FRACTIONS INTERVENTION FOR STRUGGLING 5TH GRADE STUDENTS

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Instructional Research Group

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EDUCATION WEEK

Students Thrive When They See Purpose in Their Learning

Matthew Cook, left, Darshan Patel, and Abby Simmons, all 8th graders in Armorel, Ark., display their different model attempts with a 3D printer to create a prosthetic leg for a one-legged duck.
—Photos courtesy of Armorel High School EAST

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PURPOSE OF THE STUDY

TransMath® was adapted for small-group instruction to see the impact of a fractions intervention that…

- Proactively addresses grade-level curriculum
- Combines explicit instruction while working with students on articulating their understanding

FRACTIONS INTERVENTION

1. Aligned with CCSS-M Grade 4 and 5 standards
2. *TransMath*® Level 2 (Woodward & Stroh, 2015)
   - ➢ Grade-level material (Grade 5):
     - ✓ Adding and subtracting fractions with unlike denominators
     - ✓ Multiplication and division concepts
   - ➢ Foundational material (Grade 4):
     - ✓ Fraction magnitude and equivalence

VISUAL REPRESENTATIONS

Concrete-Semi-Concrete-Abstract

1. Cuisenaire Rods
   - *linear (link part-whole to measurement understanding)*
2. Number Lines
   - *consolidate rational number and whole number principles*[1]
   - *superior representation for understanding magnitude*[1]
3. Equations

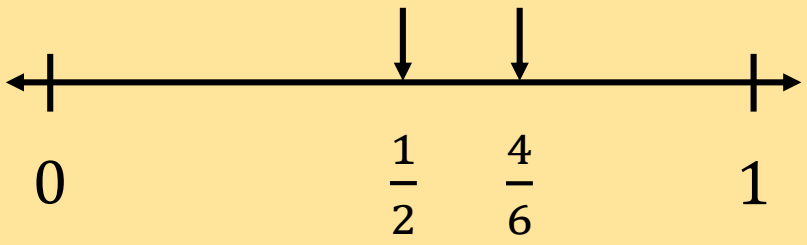
Visuals were used to scaffold:

1. Fraction Equivalence
   example: $\frac{3}{4}$ and $\frac{6}{8}$
2. Fraction Magnitude
3. Four operations (+ − × ÷)

[1]Siegler, et al. (2012)

COMPARING FRACTIONS WITH BENCHMARK NUMBERS & RELATIVE SIZE

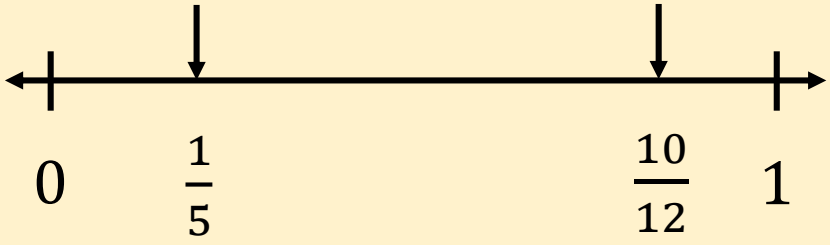
$\frac{4}{6}$ is here because it is $\frac{1}{6}$ greater than $\frac{3}{6}$, which is equivalent to $\frac{1}{2}$.



$\frac{1}{5}$ is close to 0 because 1 is relatively small compared to 5.

