REL CENTRAL
Regional Educational Laboratory at Marzano Research

Assisting Struggling Students with Mathematics

What Works for Tiered Interventions in Elementary and Middle Schools

Webinar goals and objectives

- To increase understanding of research-based strategies to improve mathematics instruction for struggling students.
- To acquire a greater understanding of available resources and actionable knowledge that can be effectively implemented to meet the needs of students who struggle in mathematics.

Agenda

- Overview of REL Central and today's webinar (Stephany Brown, REL Central)
- Presenter introductions (Stephany Brown, REL Central)
- Introduction to *Assisting Students Struggling with Mathematics: Response to Intervention (RtI) for Elementary and Middle Schools* (IES Practice Guide) (Russell Gersten, PhD)
- Participant activity (Russell Gersten)
- Fractions intervention (Russell Gersten and Robin Schumacher, PhD)
- Introduction to Data-Based Instruction and the National Center on Intensive Intervention (Russell Gersten and Robin Schumacher)
- Discussions, Q&A (Stephany Brown, REL Central)
- Closing (Stephany Brown, REL Central)

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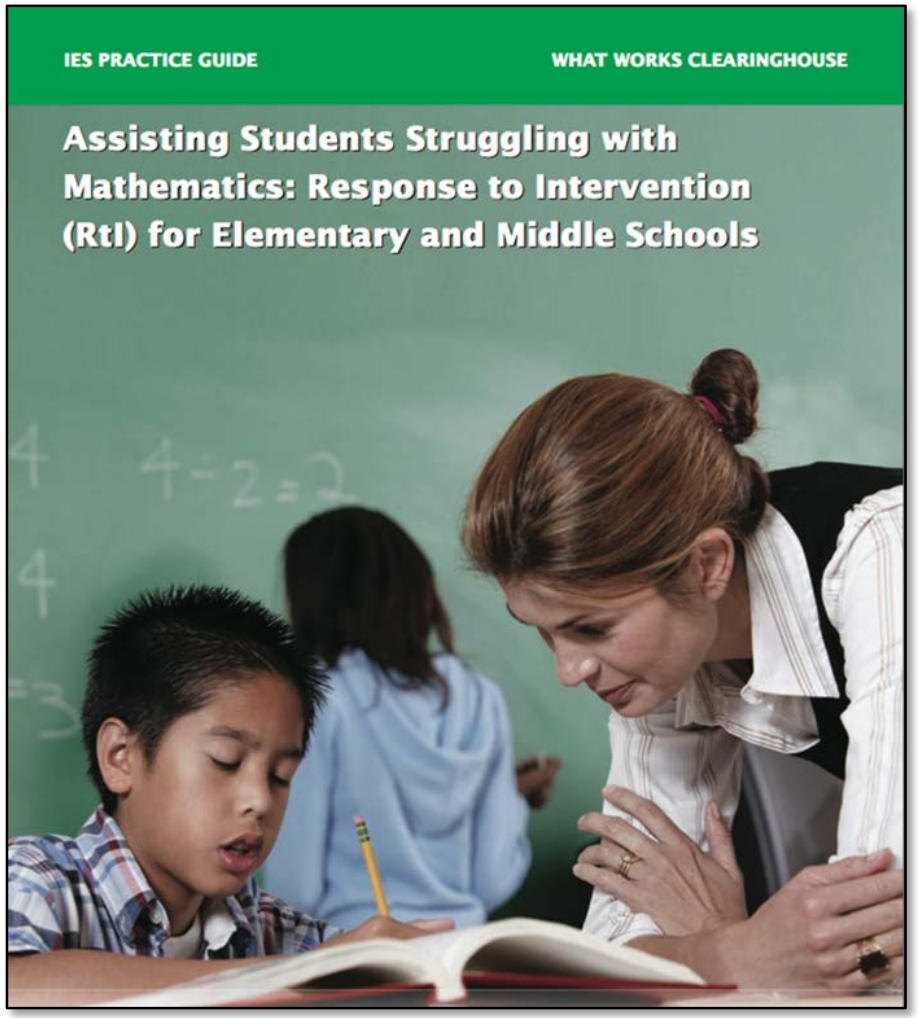
Who We Are

The Regional Educational Laboratory (REL) Central at Marzano Research serves the applied education research needs of Colorado, Kansas, Missouri, Nebraska, North Dakota, South Dakota, and Wyoming.

Presenter introductions

- Russell Gersten, PhD, Instructional Research Group
- Robin Schumacher, PhD, Instructional Research Group

RtI math practice guide



Practice guide panelists

- Russell Gersten (Chair)
- Sybilla Beckmann
- Ben Clarke
- Anne Foegen
- Laurel Marsh
- Jon R. Star
- Bradley Witzel

Practice guides

Purpose:

- Create a framework for establishing/refining instruction that is clear and practical.
- Discuss action-based recommendations that can be implemented in practice.
- Take risks: Don't equivocate!
- Create a coherent document: Common themes should underlie the various specific suggestions.

