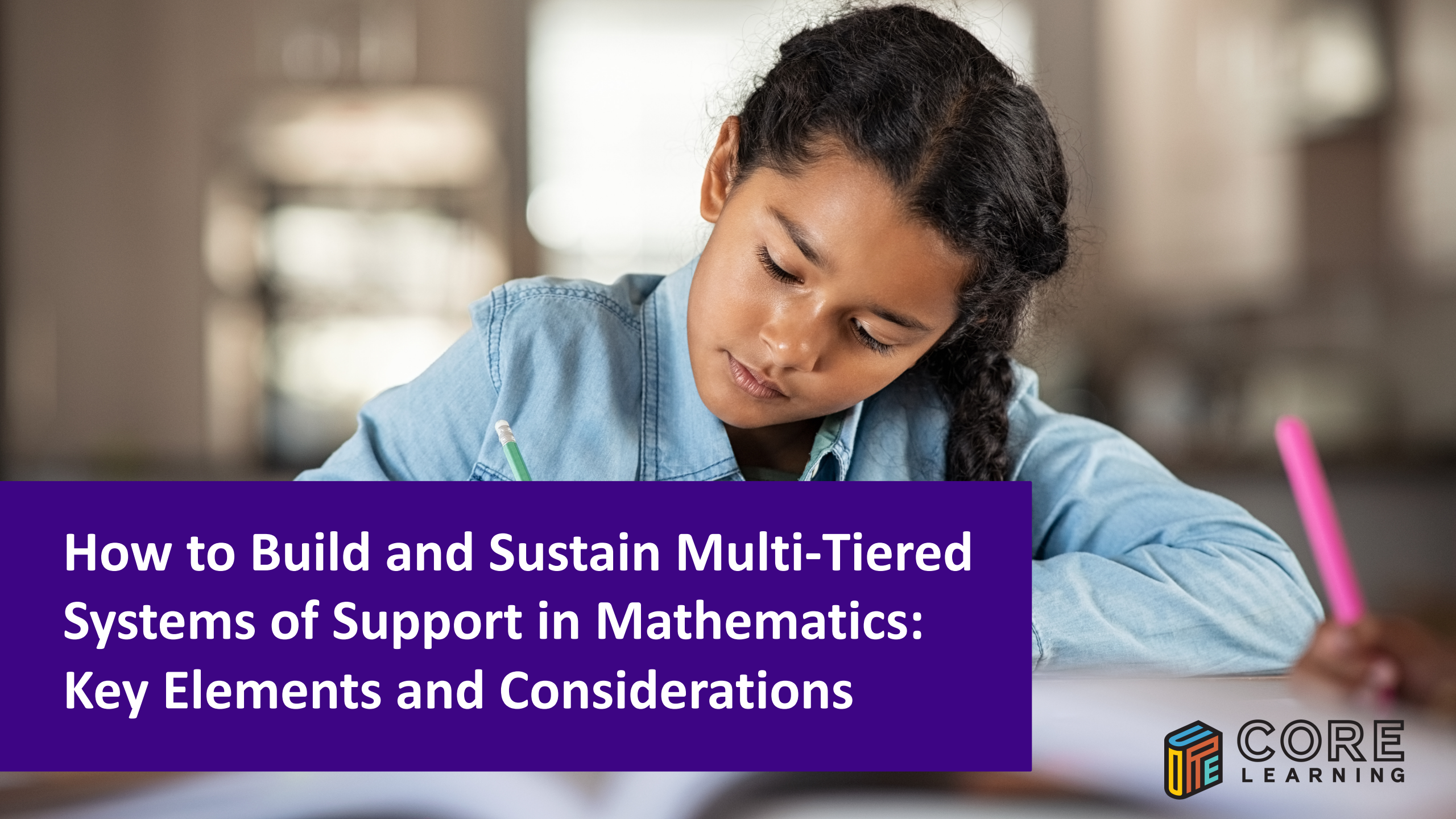


How to Build and Sustain Multi-Tiered Systems of Support in Mathematics: Key Elements and Considerations

