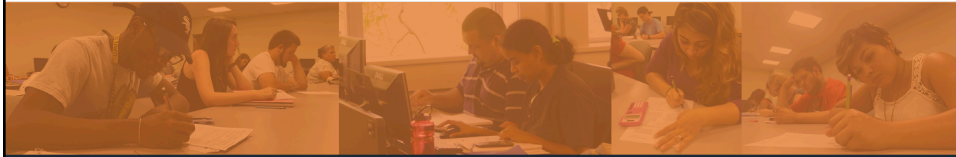


Proportional Reasoning Before Proportions

Lisa Brown and Sherri Jones

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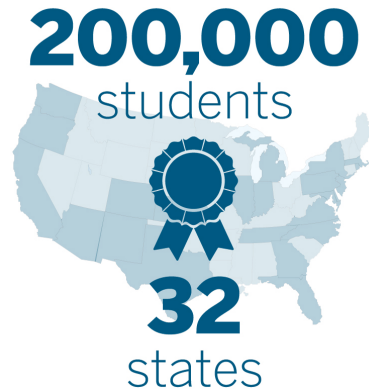


About the Dana Center

— Equity — Access — Excellence —

2019

Dana Center by the Numbers



Nearly 200,000 students in 32 states were served by Dana Center–Agile Mind courses, recognized for their quality by multiple review panels including EdReports.

Agenda

- **Introductions**
- **What is proportional reasoning?**
- **Explore four representations of ratio**
 - How they build conceptual understanding for proportional reasoning
 - How they progress to writing and using proportion equations
- **Discuss benefits and limitations of various representations**
- **Reflections**

What do we mean by proportional relationships and proportional reasoning?

- **A proportional relationship is a relationship between two varying quantities in which one quantity is a constant multiple of the other quantity.**
- **Proportional reasoning is the ability to make comparisons between objects using multiplicative thinking.**
- **How do we move students to recognize that proportional relationships are multiplicative and utilize this to solve problems?**

Representations of ratio

- **Shape diagrams**
- **Tape diagrams**
- **Double number lines**
- **Ratio tables**
- **Proportion equations**
- **$y = kx$**

Why take your students through a progression of the representations of ratio?

- **Students start with discrete and concrete objects/shapes.**
- **Each new representation adds sophistication and flexibility.**
- **Students will eventually feel constrained by a representation and see the utility in the next representation.**
- **When proportions are introduced, students will have conceptual understanding of ratio and will have a mental picture to go with the abstract equation.**

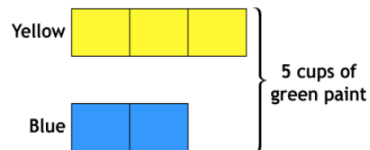
Shape Diagrams

- **Shape diagrams provide support for students to verify their thinking by counting the quantities in a given ratio.**
- **As quantities change, students can easily see that the relationship remains constant.**



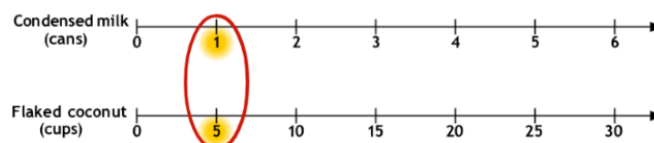
Tape Diagrams

- **Tape diagrams represent relationships geometrically.**
- **Help students compare quantities using multiplication and division.**
- **Help students reason about the parts and the whole when the quantities in a ratio are in the same units or in different units.**



Double Number Lines

- **A double number line helps students think about multiple scaled quantities without having to draw them.**
- **Each part of the ratio is represented by a separate line that corresponds to a quantity related by the ratio.**
- **Students can reason about “how much for 1?” and use rational number scale factors.**



Ratio Tables

- Once students have a conceptual understanding of ratio, ratio tables allow for more flexibility and sophistication in scaling.
- Students can easily find the “how much for 1?” for both quantities being compared and use these to find any other quantity of interest.
- Moving from a ratio table to a proportion equation is a natural step.

Caramel popcorn (cups)	Cheddar popcorn (cups)
7	4
21	12
1	$\frac{4}{7}$
$3\frac{1}{2}$	2
$\frac{7}{4} = 1\frac{3}{4}$	1
5	$\frac{20}{7} = 2\frac{6}{7}$

• 5 (left side) and • 5 (right side) with arrows pointing to the table.

Proportion equations

- Focus strictly on the quantities
- Succinct
- When introduced carefully, can connect to prior work with equivalent fractions

Some cautions

- Easily and often confused with fractions
- When used to set up “cross products”—often create more harm than help

Reflections

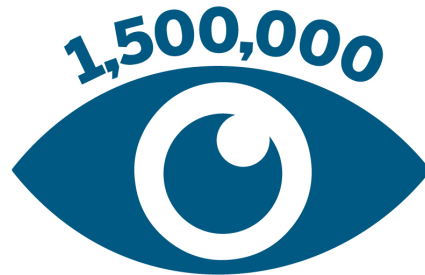
- Which representations are new for you?
- Which representations would you like to explore more?
- How will you use the session information we have explored today?

Dana Center by the Numbers



Downloads of **free resources** for elementary and secondary classrooms from **Inside Mathematics**.

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