Supporting Practice Guide Implementation: *Assisting Students Struggling with Mathematics: Intervention in the Elementary Grades*

Research to Practice Spotlight Series: Session 4

November 2024

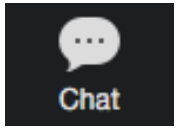
Nicole Bucka, MA, MTSS Rhode Island, Practice Guide Panel Member
Robin Schumacher, PhD, Instructional Research Group, Practice Guide Staff
Laura Berry Kuchle, PhD & Kathleen Pfannenstiel, PhD, and Elizabeth Zagata, PhD, (NCSI)

Thank you for joining us!

While we wait to start, feel free to share in the chat what brings you to this event and any questions you may have.

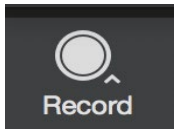
Zoom Housekeeping

Microphones and videos are off for this event.



Look for the flashing orange alert, which will take you to the chat box when it is active.

Closed captions are available.



This webinar is being recorded.

Agenda

- Welcome and Overview
- Review of the Practice Guide Recommendations
- State Education Agency (SEA) Considerations for Supporting the Recommendations
- Closing and Additional Resources

Introduction to NCSI

The National Center for Systemic Improvement (NCSI) supports states to transform systems to improve outcomes for students with disabilities. Today's webinar relates to one of our three priority areas: Effective Instruction.

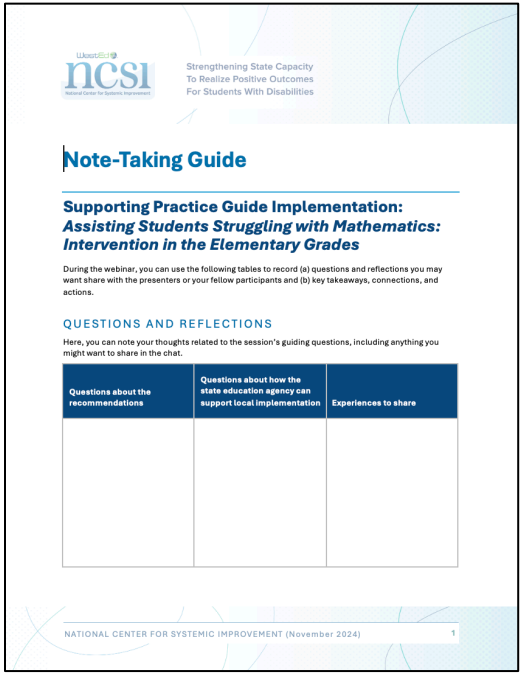
Overview and Purpose of NCSI's Research to Practice Spotlight Series

- Unpack key evidence-based practices (EBPs) to promote learning for students with disabilities and others struggling to learn reading and mathematics.
- Share considerations for SEAs and local education agencies (LEAs) to support educators with implementation.

Setting the Stage: How SEAs Can Support Local Implementation

- Build SEA capacity about EBPs, including how to support local implementation.
- Identify and disseminate mathematics EBPs.
- Offer guidance and professional learning on how to implement the mathematics EBPs within a variety of educational settings (e.g., core classroom, intervention).

Introducing the Note-Taking Guide



WestEd
ncsi
National Center for Systemic Improvement

Strengthening State Capacity
To Realize Positive Outcomes
For Students With Disabilities

Note-Taking Guide

Supporting Practice Guide Implementation:
Assisting Students Struggling with Mathematics: Intervention in the Elementary Grades

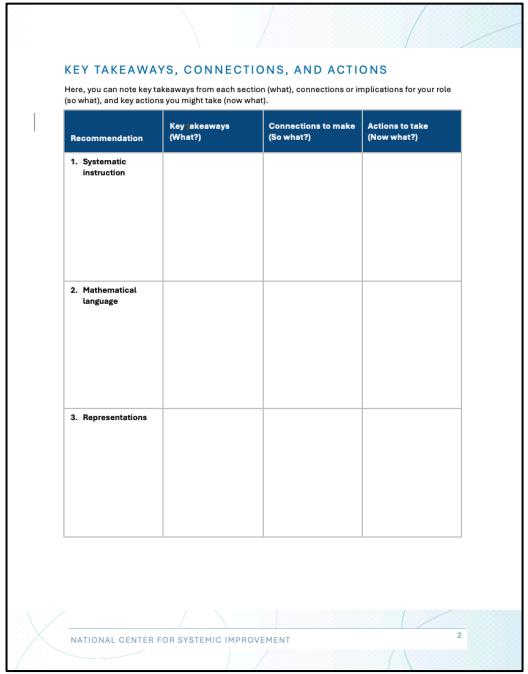
During the webinar, you can use the following tables to record (a) questions and reflections you may want share with the presenters or your fellow participants and (b) key takeaways, connections, and actions.

QUESTIONS AND REFLECTIONS

Here, you can note your thoughts related to the session's guiding questions, including anything you might want to share in the chat.

Questions about the recommendations	Questions about how the state education agency can support local implementation	Experiences to share

NATIONAL CENTER FOR SYSTEMIC IMPROVEMENT (November 2024) 1

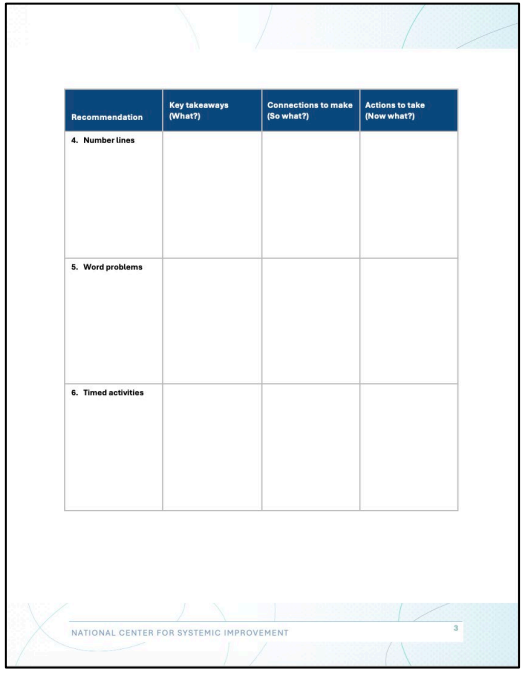


KEY TAKEAWAYS, CONNECTIONS, AND ACTIONS

Here, you can note key takeaways from each section (what), connections or implications for your role (so what), and key actions you might take (now what).

Recommendation	Key takeaways (What?)	Connections to make (So what?)	Actions to take (Now what?)
1. Systematic instruction			
2. Mathematical language			
3. Representations			

NATIONAL CENTER FOR SYSTEMIC IMPROVEMENT 2



Recommendation	Key takeaways (What?)	Connections to make (So what?)	Actions to take (Now what?)
4. Number lines			
5. Word problems			
6. Timed activities			

NATIONAL CENTER FOR SYSTEMIC IMPROVEMENT 3

Guiding Questions

- What questions do you have about the recommendations on how SEAs can support local implementation?
- Do you have relevant experiences to share?