Note: This guide has been the most frequently downloaded of all published guides by the U.S. Department of Education!!!
https://ies.ed.gov/ncee/wwc/Docs/PracticeGuide/rti_math_pg_042109.pdf

Structure of the practice guide

- Recommendations
- How to carry out the recommendations
- Levels of evidence
- Potential roadblocks and suggestions

Evidence rating

Each recommendation receives a rating based on the strength of the research evidence.

- Strong
- Moderate
- Minimal (simply means no rigorous evidence, not contradictory evidence)

Review the handout with this table. Ask yourself: *Which levels of evidence are most surprising?*

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

Poll

Which levels of evidence are most surprising?

Choose one from each group.

Choose one from group one.

Recommendation	Level of Scientific Evidence
1. Universal screening (Tier I)	Moderate
2. Focus instruction on whole numbers for grades K-5 and rational numbers for grades 6-8	Minimal
3. Systematic instruction	Strong
4. Solving word problems	Strong

Choose one from group two.

Recommendation	Level of Scientific Evidence
1. Visual representations	Moderate
2. Building fluency with basic arithmetic facts	Moderate
3. Progress monitoring	Minimal
4. Use of motivational strategies	Minimal

Evidence (updated)

Recent gold standard studies have supported this approach to content.

Example:

- Use of *number line* beginning in grade 1 intervention (Gersten et al., 2015)
- Teaching fractions using the *linear representation* (number line) (Fuchs et al., 2016)
- The impact of *TransMath* on the mathematics proficiency of grade 5 students receiving Tier 2 intervention (Instructional Research Group, 2017)

Today we will focus on three recommendations

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

Fraction interventions: *Fraction Face-Off!* and *TransMath*

Fraction Face-Off!

Slides include instructional approaches from the series of five studies from the Fraction Center funded by IES.

Improving At-Risk Learners' Understanding of Fractions (Fuchs et al., 2013)

TransMath

Slides include instructional approaches from the third edition of the published curriculum.

TransMath Level 2, 3rd Edition (Woodward & Stroh, 2015)

Big ideas: *Fraction Face-Off!*

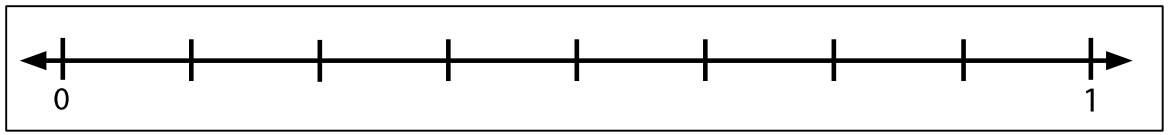
- Build understanding of a fraction as **one** number (since some students think it is two numbers)
- Primary focus: Linear representations (aka: measurement interpretation)
  - ✓ Number lines
  - ✓ Fraction tiles as a transition tool
  - ✓ Magnitude: Ability to reason about size through benchmark numbers
- Secondary focus: Part-whole understanding
  - ✓ Shaded regions of one or more units (e.g., pizzas, etc.)

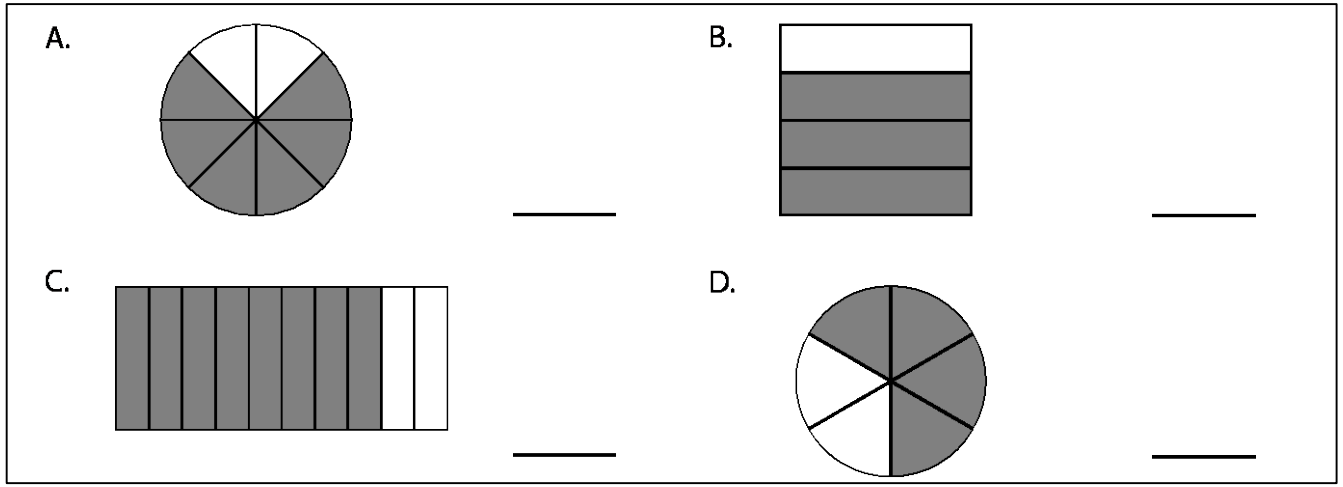
Note: Typical U.S. curricula stress the part-whole interpretation, whereas Asian curricula stress the linear representations.