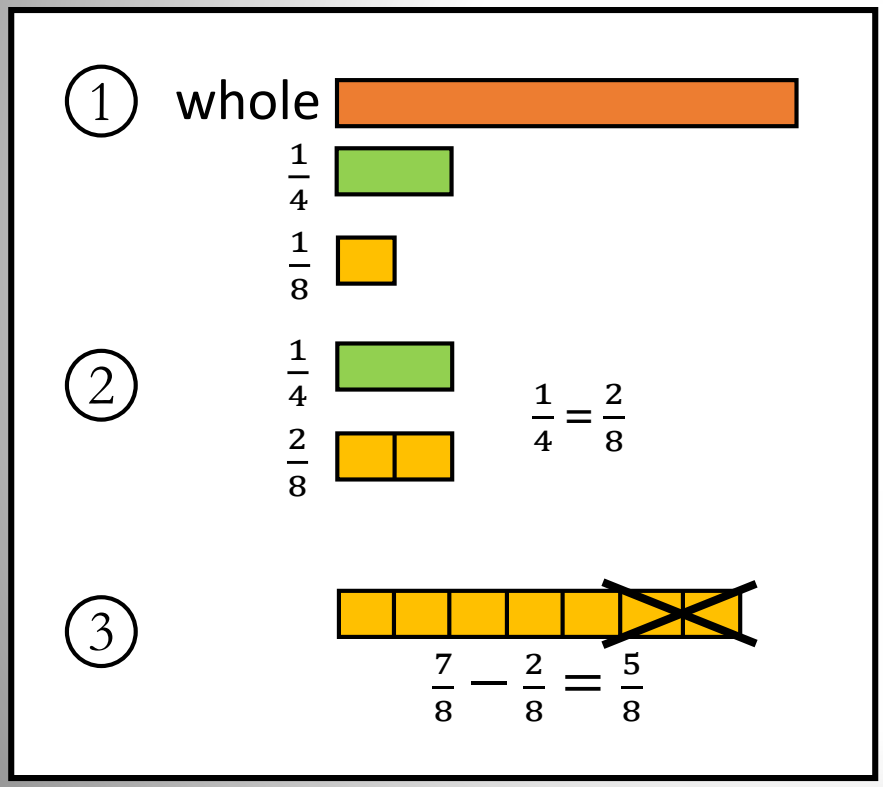
$\frac{10}{12}$ is close to 1 because 10 is relatively large compared to 12.

Therefore $\frac{1}{5} < \frac{10}{12}$.

