-style-type: none">Analyze Properties of 2D ShapesSolve Perimeter & Area Problems for 2D ShapesAnalyze Properties of 3D ShapesSolve 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

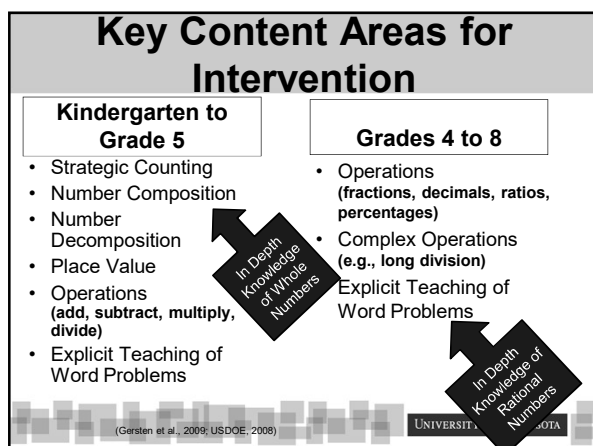
Checking work and answers

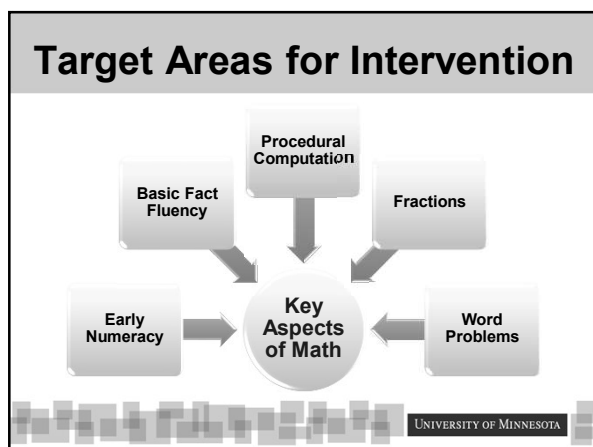
Automatic recall of basic facts

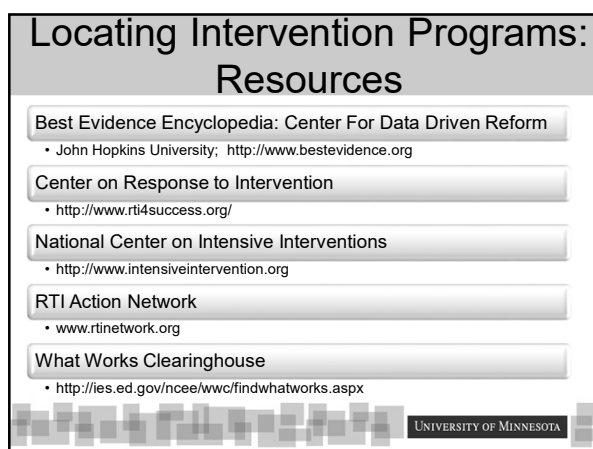
Fractions

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

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Key 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, Codding, Boice, & Lukito, 2010; Codding, 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

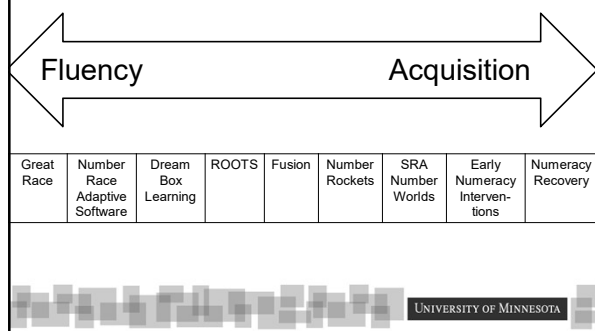
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Early Numeracy Interventions