CORE LEARNING

Webinar Tips

Close all programs & browsers to maximize bandwidth

Exit & re-enter the webinar if you experience an audio or video lag

Use the Q&A Icon to ask a question; **Use Chat** for technical assistance

The **recording, slide deck & certificate** will be sent by email

Meet Your Presenter

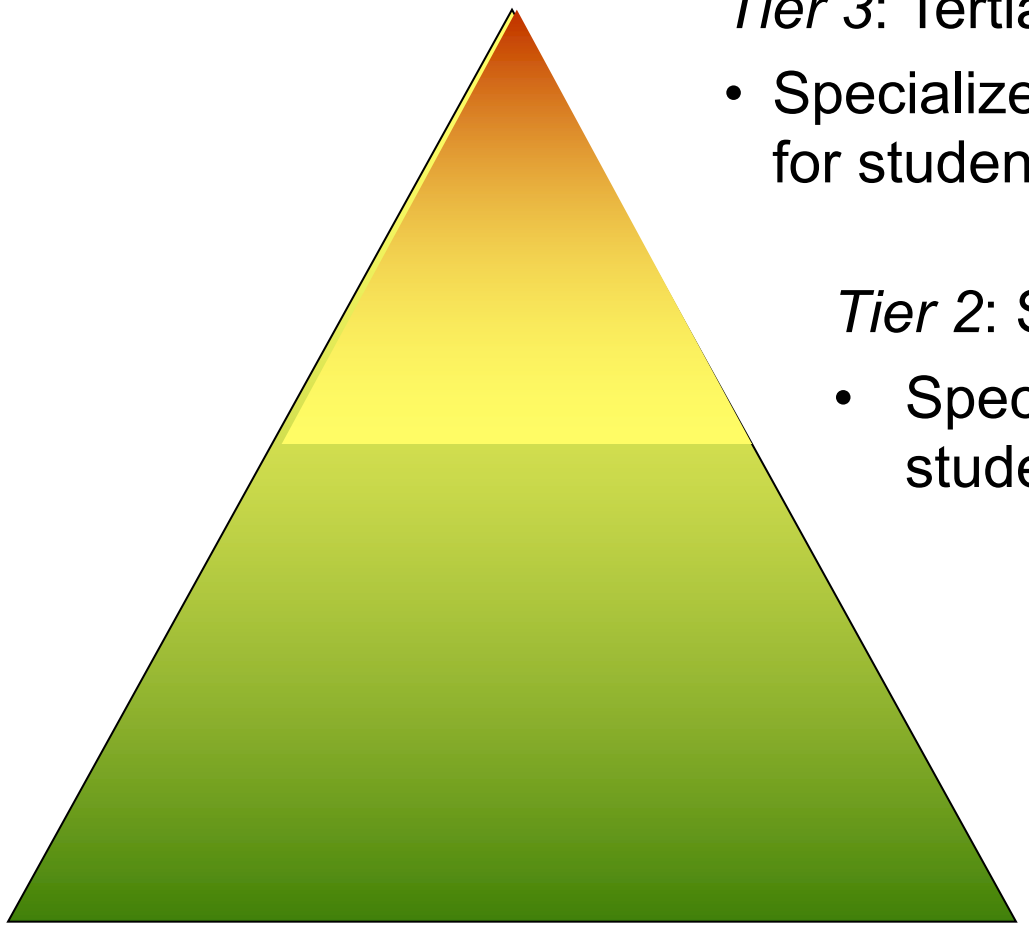
Dr. Ben Clarke

Professor, School Psychology Program
& Director of the Center on Teaching
and Learning, University of Oregon

What You Will Learn

- How assessment fits within MTSS
- High-leverage instructional practices
- Data-based decision making

MTSS: A Framework



Tier 3: Tertiary/Intensive

- Specialized, individualized interventions for students with significant needs

Tier 2: Secondary/Targeted

- Specialized interventions for students at-risk for failure

Tier 1: Primary/Universal

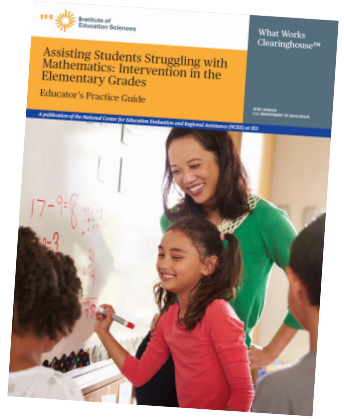
- School-wide system of support
- Designed to support the needs of all students

Discussion Items

- What initiatives are in place to improve mathematics achievement?
- Is that work linked to an RtI/MTSS model?
- How does your student performance compare to the RtI “triangle” and what type of RtI/MTSS system do you use?

Assisting Students Struggling with Mathematics: Response to Intervention (RtI) for Elementary and Middle Schools (2009)

Assisting Students Struggling with Mathematics: Intervention in the Elementary Grades Educator's Practice Guide (2021)



Copies available at the IES website:

http://ies.ed.gov/ncee

https://ies.ed.gov/ncee/wwc/practiceguides

Recommendation	Level of Scientific Evidence
1. Universal screening (Tier I)	Moderate
2. Focus instruction on whole number for grades K-5 and rational number for grades 6-8	Low
3. Systematic instruction	Strong
4. Solving word problems	Strong
5. Visual representations	Moderate
6. Building fluency with basic arithmetic facts	Moderate
7. Progress monitoring	Low
8. Use of motivational strategies	Low

Practice Recommendation	Level of Evidence		
	Minimal	Moderate	Strong
1. Systematic Instruction: Provide systematic instruction during intervention to develop student understanding of mathematical ideas.			✓
2. Mathematical Language: Teach clear and concise mathematical language and support students' use of the language to help students effectively communicate their understanding of mathematical concepts.			✓
3. Representations: Use a well-chosen set of concrete and semi-concrete representations to support students' learning of mathematical concepts and procedures.			✓
4. Number Lines: Use the number line to facilitate the learning of mathematical concepts and procedures, build understanding of grade-level material, and prepare students for advanced mathematics.			✓
5. Word Problems: Provide deliberate instruction on word problems to deepen students' mathematical understanding and support their capacity to apply mathematical ideas.			✓
6. Timed Activities: Regularly include timed activities as one way to build fluency in mathematics.			✓