Meet Your Presenters

Nicole Bucka, MA

Senior MTSS Implementation Specialist, West Bay Collaborative

MTSS Rhode Island

Practice Guide Panel Member

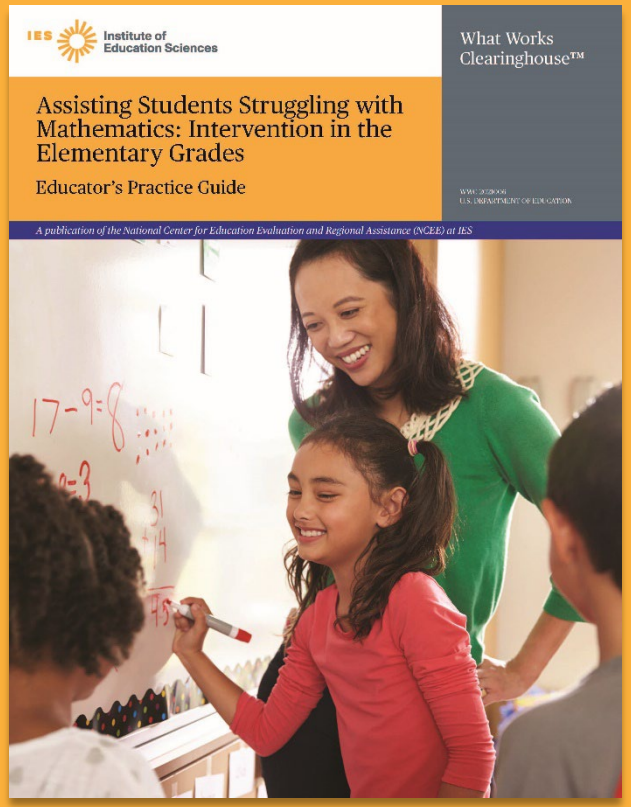
Robin Schumacher, PhD

Principal Research Scientist, Instructional Research Group

Practice Guide Staff

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

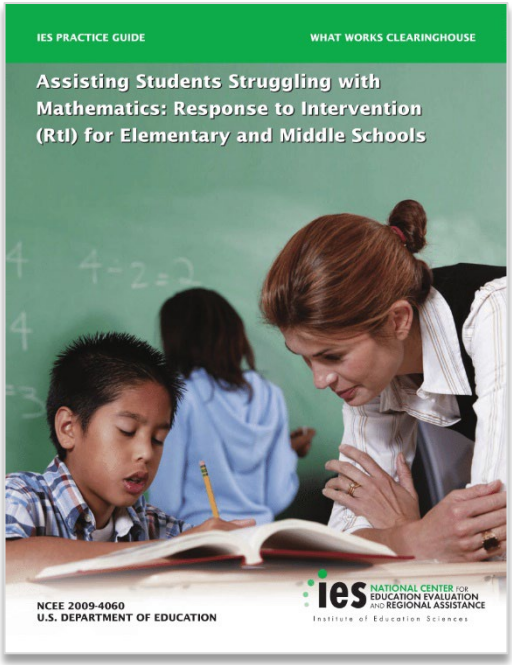
Introduction



Panel

- Lynn S. Fuchs (Chair): Vanderbilt University
- Nicole Bucka: Bridging Research, Implementation, & Data to Guide Educators in Rhode Island (BRIDGE-RI)
- Ben Clarke: University of Oregon
- Barbara Dougherty: Curriculum Research & Development Group, University of Hawai'i
- Nancy C. Jordan: University of Delaware
- Karen S. Karp: Johns Hopkins University
- John Woodward: University of Puget Sound

This new practice guide is an update of the 2009 Mathematics RTI practice guide.



How does this guide compare to the earlier guide?

1. The updated guide's narrower focus
   - covers only effective interventions, not all aspects of MTSS;
   - applies only to grades K–6, rather than K–8; and
   - primarily includes students receiving Tier 2 intervention, rather than the range of students in MTSS.
2. The updated guide includes different challenging topics such as the use of
   - number lines and
   - precise mathematical language.
3. As with the previous guide, the panel included mathematics educators as well as special education educators.

Recommendations and Levels of Evidence

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.			✓

Recommendation 1: Systematic Instruction

Provide systematic instruction during intervention to develop student understanding of mathematical ideas.

Level of Evidence: **Strong**

Recommendation 1: How to Steps

How to Step 1: *Review and integrate previously learned content throughout intervention to ensure that students maintain understanding of concepts and procedures.*

How to Step 2: *When introducing new concepts and procedures, use accessible numbers to support learning.*

How to Step 3: *Sequence instruction so that the mathematics students are learning builds incrementally.*

How to Step 4: *Provide visual and verbal supports.*

How to Step 5: *Provide immediate, supportive feedback to students to address any misunderstandings.*

Roadblocks

- *"I don't have access to an intervention curriculum in my school. Are you saying I should create my own materials or locate free materials? How do I know if the resources I create or find are systematic?"*
  - The panel suggests using the How to steps as guidelines for evaluating curricula to adopt.
- *"I feel like there is so much to cover at every grade level that choosing topics for more intensive instruction and/or slowing down instruction means I cannot cover all the grade-level material. This feels like I am doing my students a disservice."*
  - During intervention, structure the pace and topics in intervention in such a way that promotes learning the mathematics more deeply; this often means taking more time.

Recommendation 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.

Level of Evidence: **Strong**

Recommendation 2: How to Steps

How to Step 1: *Routinely teach mathematical vocabulary to build students' understanding of the mathematics they are learning.*

How to Step 2: *Use clear, concise, and correct mathematical language throughout lessons to reinforce students' understanding of important mathematical vocabulary words.*