| | Grade | Details | Topics | Length |
|---|-------|---|--|---------------|
| DreamBox Learning® http://www.dreambox.com/ | K-2 | Online; Tailors Activities to Instructional Level | Subitizing, Counting, Magnitude Comparison, # Line, # Identification, # Writing, Part-Whole Relations, Place Value, Basic Facts, Problem Solving | 90 Min Weekly |
| Early Numeracy Interventions Psychoeducational Services | 1 | Small Group Intervention Program 3-4 Times Weekly | | 25-30 Min |
| focusMath Intensive Intervention® http://www.pearsonschool.com/focusmath | K-6 | Small Group or Individual Administration | | 45-60 Min |
| Fusion https://dibels.uoregon.edu/market/movingup/firstfoundation | 1 | Small Groups of 3-5 Students; 4-5 Days Weekly | | 30 Min |
| Number Rockets http://kmc.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://dibels.uoregon.edu/market/movingup/foundation | 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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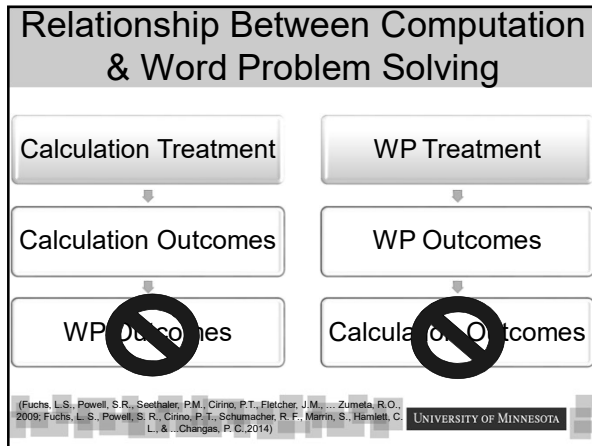
Early Numeracy Interventions

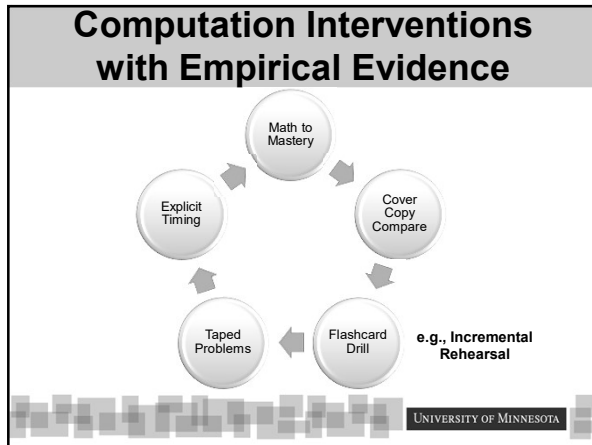


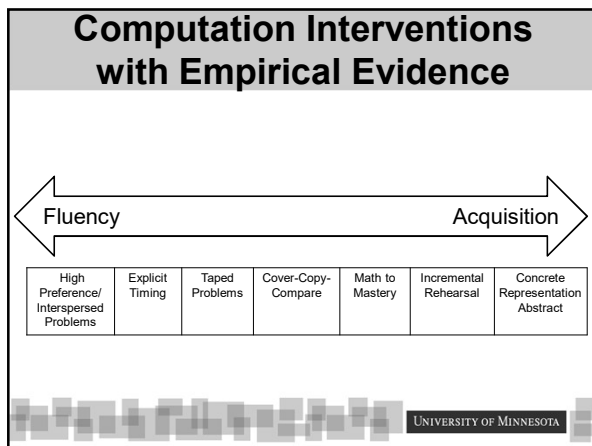
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COMPUTATION INTERVENTIONS

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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 (Crawford, 2003) | 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

- $358 + 421$

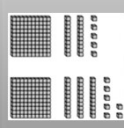


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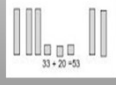
Conceptual Understanding & Visual Representation

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

Concrete
Base-10 Blocks



Representation
Pictures of Objects
Tallies
Number lines



Abstract
Symbolic

RENAME

R = Read the Problem
E = Examine the Operation
N = Name the Steps in the Operation
A = Address the Operation
M = Make the Steps in the Operation
E = Examine & Name the Results. Use with a Quick Check

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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; Jitendra, 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)

Beginning

Change

Ending 93

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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.esinn.net/solve-it.html http://files.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.)

