

Links

Visit www.sudds.co to create an account, explore our learning map, view curricular resources, and take a sample assessment.

(Creating an account will allow you to follow along with us as we tour the map during the presentation)

Visit <https://sudds.ced.ncsu.edu> to learn more about our work.



Are Your Students Learning what You Intend?

Effective Uses of Open Ed Resources

Dr. Will McGowan
North Carolina State University

Our Staff, Partners, and Support

Project Staff

Jere Confrey, Project Director
Emily Toutkoushian, Psychometrician
William McGowan, Project and Outreach Coordinator
Margaret Hennessey, Senior Research Scholar
Michael Moody, UX/UI Designer
Yungjae Kim, Lead Software Engineer
Gary Aleixo, Software Developer
David Meza, Junior Software Developer
Meetal Shah, Graduate Research Assistant
Michael Belcher, Graduate Research Assistant

We gratefully acknowledge support from:



BILL & MELINDA
GATES *foundation*

SUDDS technology has been licensed to
The Math Door to support efforts to scale.



Knowing the Room

1. How many are current middle school teachers?
2. Instructional coaches/administrators?
3. How do you go about gathering resources?
4. Have you found a resource claiming to address a standard, but found it didn't?

An Observation

Standards may take multiple lessons to address, and any given resource (regardless of quality) may not cover the standard entirely.

Two Needs

- Scaffolding to organize lesson resources into coherent units
- An objective measure to determine if the necessary learning is taking place

An Example: Unit Rate Standards

In 6th grade, unit rates are addressed by two common core standards:

6.RP.A.2- Understand the concept of a unit rate a/b associated with a ratio $a:b$ with $b \neq 0$, and use rate language in the context of a ratio relationship. *For example, “This recipe has a ratio of 3 cups of flour to 4 cups of sugar so there is $\frac{3}{4}$ cup of flour for each cup of sugar.” We paid \$75 for 15 hamburgers which is a rate of \$5 per hamburger.”*

6.RP.A.3.b- Solve unit rate problems including those involving unit pricing and constant speed. *For example, if it took 7 hours to mow 4 lawns, then at that rate how many lawns could be mowed in 35 hours. At what rate were the lawns being mowed.*

Price per pound and pounds per dollar



Attribution-NonCommercial-ShareAlike 4.0
International (CC BY-NC-SA 4.0)



The grocery store sells beans in bulk. The grocer's sign above the beans says,

5 pounds for \$4.

At this store, you can buy any number of pounds of beans at this same rate, and all prices include tax.

Alberto said,

*"The ratio of the number of dollars to the number of pounds is 4:5.
That's \$0.80 per pound."*

Beth said,

"The sign says the ratio of the number of pounds to the number of dollars is 5:4. That's 1.25 pounds per dollar."

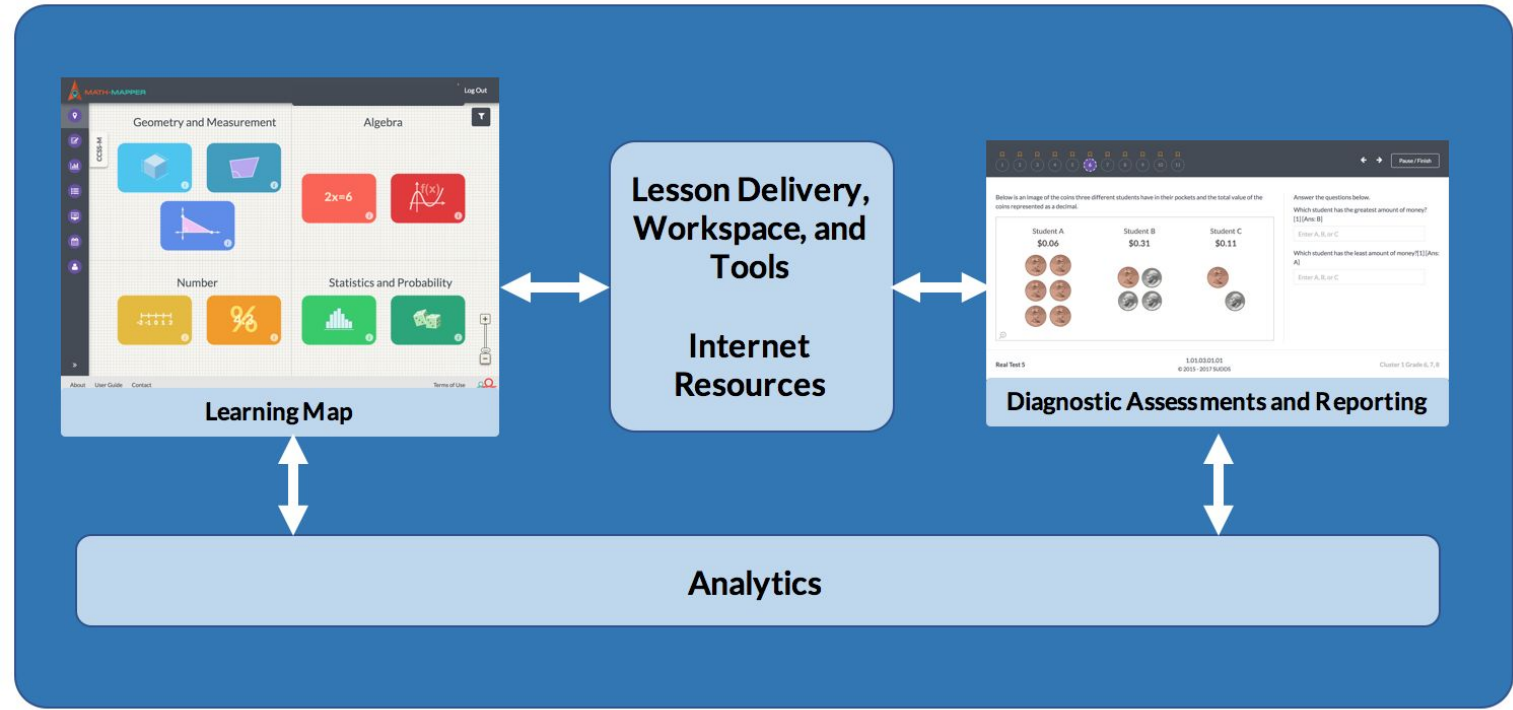
a.