Three Major Areas of Focus

1. Assessment
   - Screening/PM (2009 Guide)
2. Content
   - Focus (2009), Word Problems (2009 & 2021), Fluency (2009 & 2021), Math Language (2021)
3. Instructional Design
   - Systematic (2009 & 2021), Representations (2009 & 2021)/NumberLine (2021)

ASSESSMENT

Recommendation: Screening and Progress Monitoring

- Screen all students to identify those at risk for potential mathematics difficulties and provide interventions to students identified as at risk
  - Level of Evidence: **Moderate**
- Monitor the progress of students receiving supplemental instruction and other students who are at risk
  - Level of Evidence: **Low**

What is Assessment?

Definition:

Assessment is the collection of data to make decisions.

(Salvia & Ysseldyke, 1997)

Assessment is useless if we don't use it to guide our actions

Assessment for Different Purposes

An effective, comprehensive mathematics assessment program includes assessments for four purposes:

1. Outcome
2. Screening
3. Progress Monitoring
4. Diagnostic

Outcome Assessment

- Purpose: To determine level of proficiency in relation to norm or criterion
- When: Typically administered at end of year. Can be administered pre/post to assess overall growth
- Who: All students
- Relation to instruction: Provides index of overall efficacy but limited timely instructional information

Screening Assessment

- Purpose: To determine children who are likely to require additional instructional support (predictive validity)
- When: Early in the academic year or when new students enter school; May be repeated in the Winter and Spring
- Who: All students
- Relation to instruction: Most valuable when used to identify children who may need further assessment or additional instructional *support*

Progress Monitoring Assessment

- Purpose: Frequent, timely measures to determine whether students are learning enough of critical skills
- When: Weekly or Monthly
- Who: At-risk students
- Relation to Instruction: Indicates student response to instruction

Diagnostic Assessment

- Purpose: To provide specific information on skills and strategy needs of individual students
- When: Following screening or at points during the year when students are not making adequate progress
- Who: Selected students as indicated by screening, or progress monitoring measures, or teacher judgment
- Relation to Instruction: Provides specific information on *target skills*; highly relevant

Coherent Assessment Systems

- Each type of assessment has a purpose
- The design of the tool should match the purpose
  - What are the implications for screening tools used with all students?
- How do each of these purposes fit together?

Discussion: Do your current assessments function as a whole?

Talk with your colleagues about how the four types of assessments work in one system at your school/district.

- Does each assessment tool match the purpose it is used for?
- Does the system link together in a logical manner?

CONTENT

Recommendation: Intervention Content

Instructional materials for students receiving interventions should focus intensely on in-depth treatment of whole numbers in kindergarten through grade 5 and on rational numbers in grades 4 through 8. These materials should be selected by committee.

- Level of Evidence: **Low**

Tier 2 Programs Should Prioritize Critical Mathematics Content

Grade K Overview

Counting and Cardinality

- Know number names and the count sequence.
- Count to tell the number of objects.
- Compare numbers.

Operations and Algebraic Thinking

- Understand addition as putting together and adding to, and understand subtraction as taking apart and taking from.

Number and Operations in Base Ten

- Work with numbers 11–19 to gain foundations for place value.

Measurement and Data

- Describe and compare measurable attributes.
- Classify objects and count the number of objects in categories.

Geometry

- Identify and describe shapes.
- Analyze, compare, create, and compose shapes.

Grade 1 Overview

Operations and Algebraic Thinking

- Represent and solve problems involving addition and subtraction.
- Understand and apply properties of operations and the relationship between addition and subtraction.
- Add and subtract within 20.
- Work with addition and subtraction equations.

Number and Operations in Base Ten

- Extend the counting sequence.
- Understand place value.
- Use place value understanding and properties of operations to add and subtract.

Measurement and Data

- Measure lengths indirectly and by iterating length units.
- Tell and write time.
- Represent and interpret data.

Geometry

- Reason with shapes and their attributes.

Grade 2 Overview

Operations and Algebraic Thinking

- Represent and solve problems involving addition and subtraction.
- Add and subtract within 20.
- Work with equal groups of objects to gain foundations for multiplication.

Number and Operations in Base Ten

- Understand place value.
- Use place value understanding and properties of operations to add and subtract.

Measurement and Data

- Measure and estimate lengths in standard units.
- Relate addition and subtraction to length.
- Work with time and money.
- Represent and interpret data.

Geometry

- Reason with shapes and their attributes.