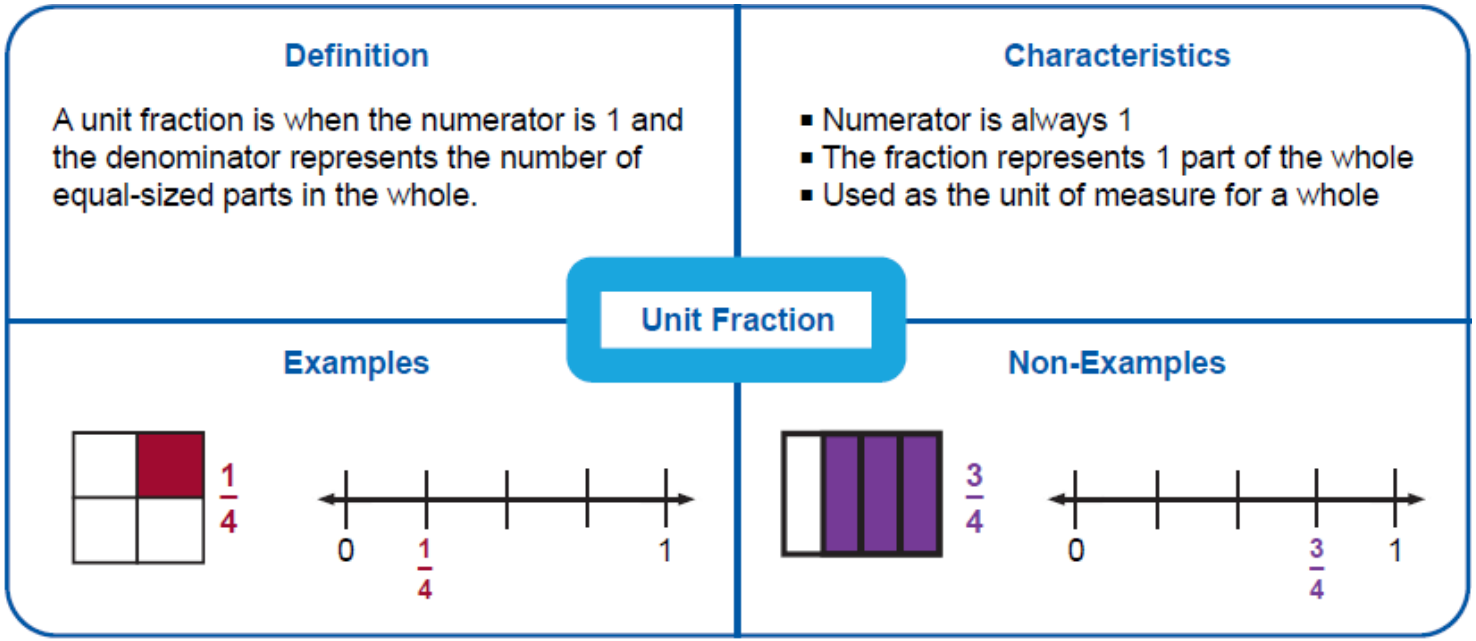
How to Step 3: *Support students in using mathematically precise language during their verbal and written explanations of their problem solving.*

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**

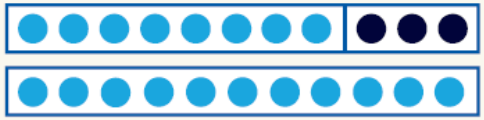
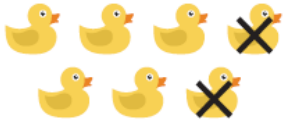
Note: This list is not comprehensive. It only contains a sample of words that might appear on a more comprehensive shared list used in a school.

Graphic organizer that depicts a student-friendly definition, characteristics, examples, and non-examples for the term *unit fraction*.



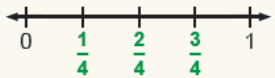
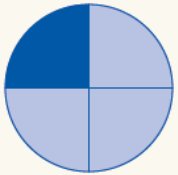
(p. 12)

A mathematical language chart that supports early elementary (grades K–2) students as they use mathematical language to present their thinking.

Term	Definition	Example/Representation
Addition	Joining or combining two sets together. Addition is represented with the symbol +.	Example: 8 + 3 = 11 is an addition equation.  8 + 3 = 11 Addend Addend Sum
Subtraction	Taking away an amount or comparing two quantities to find the difference. Subtraction is represented with the minus sign, –.	Example of decreasing: 7 − 2 = 5 If we have 7 rubber ducks and then subtract 2, we are left with 5 rubber ducks.  Example of comparing the difference: Rosie is 11 years old. Eric is 9 years old. How much older is Rosie than Eric?

(p. 19)

A mathematical language chart that supports upper elementary (grades 3–6) students as they use mathematical language to present their thinking.

Term	Definition	Example/Representation
Fraction	Fractions have different meanings: Part-whole (part of a whole) Measurement (a unit of measure)	$\frac{1}{8}, \frac{5}{8}, \frac{3}{4}, \frac{5}{5}, \frac{3}{2}$ $\frac{3}{4}$ of the area of the garden is planted in carrots. 
Numerator	The number of equal-sized parts being considered or used. It is the number of times the unit fraction is repeated. In this example 5 is the numerator.	$\frac{5}{6}$ 
Denominator	The number of equal-sized parts that make up the whole. In this example 4 is the denominator.	$\frac{1}{4}$ 

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Roadblocks

- *"I don't know what words I'm supposed to use. Everyone seems to use different terminology."*
  - Review your state's mathematics standards to identify the important language for students to learn. Also consider state assessment guidelines and the curriculum materials used in the school.
- *"Teaching vocabulary takes time that we don't have."*
  - Do not add an activity. Instead, introduce and use mathematical words intentionally and throughout lessons, to reinforce their meaning.

Recommendation 3: Representations

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

Level of Evidence: **Strong**

Recommendation 3: How to Steps

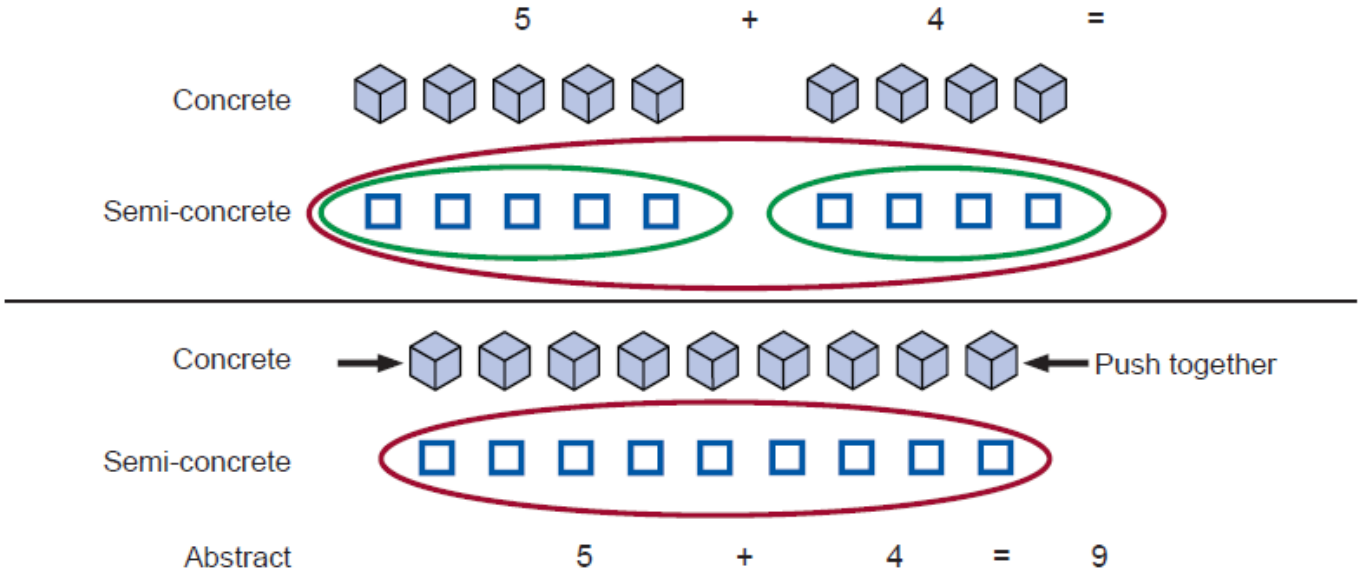
How to Step 1: *Provide students with the concrete and semi-concrete representations that effectively represent the concept or procedure being covered.*

How to Step 2: *When teaching concepts and procedures, connect concrete and semi-concrete representations to abstract representations.*

How to Step 3: *Provide ample and meaningful opportunities for students to use representations to help solidify the use of representations as "thinking tools."*

How to Step 4: *Revisit concrete and semi-concrete representations periodically to reinforce and deepen understanding of mathematical ideas.*

Example of how a teacher can connect concrete, semi-concrete, and abstract representations.