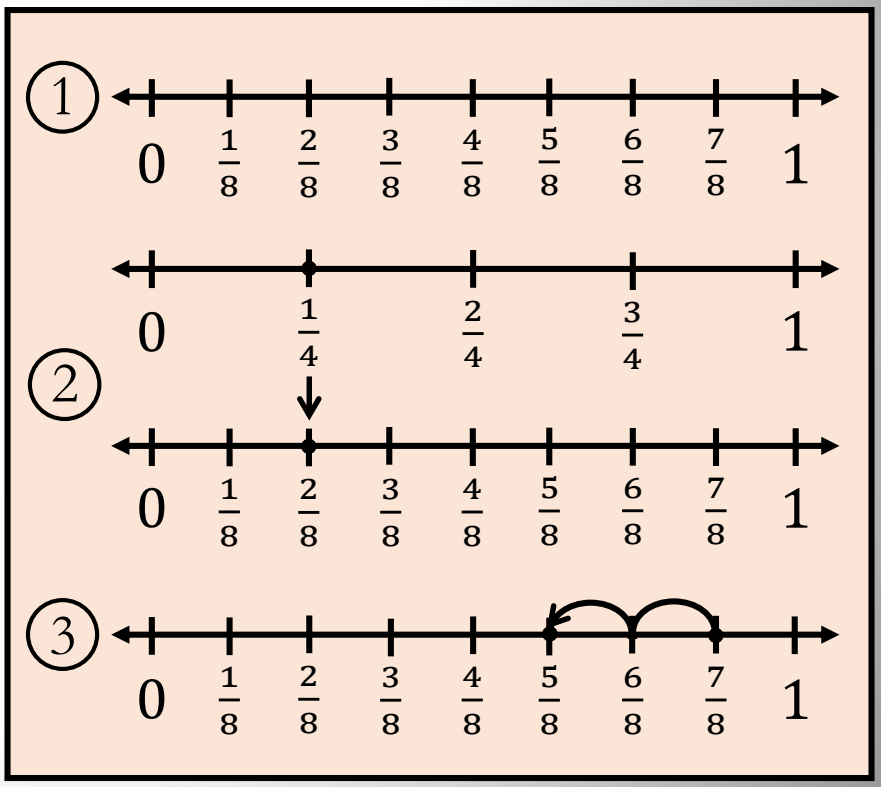


SUBTRACTION PROBLEM: $\frac{7}{8} - \frac{1}{4}$

Cuisenaire Rods



Number Line



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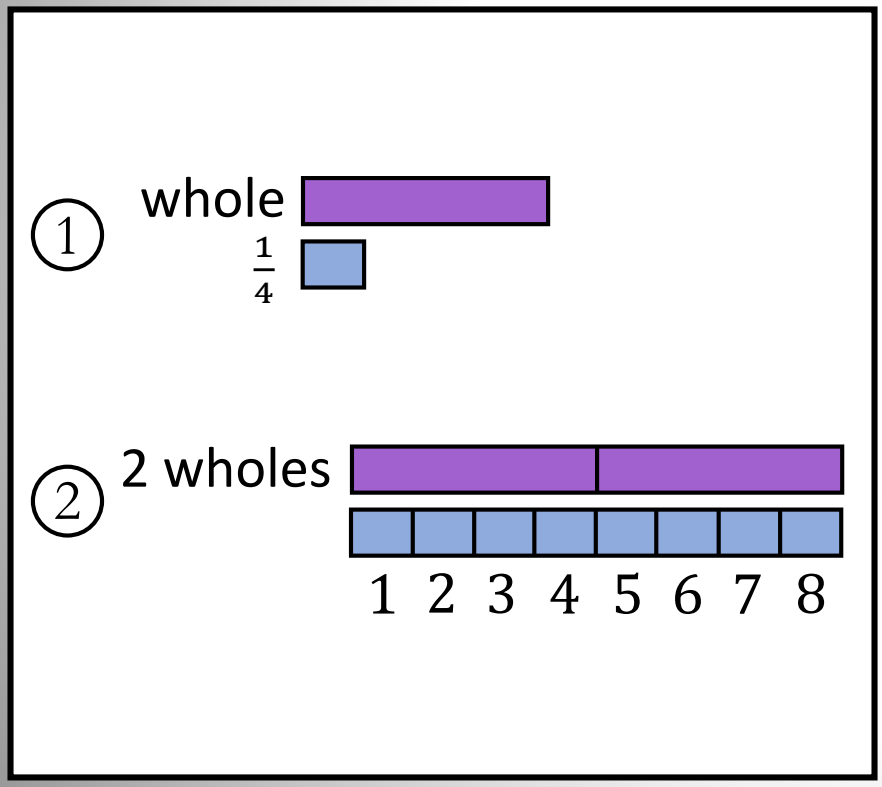
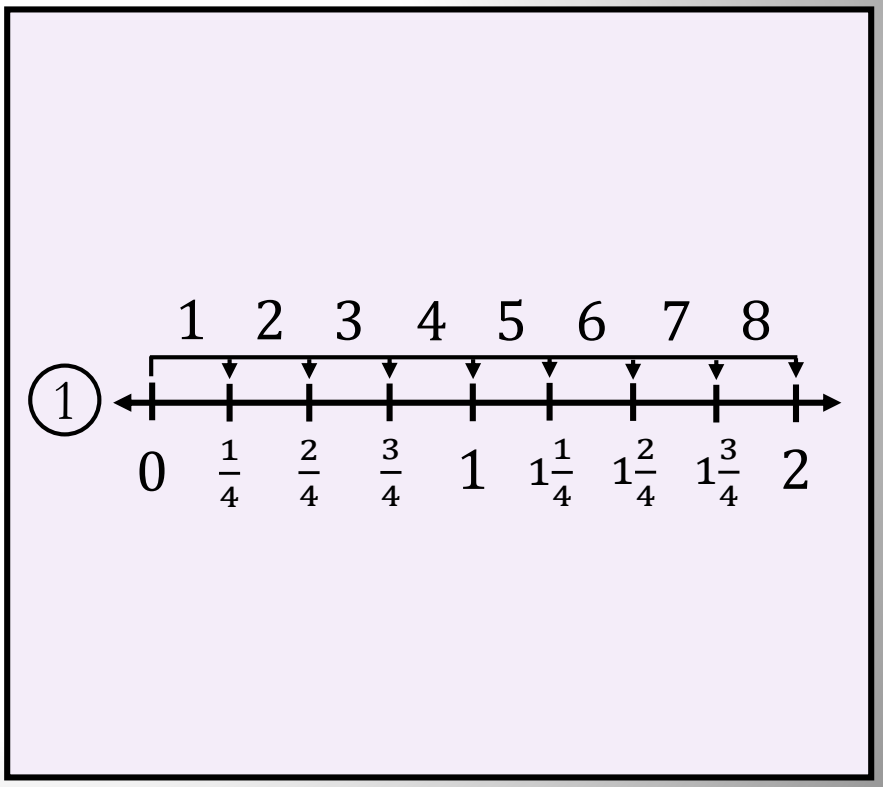
DIVISION PROBLEM: $2 \div \frac{1}{4}$