Fraction Face-Off!: Unit fractions and naming fractions

- Introduce unit fractions with circles and tiles (3D).
- Show fractions with shaded regions to show unit fractions.
- Show how unit fractions make larger fractions with manipulatives, number lines, and numbers.
- Name fractions from shaded representational regions (see example).

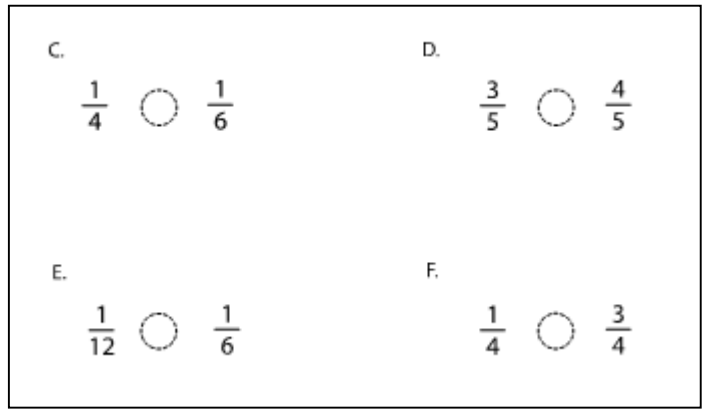
$$\frac{1}{8}+\frac{1}{8}+\frac{1}{8}+\frac{1}{8}+\frac{1}{8}=\frac{5}{8}$$