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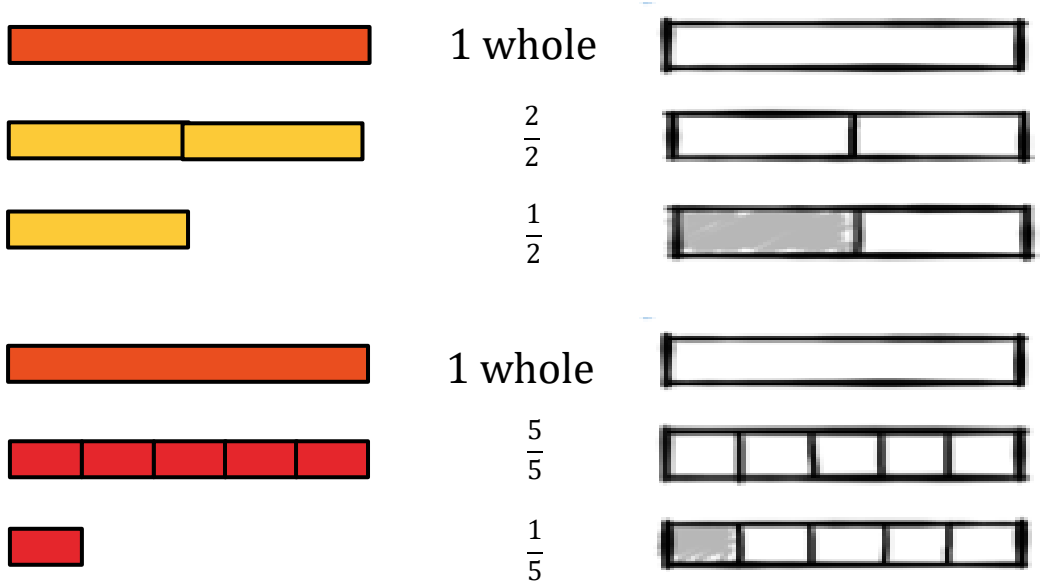
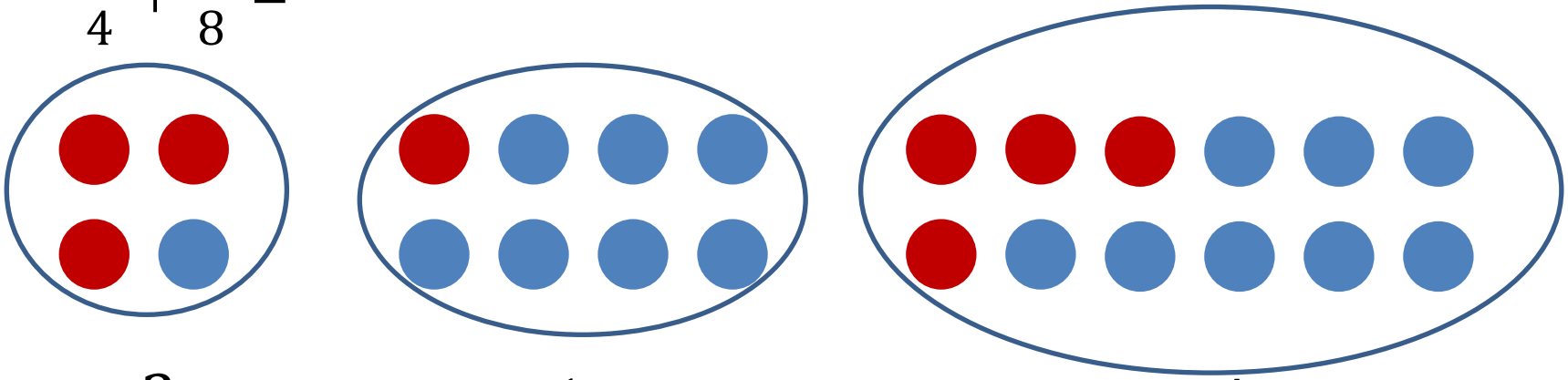
Concrete, Semi-Concrete, and Abstract Concurrent Representations



Discrete Models and Misconceptions With Fractions

$$\frac{3}{4} + \frac{1}{8} =$$



$$\frac{3}{4} + \frac{1}{8} = \frac{4}{12}$$

Roadblocks

- *"I connected the abstract concepts and procedures to concrete and semi-concrete representations and then faded them, but I don't think my students fully understand the concepts."*
  - Only fade out concrete and semi-concrete representations as students become accurate with doing the work abstractly
- *"My students just play with concrete representations and can't concentrate on the mathematics."*
  - Explain the expectations for appropriately using concrete representations as a learning tool.
- *"My students are confused because different representations are used in different classes."*
  - Keep the same set of core representations in use across grades: use the same representations as students move to the next grade.

Recommendation 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.

Level of Evidence: **Strong**

Recommendation 4: How to Steps

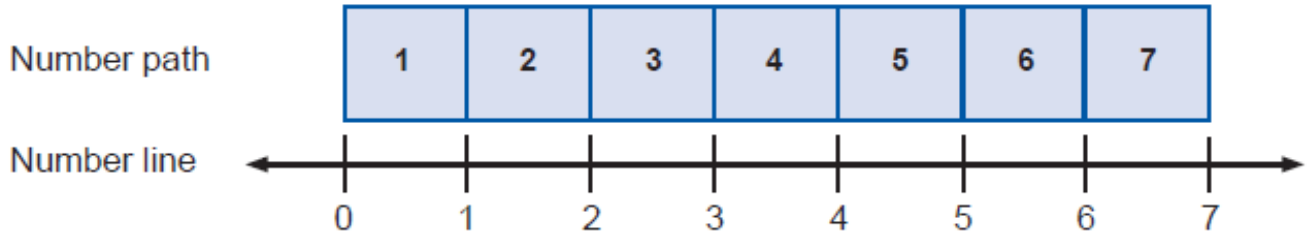
How to Step 1: *Represent whole numbers, fractions, and decimals on a number line to build students' understanding of numerical magnitude.*

How to Step 2: *Compare numbers and determine their relative magnitude using a number line to help students understand quantity.*

How to Step 3: *Use the number line to build students' understanding of the concepts underlying operations.*

How to Step 2

- Early elementary (grades K–2): Use number lines to teach the relative magnitude of whole numbers.