Cuisenaire Rods



Number Line

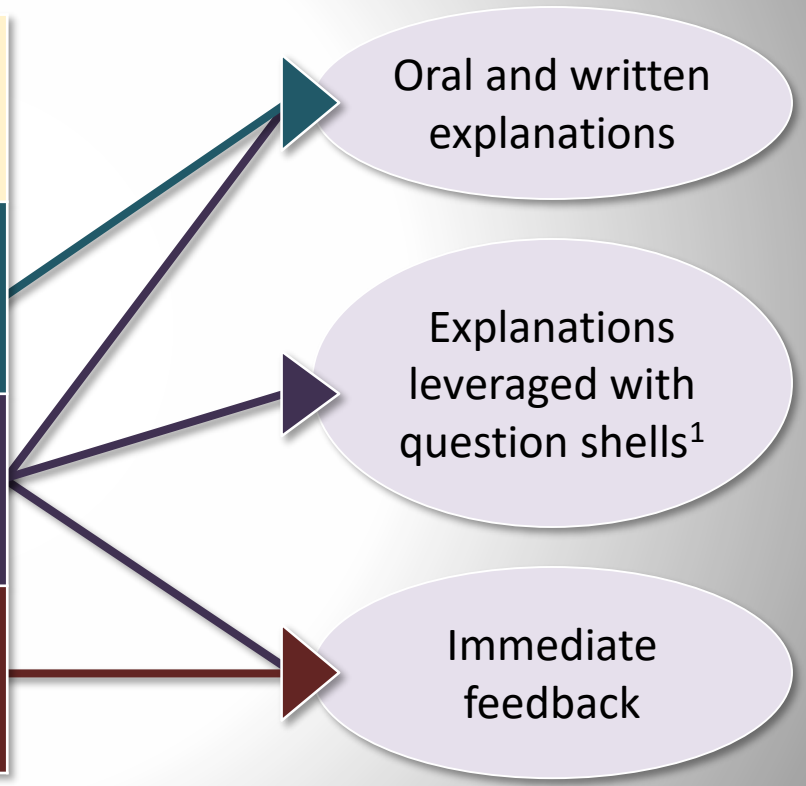


ADAPTING TRANSMATH CURRICULUM FOR TIER 2

1. Changes after the pilot study:
   - Shifting activities to accomplish 35-minute lessons
   - Embedded review of addition and subtraction with unlike denominators after introducing multiplication and division
2. Guidance for written explanations:
   - Prompt card and vocabulary list

LESSON DESIGN

Review	5 minutes	Cumulative review
Explicit Instruction	10 minutes	Scaffold w/ visuals Model explanations Problem solving
Guided Practice	10 minutes	Practice new skills Explanations Problem solving
Independent Practice	10 minutes	Partner work Independent work



[1]Developed by Ball and Shaughnessy

RANDOMIZED CONTROLLED TRIAL

1. Randomly assigned students, blocked by teacher, to two conditions:

Treatment	Control/BAU
TransMath® Fractions Intervention	What is currently offered by the school