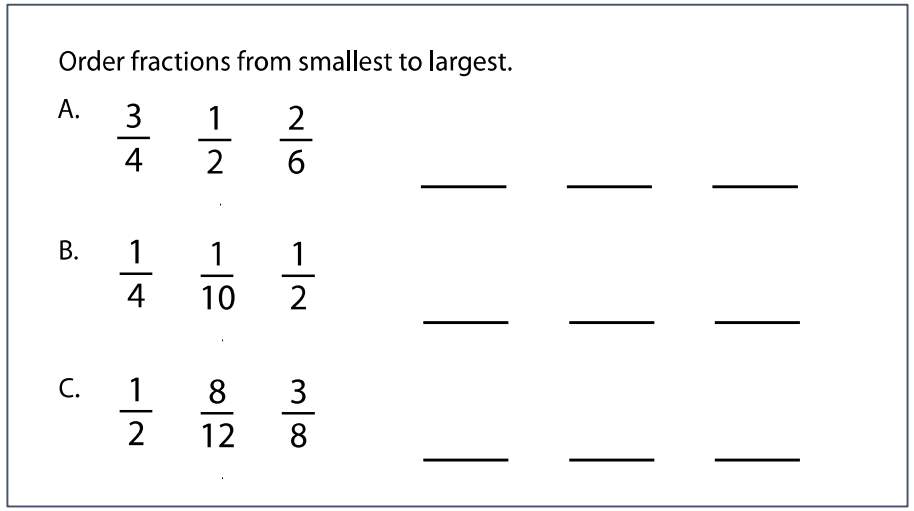


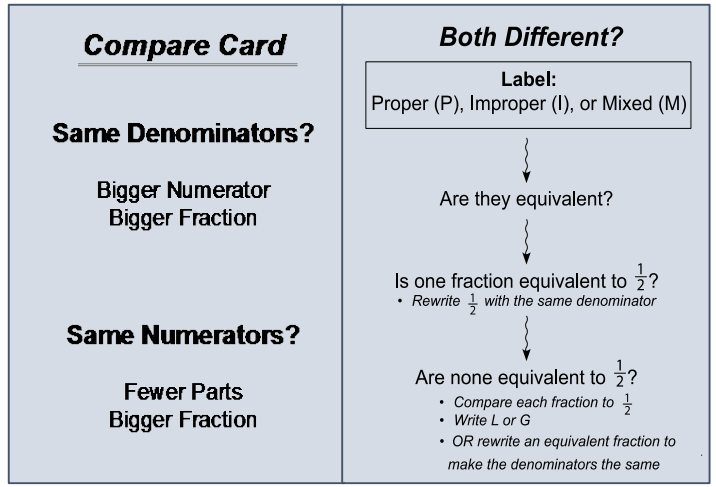


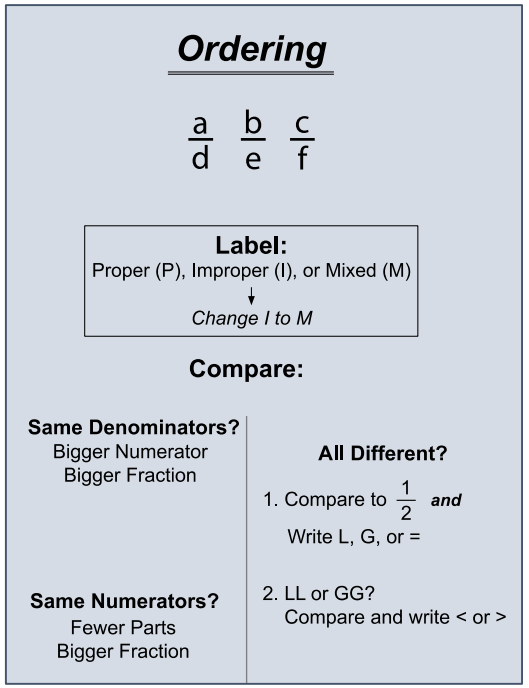
Comparing and ordering fractions

- Introduce with fraction circles and tiles.
- Build understanding.
  - ✓ Same numerators
  - ✓ Same denominators
  - ✓ Evaluating with benchmark numbers (1/2)
- Demonstrate procedures.