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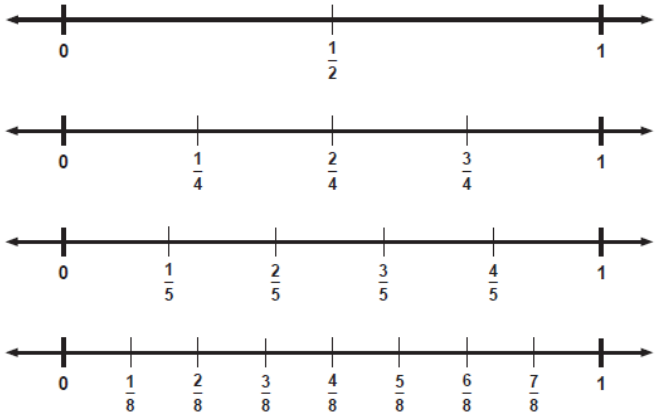
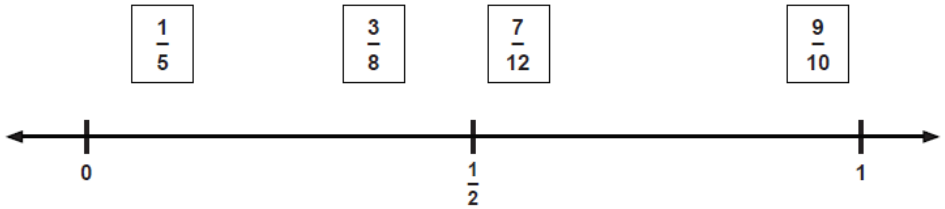
How to Step 2

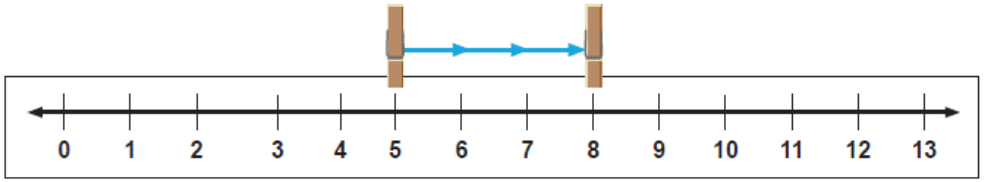
- Upper elementary (grades 3–6): Use number lines to compare the magnitude of fractions and decimals. Reinforce the idea that the denominator represents the number of partitions in one whole.



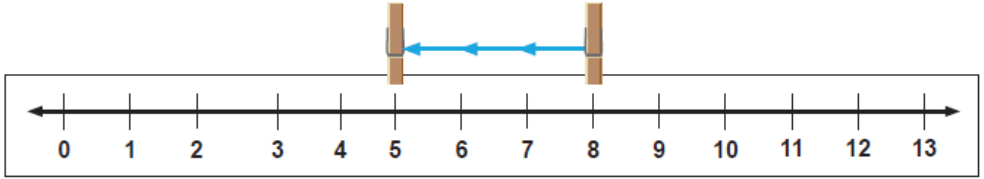


(p. 32)

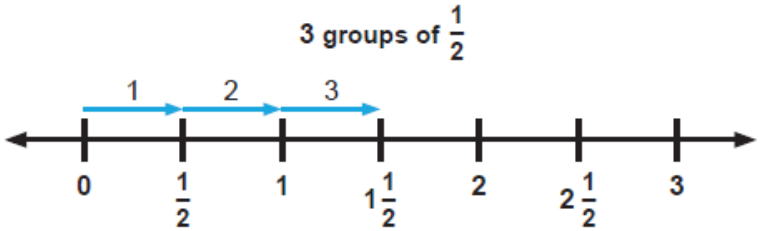
Number lines used to build students' understanding of the concepts underlying operations.



5 + 3 = 8



8 – 3 = 5



(p. 36 & 38)

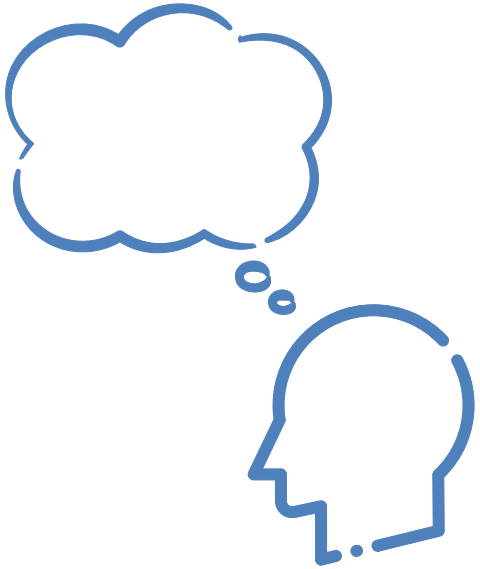
Roadblocks

- *"I used the number line for fraction multiplication and my students were confused."*
  - Multiplication and division with two fractions less than 1 are not represented well on a number line, especially when fractions have large denominators. Instead, try using an area model for multiplication when the fractions are both less than one.

- *"My students don't want to use the number line and benchmark fractions when comparing fractions because cross-multiplying is easier and faster."*
  - Cross-multiplying does not help students understand fractions in a meaningful way. Help students see that using benchmarks and thinking about the relative magnitude of fractions will help them understand this operation with fractions more deeply.

- *"My students don't seem to have a good grasp of the number line and what it represents."*
  - Use concrete representations with length models to help transition students toward understanding the number line. Show students how to build a number line with manipulatives that are of consistent and equal length units.

Questions and Reflections



- What questions do you have about the recommendations?
- How might your SEA support local implementation?
- Do you have relevant experiences to share?

Recommendation 5: Word Problems

Provide deliberate instruction on word problems to deepen students' mathematical understanding and support their capacity to apply mathematical ideas.

Level of Evidence: **Strong**

Recommendation 5: How to Steps

How to Step 1: *Teach students to identify word problem types that include the same type of action or event.*

How to Step 2: *Teach students a solution method for solving each problem type.*

How to Step 3: *Expand students' ability to identify relevant information in word problems by presenting problem information differently.*

How to Step 4: *Teach vocabulary or language often used in word problems to help students understand the problem.*

How to Step 5: *Include a mix of previously and newly learned problem types throughout intervention.*

Example of problems used to introduce a Change problem.

Change story with all quantities

There were 18 children on the bus. 7 children got off the bus at the first stop. 11 children are still on the bus.

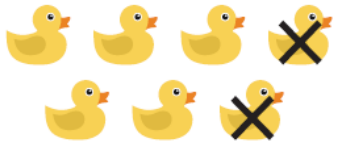
Word problem with a missing quantity

There were 18 children on the bus. 7 children got off the bus at the first stop. How many children are still on the bus?

Example of vocabulary or language in word problems that help students understand the problem

Quantity decrease:

Selina had 24 cupcakes. At her birthday the next day, she and her friends ate 16. How many cupcakes does Selina have left to share with her family?