Recommendation: Word Problems

- Interventions should include instruction on solving word problems that is based on common underlying structures.
  - Level of evidence: **Strong**
- Provide deliberate instruction on word problems to deepen students' mathematical understanding and support their capacity to apply mathematical ideas.
  - Level of Evidence: **Strong**

Word Problems

- Word problems give meaning to mathematical operations and make abstract work tangible by giving meaning to deeper mathematical ideas.
- Difficulties encountered by some students
  - Format changes, vocabulary changes, and extraneous information
  - Deficits on associated skills (reading skill and language comprehension)

Suggestions

- Teach students about the structure of various problem types, how to categorize problems, and how to determine appropriate solutions
- Teach students to recognize the common underlying structure between familiar and unfamiliar problems and to transfer known solution methods from familiar to unfamiliar problems.

Underlying Structures of Addition and Subtraction Problems

- Group Problems
  - Two smaller groups/ make up a larger group or whole/total
- Change Problems
  - Beginning quantity followed by an action that increases (adds to) or decreases (takes from)
- Compare Problems
  - Two quantities are compared with the same unit
  - One quantity is more, one is less, difference

Doabler, 2013

Recommendation: Fluency

- Interventions at all grades should devote about 10 minutes in each session to building fluent retrieval of basic arithmetic facts
  - Level of Evidence: **Moderate**
- Regularly include timed activities as one way to build students' fluency in mathematics
  - Level of Evidence: **Strong**

Suggestions

- Provide 10 minutes per session of instruction to build quick retrieval of basic facts. Consider the use of technology, flash cards, and other materials to support extensive practice to facilitate automatic retrieval.
- For students in grades K–2, explicitly teach strategies for efficient counting to improve the retrieval of math facts.
- Teach students in grades 2–8 how to use their knowledge of math properties to derive facts in their heads.

When to begin?
After conceptual introduction of the operation

- 1st Grade: Addition & Subtraction
  - Sums and Minuends to 9 (or 10)
- 2nd Grade: Addition & Subtraction
  - Sums and minuends to to 18 (or 20 or 24)
- 3rd Grade: Multiplication (& Division)
  - Products (and dividends) to 81
- 4th Grade: Review Multiplication / Division
  - Products and dividends to 81 (or 100 or 144)
- 5th Grade
  - Review Multiplication/Division up through 144
  - Review Addition
  - Review Subtraction

Recommendation: Mathematical Language

Teach clear and concise mathematical language and support students' use of the language to help students effectively communicate their understanding of mathematical concepts.

- Level of Evidence: Strong Strong

Suggestions

- Routinely teach mathematical vocabulary to build students' understanding of the mathematics they are learning.

- Use clear, concise, and correct mathematical language throughout lessons to reinforce students' understanding of important mathematical vocabulary words.

- Support students in using mathematically precise language during their verbal and written explanations of their problem solving.

Example word list that can be used across settings in grades K–6 by all teachers in the school.

Rather than using this term…	*Consider using this term…*
Reduce	Simplify
Borrowing or Carrying	Regrouping
Flat Shape or Fat Shape	Two-Dimensional or Three-Dimensional Shapes
Bigger, Smaller	Greater Than, Less Than
Flip-Flop Property	Commutative Property

Note: This list is not comprehensive. It only contains a sample of words that might appear on a more comprehensive shared list used in a school.

Discussion: How well do your current intervention materials….

- Focus on critical content?
- Incorporate a focus on word problems?
- Build procedural fluency with basic number combinations?
- Incorporate a focus on mathematical language?

INSTRUCTIONAL DESIGN

Recommendation: Systematic Instruction

- Instruction during the intervention should be explicit and systematic. This includes providing models of proficient problem-solving, verbalization of though processes, guided practice, corrective feedback, and frequent cumulative review.
  - Level of Evidence: **Strong**
- Provide systematic instruction during intervention to develop student understanding of mathematical ideas.
  - Level of Evidence: **Strong**

Systematic and Explicit Instruction

- Explicit instruction is a structured, systematic instructional methodology for teaching foundational concepts, principles, and skills in the most effective and efficient manner possible.

- The National Mathematics Advisory Panel stated that “Explicit systematic instruction typically entails teachers explaining and demonstrating specific strategies and allowing students many opportunities to ask and answer questions and to think about the decisions they make while solving problems” (p.48).

Suggestions

- Ensure that intervention materials are systematic and explicit and include numerous models of easy and difficult problems with accompanying teacher think-alouds.
- Provide students with opportunities to solve problems in a group and communicate problem- solving strategies.
- Ensure that instructional materials include cumulative review in each session.