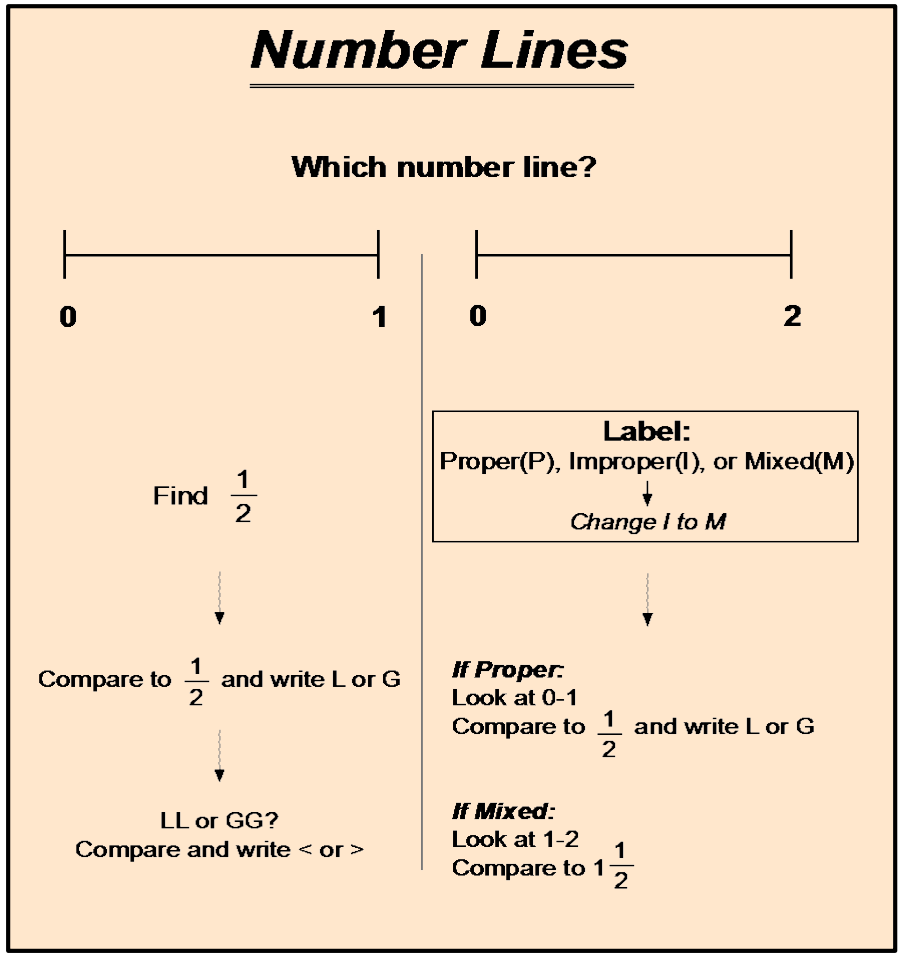




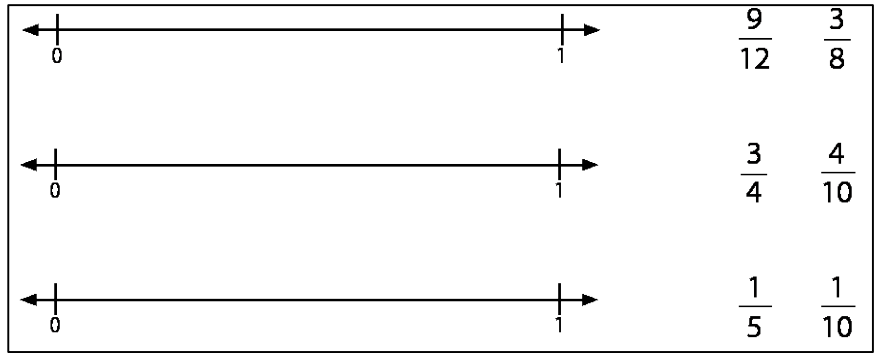


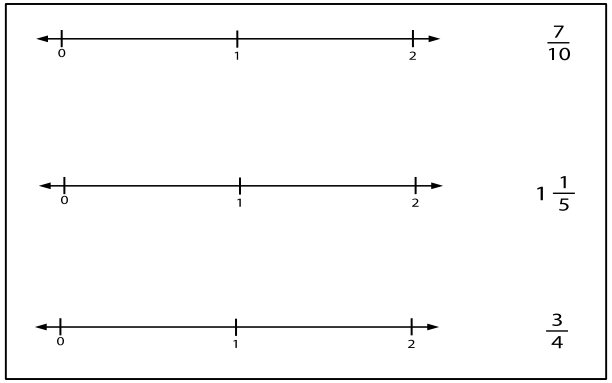
Number lines 0 – 1 & 0 – 2

Most advanced card



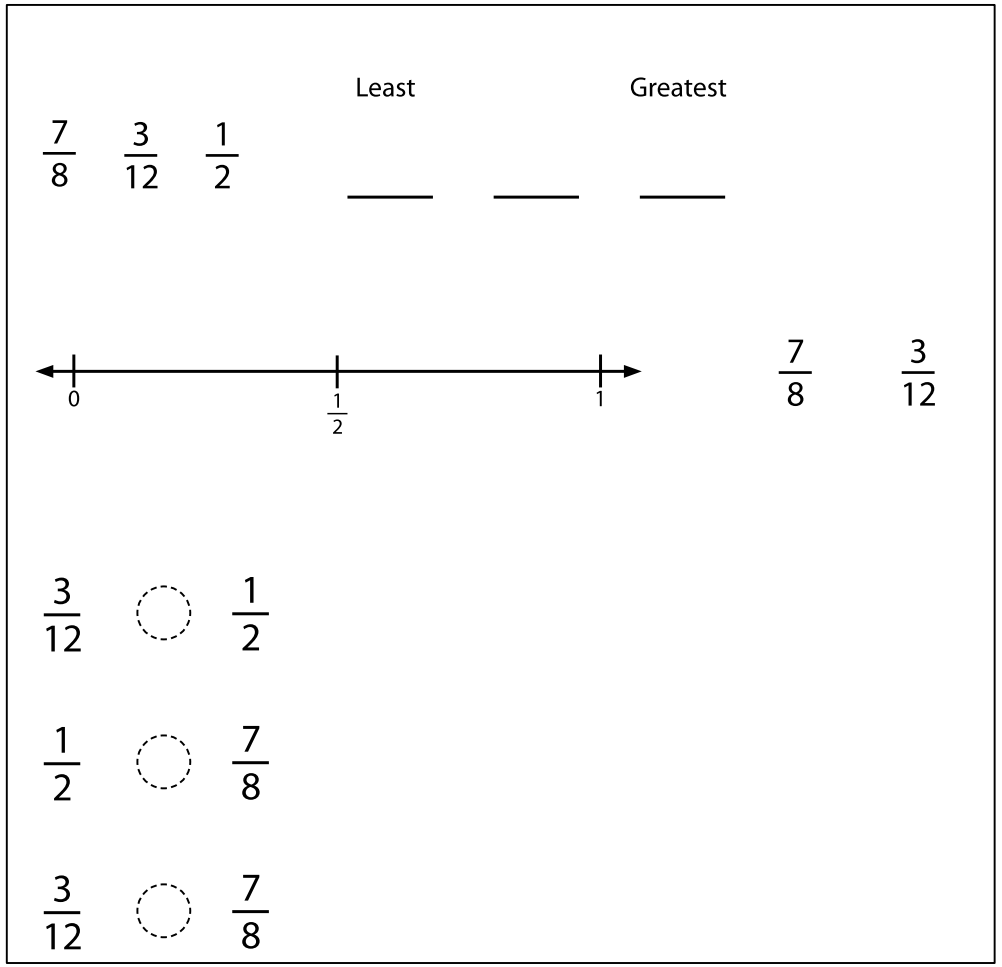
- ✓ Extension of comparing & ordering
- ✓ Extends measurement understanding
- ✓ 0 – 1 introduced first
- ✓ 0 – 2 after improper & mixed fractions