Term	Definition	Example/Representation
Subtraction	Taking away an amount or comparing two quantities to find the difference. Subtraction is represented with the minus sign, –.	Example of decreasing: 7 − 2 = 5 If we have 7 rubber ducks and then subtract 2, we are left with 5 rubber ducks.  Example of comparing the difference: Rosie is 11 years old. Eric is 9 years old. How much older is Rosie than Eric?

(p. 19)

Roadblocks

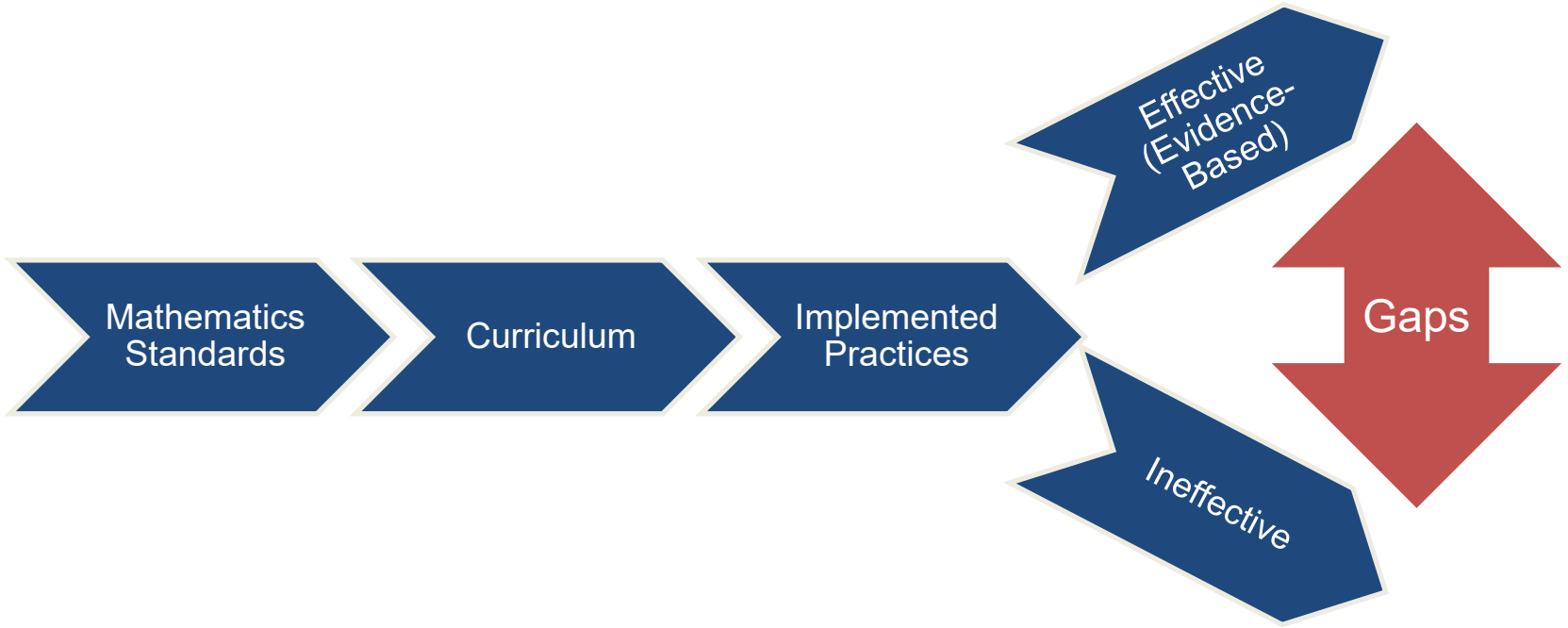
- *"This type of word problem instruction isn't in my curriculum. Should I develop my own materials?"*
  - Use this recommendation as a guideline for evaluating curricula to adopt. Work with a team, including a mathematics coach or special educator, to evaluate whether the curriculum aligns with the steps in this recommendation.
- *"I don't want to teach my students how to solve a problem using a specific method. I want to encourage my students to come up with their own solution approach."*
  - By teaching specific solution strategies, you offer students a way to move through the problem-solving process successfully so that eventually they may be able to develop their own solution methods.
- *"My students often don't know the operations to solve the word problems in our curriculum."*
  - Before introducing a strategy for solving a problem type, make sure students have the necessary prerequisite skills to be able to apply the method for solving the problem.
- *"I use the key word strategy, but I don't feel like my students understand the word problems."*
  - Avoid teaching key words that link specific words to operations.

Examples of key words matched to an operation and why they fail.

Key word	Supposed operation related to the key word	Sample problem in which the key word method fails	Example of failed operation
More	addition	Colin had some crayons. Then, he bought 12 **more** crayons. Now, he has 90 crayons. How many crayons did Colin have to start with?	$90 + 12 = 102$
Fewer	subtraction	Paulo picked apples. Zach picked 12 **fewer** apples. If Zach picked 20 apples, how many apples did Paulo pick?	$20 - 12 = 8$
Left	subtraction	Liz shared 55 candies equally with 3 friends. After sharing, how many candies were **left** over?	$55 - 3 = 52$
Each	multiplication	Miles had 3 trays of building blocks with the same number of blocks on **each** tray. If Miles had 75 blocks altogether, how many were on each tray?	$75 \times 3 = 225$

(p. 50)

Curriculum Roadblocks



Recommendation 6: Timed Activities

Regularly include timed activities as one way to build students' fluency in mathematics.

Level of Evidence: **Strong**

Recommendation 6: How to Steps

How to Step 1: *Identify already-learned topics for activities to support fluency and create a timeline.*

How to Step 2: *Choose the activity and accompanying materials to use in the timed activity and set clear expectations.*

How to Step 3: *Ensure that students have an efficient strategy to use as they complete the timed activity.*

How to Step 4: *Encourage and motivate students to work hard by having them chart their progress.*

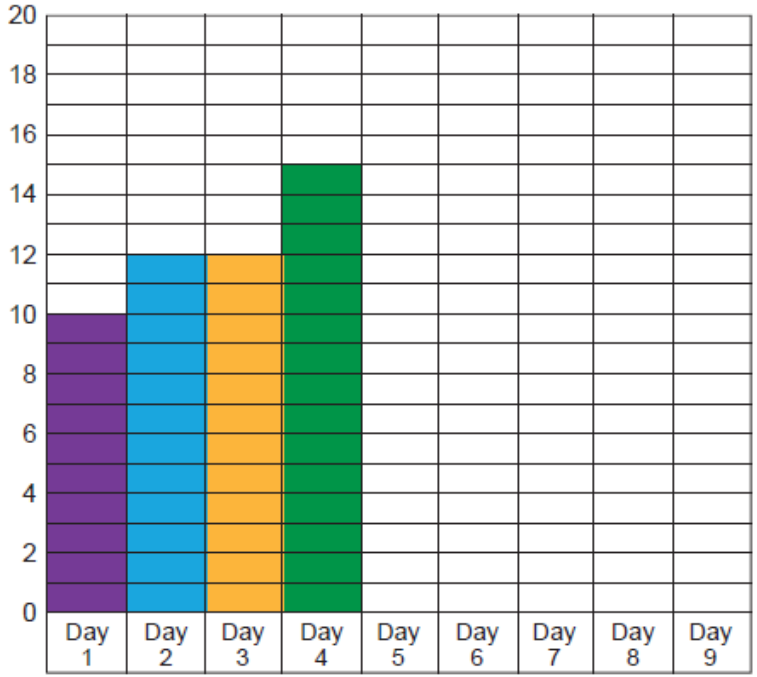
How to Step 5: *Provide immediate feedback by asking students to correct errors using an efficient strategy.*

Why Fluency?