2. BAU – varied across sites
3. Core mathematics instruction was common across conditions.

ANALYTIC SAMPLE

Fifth-Grade Students from 3 districts, 14 schools, 43 classrooms

District 1	District 2	District 3
5 schools	6 schools	3 schools
15 classrooms	12 classrooms	16 classrooms

Screened Using *TUF-4*	Qualified on *TUF-4* (15-38th Percentile)	Randomly Assigned	Analytic Sample
1,154 ⇨	340 ⇨	205 ⇨	**189**

Overall Attrition = 6.9%

Differential Attrition = 6.1%

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SAMPLE DIVERSITY

Race/Ethnicity	District 1	District 2	District 3	Total
African American/Black	3	19	6	28 (15%)
Asian	12	0	0	12 (6%)
Hispanic	0	30	2	32 (17%)
White	13	32	27	72 (38%)
Multiracial	34	10	0	44 (23%)

Student Demographic	Total
Free & Reduced Lunch	
Yes	109 (58%)
No	62 (33%)
Missing	18 (9%)
IEP/504	
Yes	15 (8%)
No	82 (43%)
Missing	92 (49%)

IMPLEMENTATION

Small-group intervention (n = 5)

Provided 3-4 times per week (52 lessons) for 35 minutes

Interventionists (retired teachers, math tutors)

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IMPLEMENTATION FIDELITY

1. Fidelity of implementation:
   - Overall Quality

     (5-point Likert Scale)

     Mean = 4.0

     Range = 3.8 – 4.2
   - Overall Procedural

     Mean = 80%

     Range = 74% – 91%
2. Areas of issue for interventionists:
   - Pacing
   - Behavior management
   - Scheduling interruptions

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DATA ANALYSIS

1. Partially nested mixed-model to account for partial clustering:
   - Treatment students nested within tutoring groups and unclustered control students
2. Covariates
   - *WRAT4*
   - *NLE 0-1*
3. Random effects model

IMPACTS

		TUF4	*TUF5*	*Fractions Procedure Test*[a]	*NLE 0-1*[b]	*NLE 0-2*[b]
Fixed Effects	**Condition (*TransMath*)**	3.21 (.55)	2.33 (.46)	10.58 (1.33)	-10.86 (1.20)	-6.54 (.94)
	WRAT4 Pre	.16 (.02)	.14 (.02)	.38 (.06)	-.27 (.06)	-.22 (.05)
	NLE 0-1 Pre	-.14 (.02)	-.09 (.02)	-.32 (.05)	.37 (.05)	.35 (.04)
Hedges' *g*	**Condition**	0.776	0.652	1.043	-1.096	-0.794
ICC	**Tutoring Groups**	.30	.11	.23	.13	.01

All significant at $p = .0001$.

[a]Jordan et al., 2013.

[b]Siegler & Opfer, 2003.

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OTHER INTERESTING FINDINGS

1. ICC:
   - Tutoring Group = .14
   - Tutor = .19
2. Performance Assessment Effects:
   - Accuracy: *g* = .73 – 1.25
   - Explanations: *g* = 1.04 – 1.12
3. Significant Moderators:
   - Free & Reduced Lunch
   - *WRAT4* and *NLE 0-1*

ASSESSMENT OF PERFORMANCE AND UNDERSTANDING

(aligned with contemporary state standards)

Solve the word problem. Use pictures, number lines, or numbers to show your problem solving.

Bella likes to build with Legos. In her set of Legos, $\frac{1}{5}$ are red. Bella used $\frac{2}{3}$ of her red Legos to build a fire truck. What fraction of her total set of Legos did she use to build the fire truck?

Explain your thinking.

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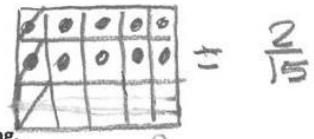
PERFORMANCE ASSESSMENT

Student A

$\frac{1}{5} \cdot \frac{2}{3} = \frac{2}{15}$



$= \frac{2}{15}$

Explain your thinking.