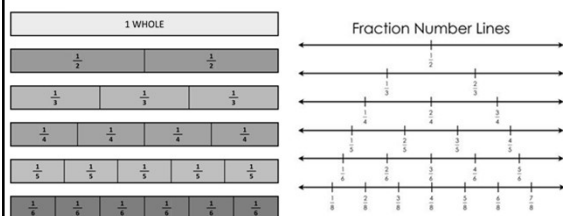


Problems Require Sharing a Set of Objects among Multiple People (e.g., $\frac{3}{4}$)



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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

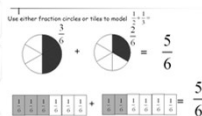
Use Estimation

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 |

(Gersten et al., 2009; Saha, Ysseldyke, & Bort, 2007)UNIVERSITY OF MINNESOTA

Monitor Student Progress TWO Ways

General Outcome Measure

Are Students Making Progress on Grade Level Skills?

Grade Level Content

Can Be Consistent with Screening Tool

Curriculum-Embedded/Mastery Measure

Specific Sub-Skills


Measures Mastery on Smaller Aspects

Are Students Learning Each Skill Along the Way?

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Progress Monitoring Tools

- Curriculum-Based Measurement (CBM)**
 - AIMSweb
 - DIBELS Math
 - EASYcbm
 - mCLASS: Math
 - Monitoring Basic Skills Progress
 - iSTEEP
 - Yearly Progress Pro
- Computer Adaptive Tests (CAT)**
 - FAST/FAST BRIDGE
 - STAR



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Early Numeracy Options

Mastery Measures

Number Identification
 Missing Number
 Quantity Discrimination
 Match Quantity

- 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 | Free Resources |
|---|--|
| <ul style="list-style-type: none"> Single Skill Computation Multi-digit Computation Fractions Decimals Word Problems | <ul style="list-style-type: none"> 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

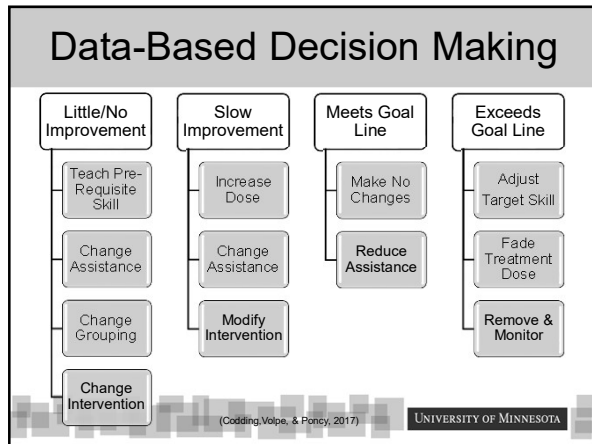


- Work with your neighbor(s) to identify tools
 - With good psychometric properties
 - Feasible for implementation

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EVALUATING RESPONSIVENESS

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Fine Tuning Intervention Supports with Assessment

Implement a Brief Experimental Analysis

- Tests Different Intervention Strategies

Administer a Fact Assessment

- Determines Knowns and Unknowns of Basic Facts

Conduct an Error Analysis

- Determine Error Patterns

Interview a Student

- Assess the HOW or WHY of Problem Solving
- Student Explains or Demonstrates Understanding

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<http://www.guilford.com/books/Effective-Math-Interventions/Coddling-Volpe-Poncy/9781462528288>

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Establishing a Multi-Tiered System of Support for Mathematics

Robin S. Coddling, Ph.D., BCBA
rcoddling@umn.edu

Ohio School Psychologists Association

Friday, November 11, 2016
Columbus, Ohio

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