Building fluency through independent practice supports the generalization, adaptation, and maintenance needed for higher level mathematics skills.

For more on the stages of learning, see the following resources: Jimenez, B., Root, J., Shurr, J., & Bouck, E. C. (2024). Using the Four Stages of Learning to assess, set goals, and instruct. *TEACHING Exceptional Children*, *56*(6), 452–461. https://doi.org/10.1177/00400599211054873; Haring, N. G., & Eaton, M. D. (1978). Systematic instructional procedures: An instructional hierarchy. In N. G. Haring, T. C. Lovitt, M. D. Eaton, & C. L. Hansen (Eds.), *The fourth R: Research in the classroom* (pp. 23–40). Merrill.

Graph tracking scores for timed fluency activities

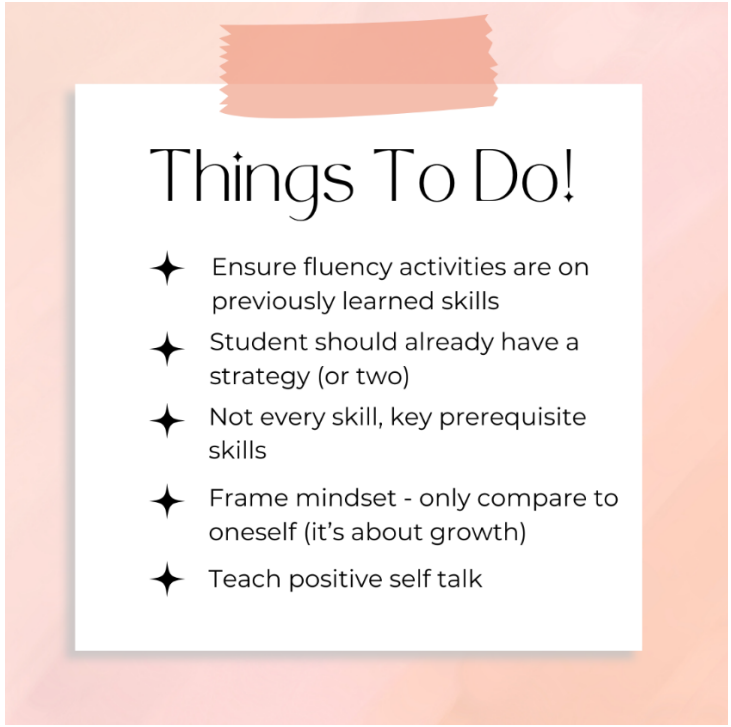


(p. 54)

Roadblocks

- *"We do fluency worksheets every day, and my students are not improving."*
  - Activities that support fluency need to address the elements in this recommendation to be effective.
- *"Some students seem to race through and guess."*
  - Show students how their scores reflect their correct responses. Remind students that accuracy is the goal; not how many problems were attempted.
- *"Some of my students have anxiety when doing timed activities, especially when completing an activity with a large number of problems."*
  - Instead of presenting a large list of problems to solve, use flashcards or other activities that do not present many problems at the onset.

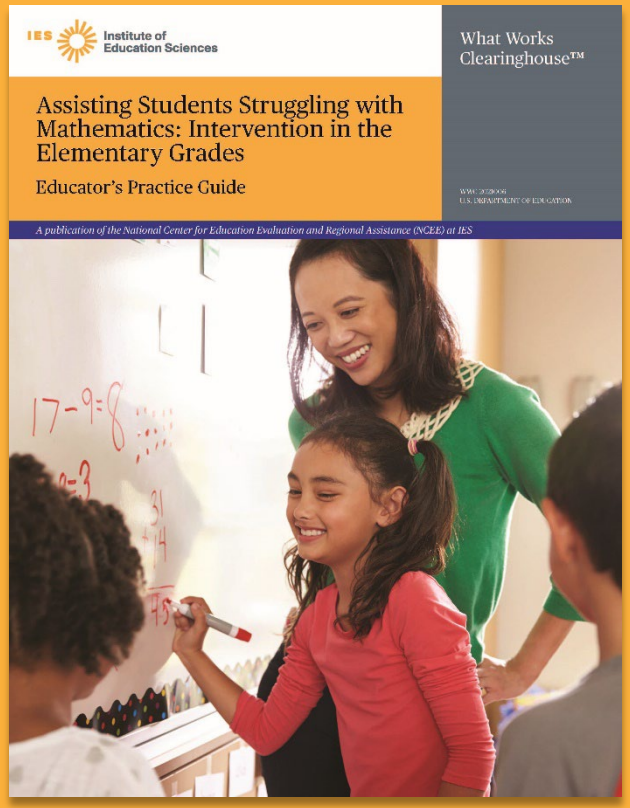
Addressing Anxiety



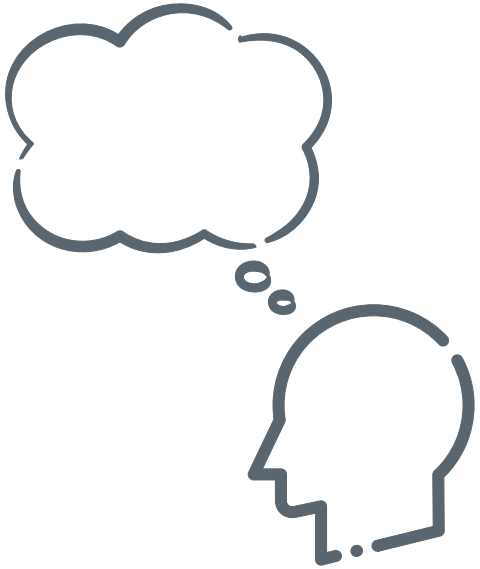
The practice guide and supporting materials provide more details and are available on the What Works Clearinghouse website.

Submit questions and requests via email to the WWC Help Desk at Contact.WWC@ed.gov.

For more information on similar products, subscribe to the WWC via email or follow the WWC on Facebook and on X.