I multiplied $\frac{1}{5}$ and $\frac{2}{3}$ becoues in the question it says what fraction of her set of Legos did she use to build the fire truck. What I did was multiple across and I used a area model to check. I multiplied 1 and 2 and got 2 for my numerator and multiplied 5 and 3 and got 15 for the denomanator. That was how I got $\frac{2}{15}$ from multiping and from the area model.

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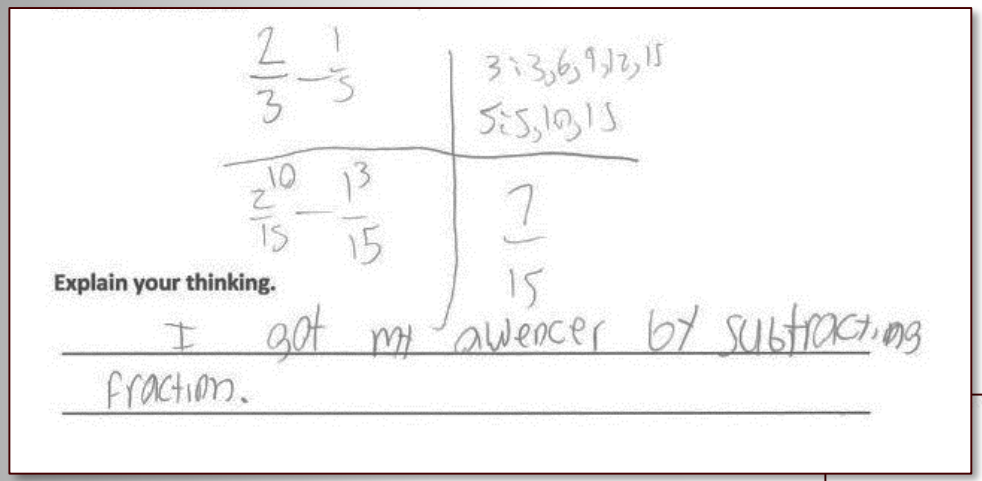
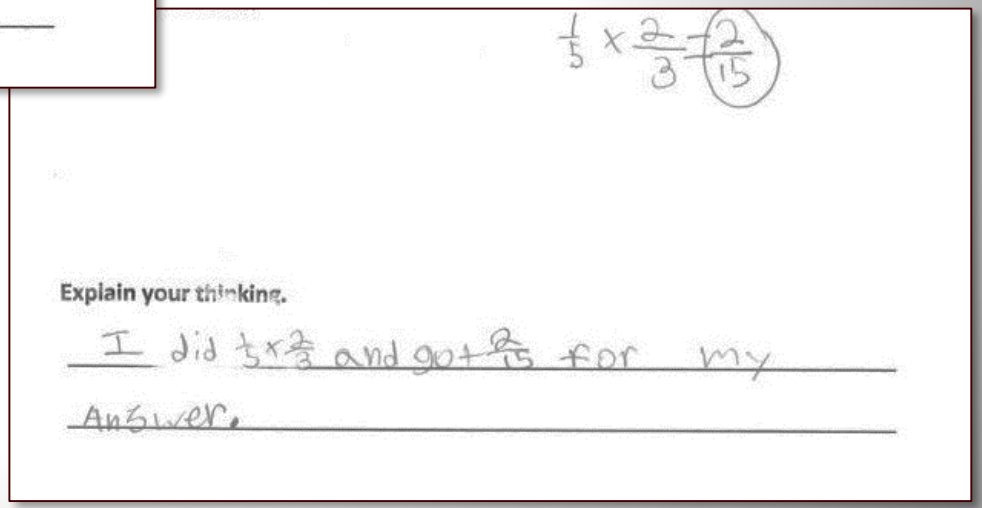
PERFORMANCE ASSESSMENT



Student B

Student C



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OUR RESEARCH TEAM

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Samantha Spallone

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GENERAL CONSIDERATIONS

1. Content-specific fraction measure vs. measure of general math achievement:
   - ➢ As a screener: fractions measure
   - ➢ As a covariate: general math achievement
2. Using common norms across districts vs. local norms

Across Districts	District 1	District 2	District 3
15-38th percentile	10-30th percentile	30-65th percentile	7-27th percentile