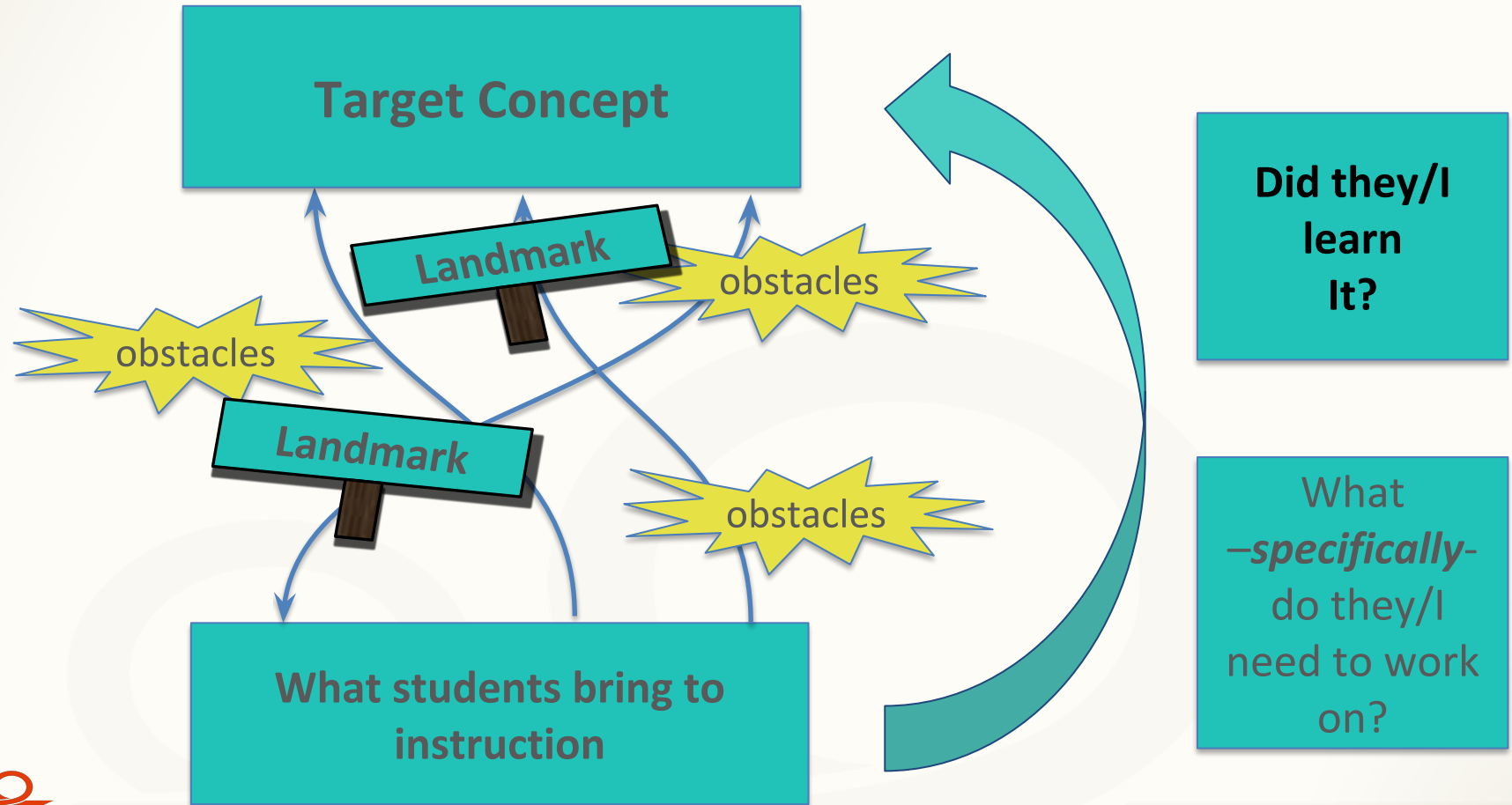
Are Alberto and Beth both correct? Explain.