Building magnitude understanding

- Relating magnitude activities.
- Use the same three fractions for each magnitude activity.
  - ✓ Comparing
  - ✓ Ordering
  - ✓ Number line



Fraction Face-Off!: Results from three years of research

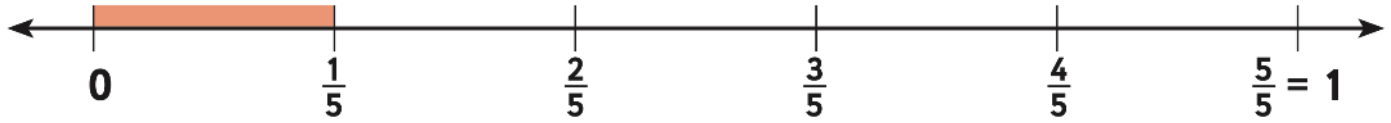
Assessment	Intervention vs. Control (Y1): Effect Size
Comparing	1.82*
Number Line	1.14*
NAEP	0.94*
Calculations	2.51*

**Note*: Generally, an effect size of .8 or higher is considered large.

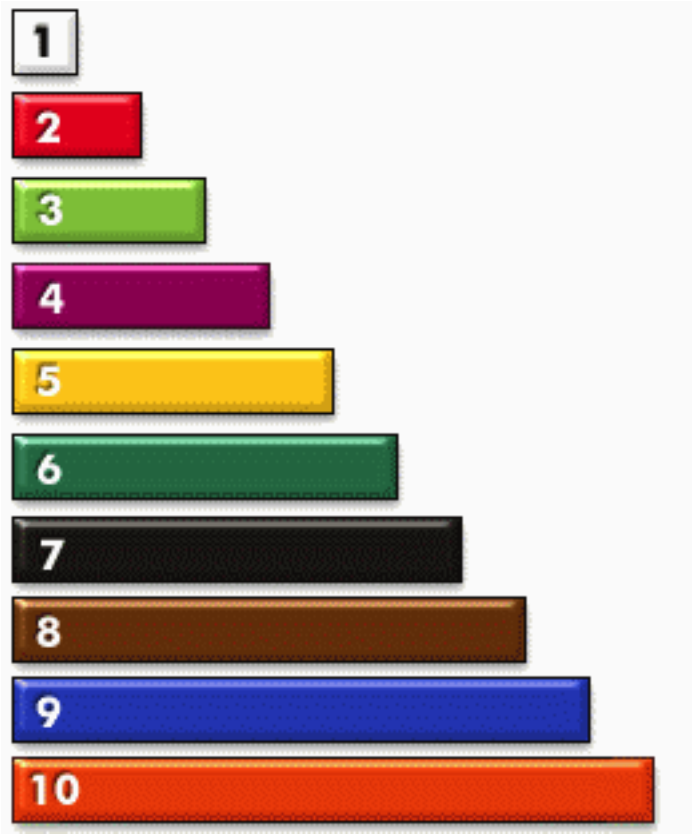
TransMath: Cuisenaire rods to number lines

Because the numerator of $\frac{2}{3}$ is very close to the denominator, this fraction is close to 1.

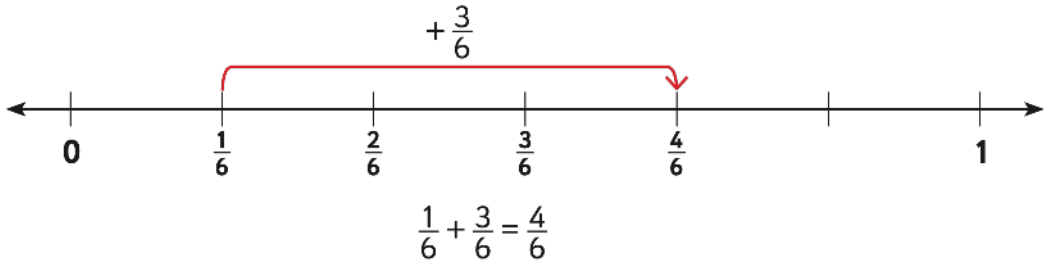
Look at another number line. This number line shows that $\frac{1}{5}$ is close to 0.