Systematic and Explicit Instructional Sequence

1. Prioritize the most critical content (“big ideas”)
2. Specify learning objectives and interaction expectations
3. Address students’ background knowledge and pre-requisite skills
4. Provide vivid, step-by-step demonstrations (I Do)
5. Use a range of examples and some non-examples
6. Teach generalizable strategies
7. Facilitate frequent instructional interactions (We Do)
8. Provide and monitor independent practice opportunities (You Do)
9. Deliver timely, academic feedback
10. Engage students in daily, weekly, and monthly review

Models and Think Alouds

- Use models think alouds so that students can hear your thought process.
  - Justifications, solution methods, and math reasoning

- Foster opportunities for students to use think-alouds on their own
  - Discourse/verbalizations opportunities are often not well designed for all students and favor students who already understand the concept
  - Process is robust and interactive with teacher feedback

Recommendation: Representations

- Interventions materials should include opportunities for students to work with visual representations of mathematical ideas and interventionists should be proficient in the use of visual representations of mathematical ideas.
  - Level of evidence: **Moderate**

- Use a well-chosen set of concrete and semi-concrete representations to support students' learning of mathematical concepts and procedures.
  - Level of Evidence: **Strong**

- Use the number line to facilitate the learning of mathematical concepts and procedures, build understanding of grade-level material, and prepare students for advanced mathematics
  - Level of Evidence: **Strong**

Building Toward Abstract Understanding

The purpose of representations is to bridge the gap to abstract understanding

- Use needs to be purposeful
- Use needs to be consistent and extensive
- Use needs to be scaffolded

Examples of Math Models

Concrete

- Place value models
- Counting blocks

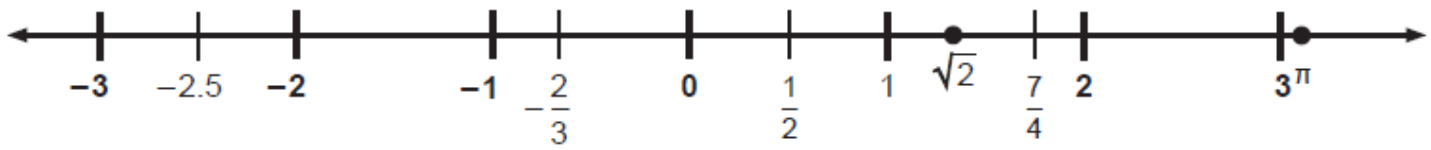
Representational

- Number lines
- Simple drawings
- Graphs

Abstract

- Equations
- Verbal description

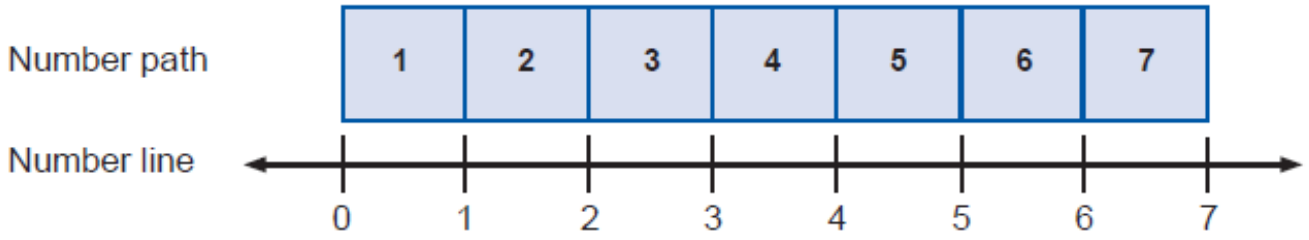
Number lines can represent whole numbers, fractions, and decimals and help build students' understanding of numerical magnitude.



Compare numbers and determine their relative magnitude using a number line to help students understand quantity.

Early elementary (grades K–2):

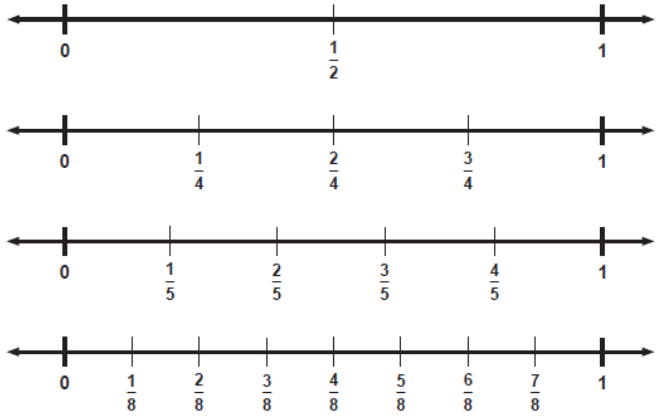
- Use number lines to teach the relative magnitude of whole numbers.

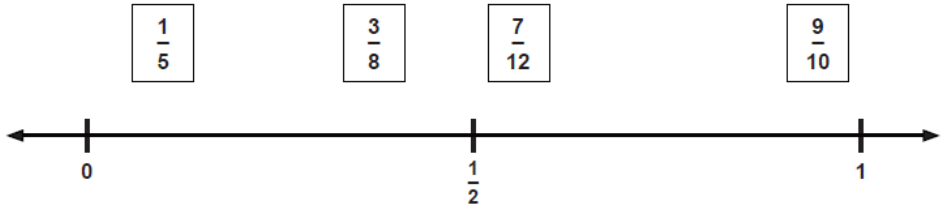


Compare numbers and determine their relative magnitude using a number line to help students understand quantity.

Upper elementary (grades 3–6):

- Use number lines to compare the magnitude of fractions and decimals. Reinforce the idea that the denominator represents the number of partitions in one whole.