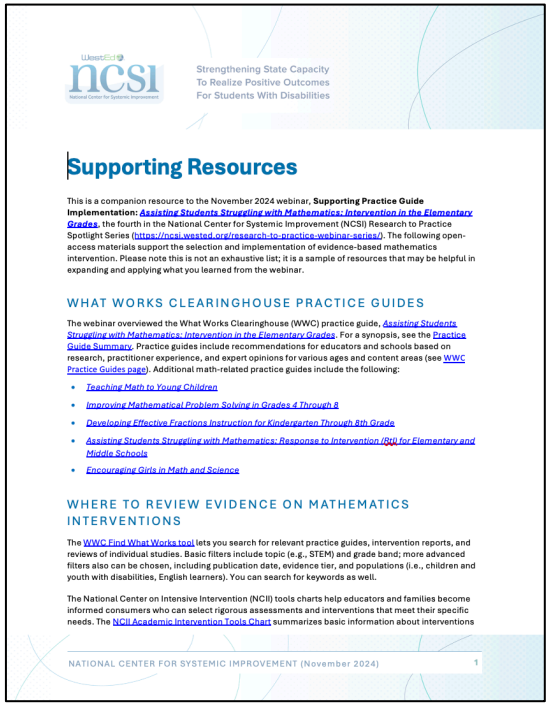
Questions and Reflections



- What questions do you have about the recommendations?
- How might your SEA support local implementation?
- Do you have relevant experiences to share?

Wrap-Up

Additional Resources



Strengthening State Capacity
To Realize Positive Outcomes
For Students With Disabilities

Supporting Resources

This is a companion resource to the November 2024 webinar, **Supporting Practice Guide Implementation:** ***Assisting Students Struggling with Mathematics: Intervention in the Elementary Grades***, the fourth in the National Center for Systemic Improvement (NCSI) Research to Practice Spotlight Series (https://ncsi.wested.org/research-to-practice-webinar-series/). The following open-access materials support the selection and implementation of evidence-based mathematics intervention. Please note this is not an exhaustive list; it is a sample of resources that may be helpful in expanding and applying what you learned from the webinar.

WHAT WORKS CLEARINGHOUSE PRACTICE GUIDES

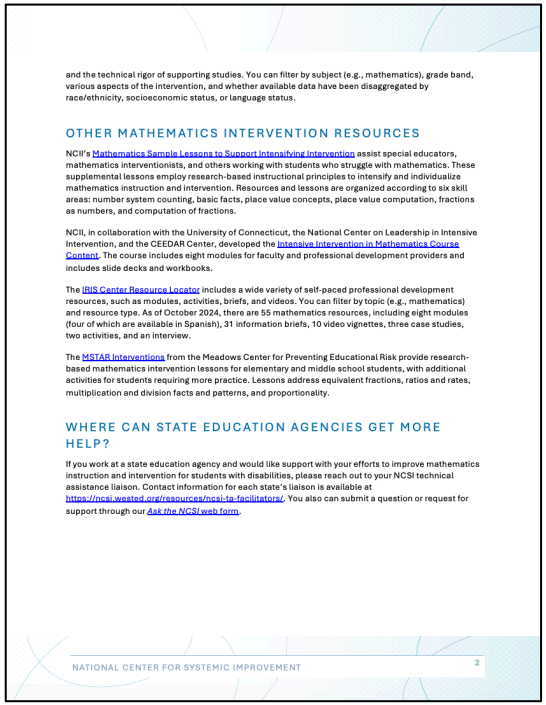
The webinar overviewed the What Works Clearinghouse (WWC) practice guide, *Assisting Students Struggling with Mathematics: Intervention in the Elementary Grades*. For a synopsis, see the Practice Guide Summary. Practice guides include recommendations for educators and schools based on research, practitioner experience, and expert opinions for various ages and content areas (see WWC Practice Guides page). Additional math-related practice guides include the following:

- *Teaching Math to Young Children*
- *Improving Mathematical Problem Solving in Grades 4 Through 8*
- *Developing Effective Fractions Instruction for Kindergarten Through 8th Grade*
- *Assisting Students Struggling with Mathematics: Response to Intervention (RtI) for Elementary and Middle Schools*
- *Encouraging Girls in Math and Science*

WHERE TO REVIEW EVIDENCE ON MATHEMATICS INTERVENTIONS

The WWC Find What Works tool lets you search for relevant practice guides, intervention reports, and reviews of individual studies. Basic filters include topic (e.g., STEM) and grade band; more advanced filters also can be chosen, including publication date, evidence tier, and populations (i.e., children and youth with disabilities, English learners). You can search for keywords as well.

The National Center on Intensive Intervention (NCII) tools charts help educators and families become informed consumers who can select rigorous assessments and interventions that meet their specific needs. The NCII Academic Intervention Tools Chart summarizes basic information about interventions



and the technical rigor of supporting studies. You can filter by subject (e.g., mathematics), grade band, various aspects of the intervention, and whether available data have been disaggregated by race/ethnicity, socioeconomic status, or language status.

OTHER MATHEMATICS INTERVENTION RESOURCES

NCII's Mathematics Sample Lessons to Support Intensifying Intervention assist special educators, mathematics interventionists, and others working with students who struggle with mathematics. These supplemental lessons employ research-based instructional principles to intensify and individualize mathematics instruction and intervention. Resources and lessons are organized according to six skill areas: number system counting, basic facts, place value concepts, place value computation, fractions as numbers, and computation of fractions.

NCII, in collaboration with the University of Connecticut, the National Center on Leadership in Intensive Intervention, and the CEEDAR Center, developed the Intensive Intervention in Mathematics Course Content. The course includes eight modules for faculty and professional development providers and includes slide decks and workbooks.

The IRIS Center Resource Locator includes a wide variety of self-paced professional development resources, such as modules, activities, briefs, and videos. You can filter by topic (e.g., mathematics) and resource type. As of October 2024, there are 55 mathematics resources, including eight modules (four of which are available in Spanish), 31 information briefs, 10 video vignettes, three case studies, two activities, and an interview.

The MSTAR Interventions from the Meadows Center for Preventing Educational Risk provide research-based mathematics intervention lessons for elementary and middle school students, with additional activities for students requiring more practice. Lessons address equivalent fractions, ratios and rates, multiplication and division facts and patterns, and proportionality.

WHERE CAN STATE EDUCATION AGENCIES GET MORE HELP?

If you work at a state education agency and would like support with your efforts to improve mathematics instruction and intervention for students with disabilities, please reach out to your NCSI technical assistance liaison. Contact information for each state's liaison is available at https://ncsi.wested.org/resources/ncsi-ta-facilitators/. You also can submit a question or request for support through our *Ask the NCSI* web form.

More to Come!

Stay updated with the NCSI newsletter:
https://ncsi.wested.org/subscribe-ncsi-news/

Other Questions?

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Thank You

The content of this document was developed under a grant from the U.S. Department of Education, #H326240001. However, those contents do not necessarily represent the policy of the U.S. Department of Education, and you should not assume endorsement by the Federal Government. Project Officer: Perry Williams (October 2024)

WestEd is the lead organization for NCSI. For more information about the work of WestEd, NCSI, and their partners, please visit www.ncsi.wested.org and www.wested.org