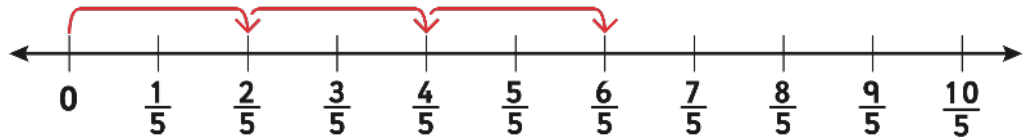
Because the numerator of $\frac{1}{5}$ is much less than the denominator, this fraction is close to 0.



TransMath: Number lines and the four operations

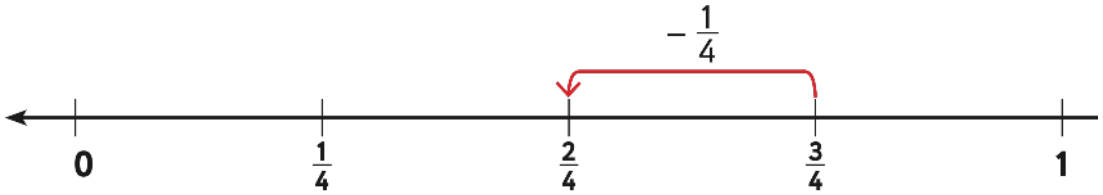


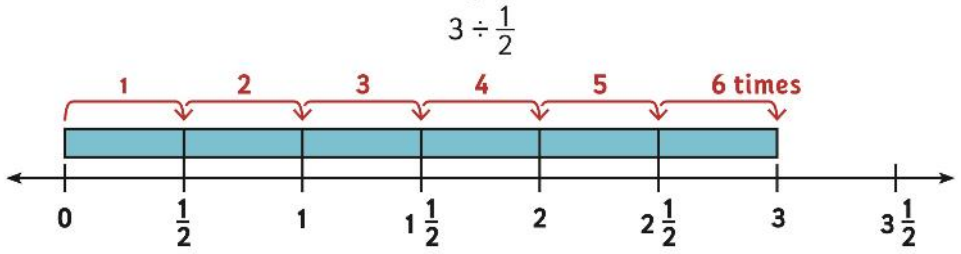
Use a number line to find $3 \cdot \frac{2}{5}$.



Use a number line to find the difference: $\frac{3}{4} - \frac{1}{4}$.

Begin by drawing a number line that shows fourths. Then start at $\frac{3}{4}$ and count back one tick mark to find the difference.





Case study: Discussion

- Shows cumulative review of subtraction after multiplication was introduced.
- Demonstrates the importance of immediate feedback.
- Look for:
  - ✓ Which foundational skills were addressed, if any?
  - ✓ Anything else regarding design and explicit instruction?

Case study

Both programs: Cumulative review

Ongoing:

- Not sporadic and short-lived.
- Cumulative review (most ideas embedded briefly in every lesson).
- Students discriminate between problem types and procedures.
- Includes systematic learning progressions.
  - ✓ Review comparing two fractions when introducing ordering three fractions.
- Includes foundational skills to support grade-level content.
  - ✓ Work on multiplication facts to support finding common multiples for equivalent fractions.

Both programs: Immediate feedback!

Immediate!

- This is more attainable in a small-group, intervention setting.
- Helps eliminate false assumptions or overgeneralizations before they become ingrained in student thinking, leading to inaccurate understandings.
- Linked to grade-level standards, BUT . . .
- Amount of time allocated to difficult, essential concepts is much higher than typical.