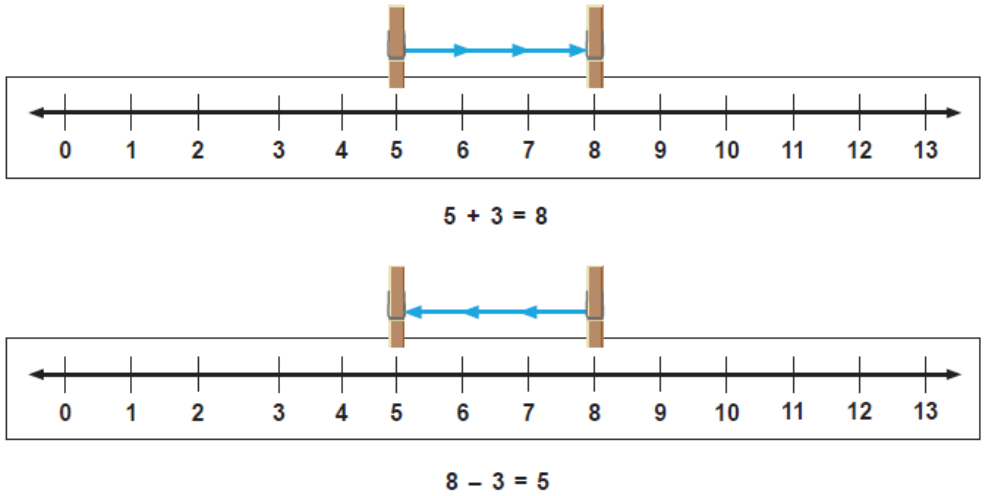


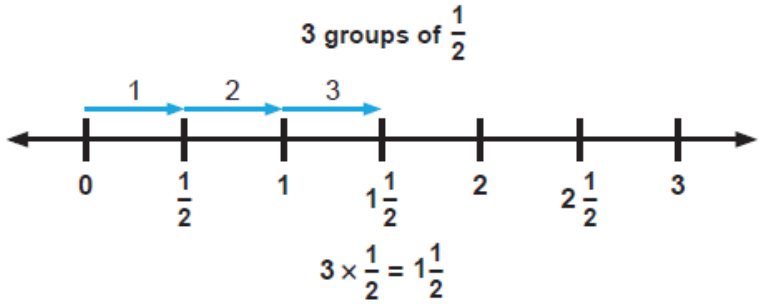


Use the number line to build students' understanding of the concepts underlying operations.

- Early elementary (grades K–2):
  - Show students how to use number lines for addition and subtraction of whole numbers by looking at the distance between whole numbers.
- Upper elementary (grades 3–6):
  - Start by adding fractions with the same denominator using one number line.

Number lines used to build students' understanding of the concepts underlying operations.





Activity

How well do your current intervention materials incorporate critical instructional design elements including:

- Explicit and systematic teaching sequences (with teacher models and multiple opportunities for math verbalizations
- Robust math models
- A focus on math language

Getting Started: Considerations

- Focus on one grade or grade band
- Primary:
  - Valid system for screening
  - An array of evidence-based standard protocol interventions
- Secondary:
  - Focus on core program efficacy
  - System for progress monitoring
  - Diagnostic assessments

Tier 1: Components

- **Screening instruments**
- Core Curriculum based on expert judgment
- Enhancements to the core curriculum

Tier 2 and 3 Components

- Progress monitoring and diagnostic assessments

- **Standard protocol interventions**
  - Students maintain in the program for a set duration of time
    - Progress monitoring data collected but not used for educational decision-making

Final Thoughts — Interventions

For interventions consider:

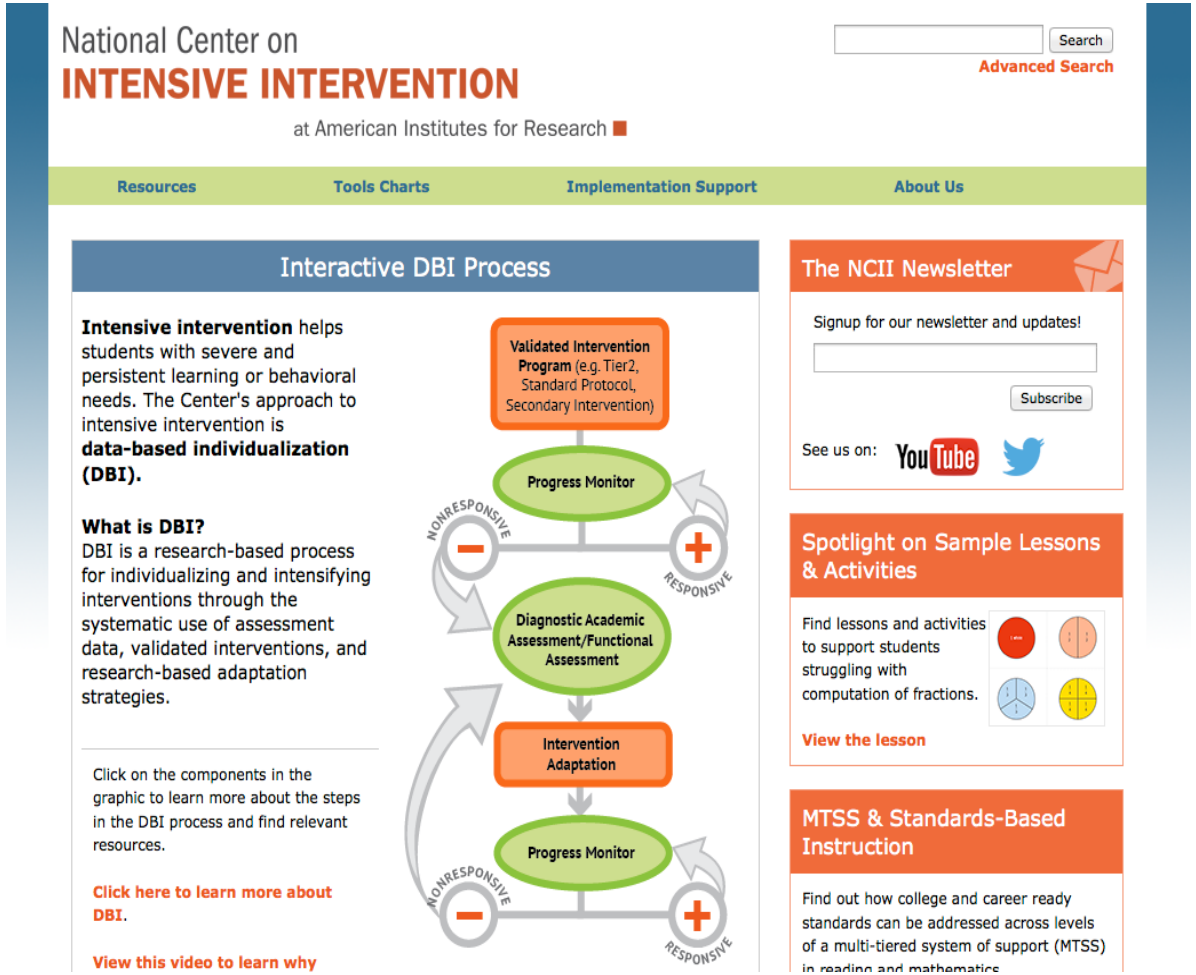
(1) Evidence of effectiveness (the Research)

*Likely to be dependent upon “trusted” resources.