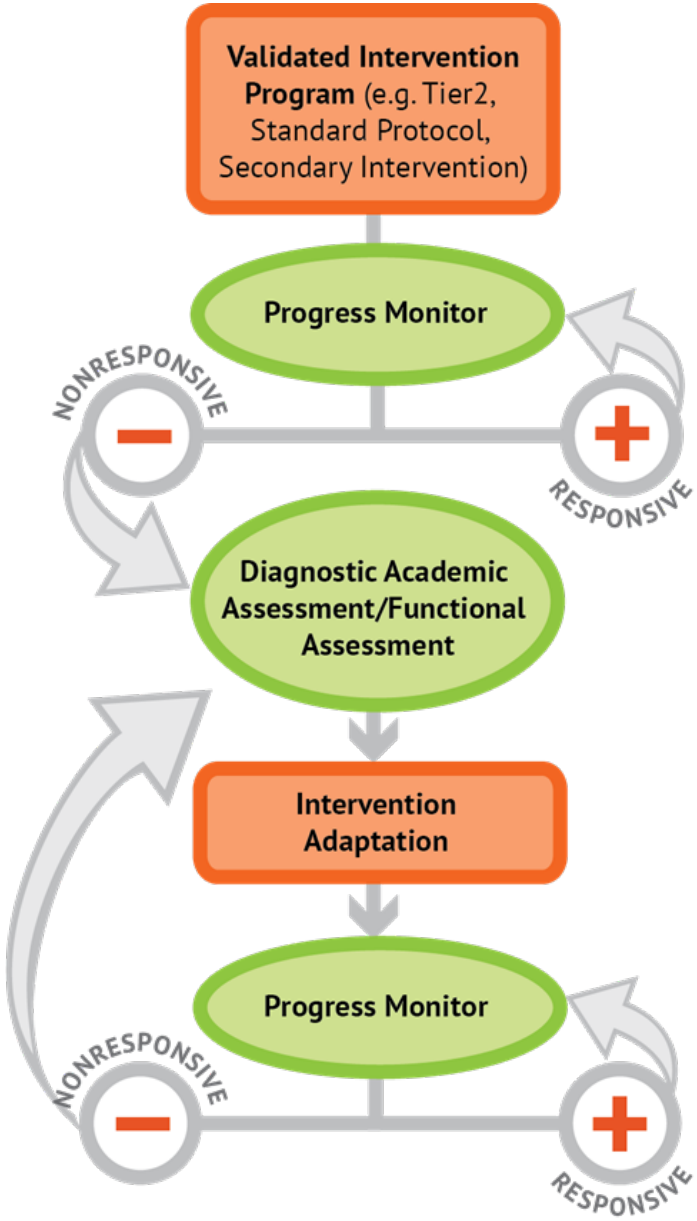
Other features of *Fraction-Face-Off!* and *TransMath*

- Both programs include **word problem instruction**.
- *Fraction Face-Off!* includes embedded motivation system.
- What are both programs missing?
  - ✓ Progress monitoring
  - ✓ Built-in individualized components

National Center on Intensive Intervention (NCII)

- NCII focuses on data-based individualization.
- Data-based individualization can be key for student learning.
- Provides resources and a framework for intensifying instruction and using progress monitoring data.
- www.intensiveintervention.org

Data-based individualization



Free mathematics resources

- Instructional video library covering counting, basic facts, place value, and computation: http://www.intensiveintervention.org/resource/mathematics-instructional-videos-supporting-students-math-difficulty
- College and career ready standards-aligned math instructional guides: http://www.intensiveintervention.org/resources/sample-lessons-activities/mathematics

  (Each guide includes a guidance document, sample lessons, worksheets, and manipulatives.)

More resources

- Progress monitoring: http://www.intensiveintervention.org/resource/using-academic-progress-monitoring-individualized-instructional-planning-dbi-training
- Using diagnostic assessment data for intervention planning: http://www.intensiveintervention.org/resource/informal-academic-diagnostic-assessment-using-data-guide-intensive-instruction-dbi-training
- Intervention design: http://www.intensiveintervention.org/resource/designing-and-delivering-intervention-students-severe-and-persistent-academic-needs-dbi

Identify evidence-based interventions and assessments

- Math interventions: http://www.intensiveintervention.org/chart/instructional-intervention-tools
- Assessment tools:
  - ✓ Progress monitoring: http://www.intensiveintervention.org/chart/progress-monitoring
  - ✓ Screening: http://www.rti4success.org/resources/tools-charts/screening-tools-chart

Response to posted questions

References

Gersten, R., Rolfhus, E., Clarke, B., Decker, L., Wilkins, C., & Dimino, J. (2015). Intervention for first graders with limited number knowledge: Large-scale replication of a randomized controlled trial. *American Educational Research Journal, 52*(3), 516–546. doi:10.3102/0002831214565787

Fuchs, L. S., Malone, A. S., Schumacher, R. F., Namkung, J., & Wang, A. (2016). Fraction intervention for students with mathematics difficulties: Lessons learned from five randomized controlled trials. *Journal of Learning Disabilities.* Advance online publication. doi:10.1177/0022219416677249

Instructional Research Group. (2017). *The impact of TransMath on the mathematics proficiency of fifth graders receiving tier 2 intervention: Technical report.* Los Alamitos, California: Author.

Thank you!

We hope you found today's webinar on *Assisting Students Struggling with Mathematics: What Works for Tiered Interventions in Elementary and Middle Schools* to be informative and useful.

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For more information

For today's PowerPoint presentation materials, please visit our website:
https://ies.ed.gov/ncee/edlabs/regions/central/

A recording of this Webinar will be posted on the Institute of Education Sciences' YouTube channel:

https://tinyurl.com/RELCENVIDEO

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