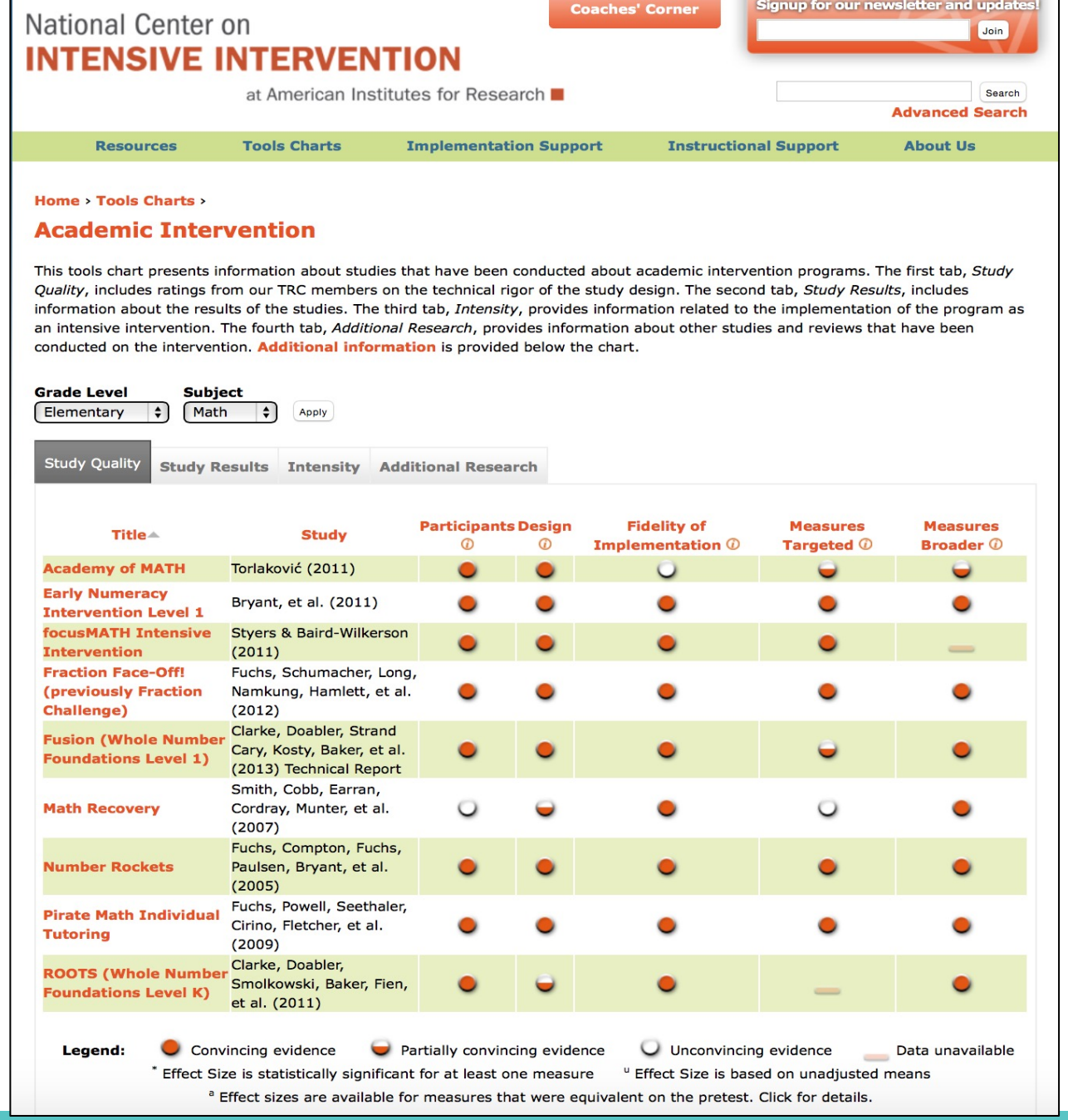
- What Works Clearinghouse

- National Center for Intensive Interventions

National Center for Intensive Intervention (NCII)



Evidence of Effectiveness



National Center on
INTENSIVE INTERVENTION
at American Institutes for Research

Coaches' Corner

Signup for our newsletter and updates!
Join

Search
Advanced Search

Resources | Tools Charts | Implementation Support | Instructional Support | About Us

Home › Tools Charts ›

Academic Intervention

This tools chart presents information about studies that have been conducted about academic intervention programs. The first tab, *Study Quality*, includes ratings from our TRC members on the technical rigor of the study design. The second tab, *Study Results*, includes information about the results of the studies. The third tab, *Intensity*, provides information related to the implementation of the program as an intensive intervention. The fourth tab, *Additional Research*, provides information about other studies and reviews that have been conducted on the intervention. **Additional information** is provided below the chart.

Grade Level: Elementary **Subject**: Math Apply

Study Quality | Study Results | Intensity | Additional Research

Title	Study	Participants	Design	Fidelity of Implementation	Measures Targeted	Measures Broader
Academy of MATH	Torlaković (2011)	●	●	○	◔	◔
Early Numeracy Intervention Level 1	Bryant, et al. (2011)	●	●	●	●	●
focusMATH Intensive Intervention	Styers & Baird-Wilkerson (2011)	●	●	●	●	–
Fraction Face-Off! (previously Fraction Challenge)	Fuchs, Schumacher, Long, Namkung, Hamlett, et al. (2012)	●	●	●	●	●
Fusion (Whole Number Foundations Level 1)	Clarke, Doabler, Strand Cary, Kosty, Baker, et al. (2013) Technical Report	●	●	●	◔	●
Math Recovery	Smith, Cobb, Earran, Cordray, Munter, et al. (2007)	○	◔	●	○	●
Number Rockets	Fuchs, Compton, Fuchs, Paulsen, Bryant, et al. (2005)	●	●	●	●	●
Pirate Math Individual Tutoring	Fuchs, Powell, Seethaler, Cirino, Fletcher, et al. (2009)	●	●	●	●	●
ROOTS (Whole Number Foundations Level K)	Clarke, Doabler, Smolkowski, Baker, Fien, et al. (2011)	●	◔	●	–	●

Legend: ● Convincing evidence ◔ Partially convincing evidence ○ Unconvincing evidence – Data unavailable

* Effect Size is statistically significant for at least one measure u Effect Size is based on unadjusted means

a Effect sizes are available for measures that were equivalent on the pretest. Click for details.

Final Thoughts — Interventions

For interventions consider:

(2) The focus of the content and underlying scope and sequence

* Breadth and depth matter. Substantive problems require substantive solutions.

(3) The instructional design of the materials (the research base)

Our understanding of how best to teach and assess mathematics is rapidly expanding.

Stay connected and be flexible in your approach to supporting mathematics achievement!

Transform Math Instruction to Deepen Mathematical Understanding

- Implementation support for all math curricula
- In person and online courses and workshops
- Coaching in evidence-based practices
- MTSS implementation support

www.corelearn.com/what-we-do/math

Questions?

Get in Touch with CORE Learning!

info@corelearn.com
888.249.6155

Consortium on Reaching Excellence in Education

@COREInc

Upcoming Webinars

October 12, 4:00 p.m. ET
Considering Dyslexia: Looking at the Big Picture

November 17, 4:00 p.m. ET
Aligning and Embedding: Critical Factors for Improving Outcomes for Older Students with Reading Difficulties

Register at www.corelearn.com/2022-23-webinars