Specific Questions

1. How can we support teachers to deliver **student-centered instruction** while maintaining focus, coherence, and rigor especially in a time of the use of open educational resources (OER)?
2. In the context of a 6th grade unit on ratios, how do we leverage timely access to Learning Trajectories research and **actionable data on student thinking** to promote rich discussions among teachers and students?

Math-Mapper: A Digital Learning System



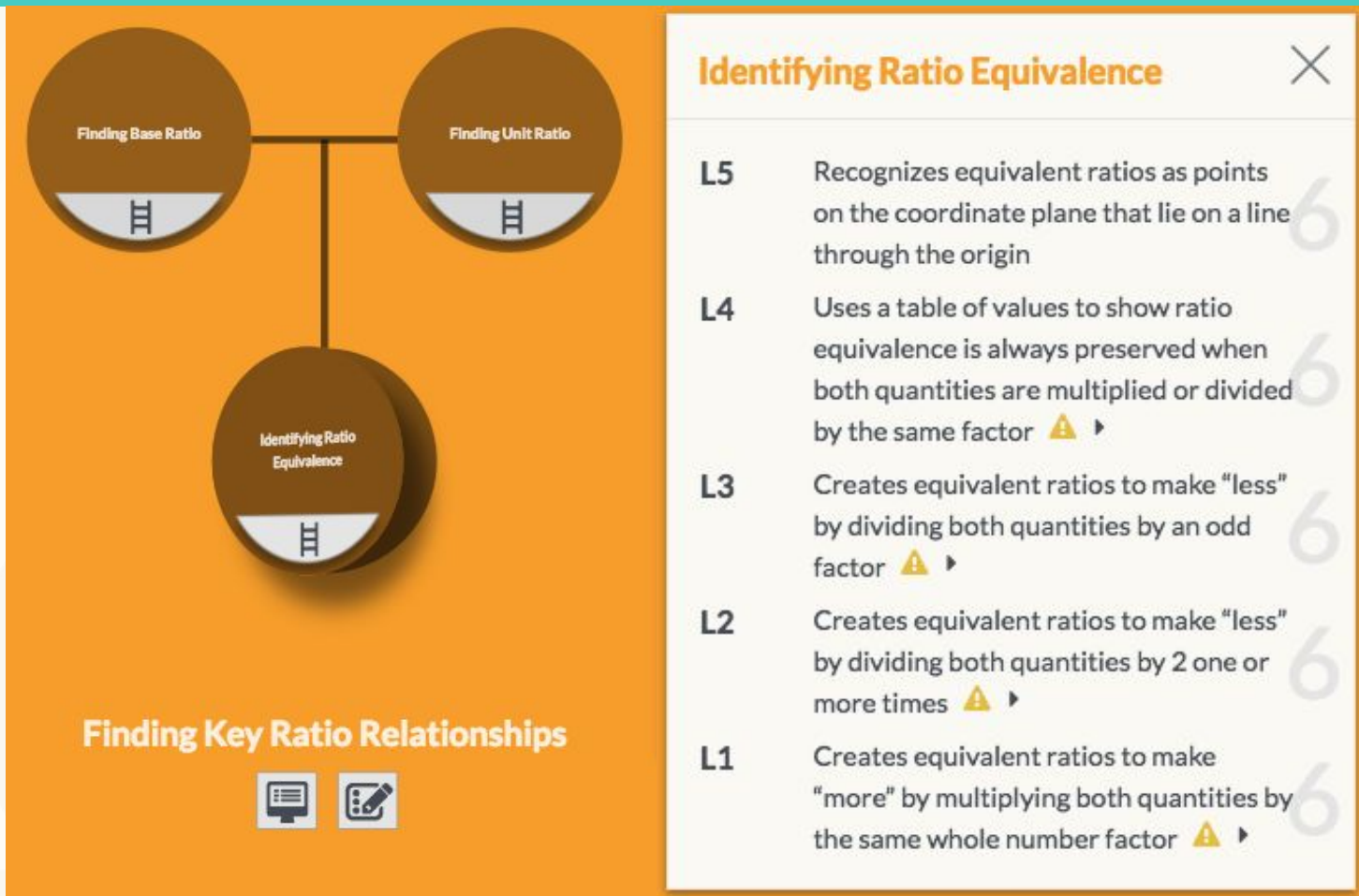


Learning Trajectories: Not Stages but Space



Why Learning Trajectories?

1. Learning Trajectories are a common framework for viewing assessment and instruction.
 - a. Assessment measures must measure the goal, as well as progress towards it
 - b. Instructional activities should provide evidence of student progress, as predictors of assessment results



Arturo's Lemonade Stand

Arturo has a lemonade stand. He makes and sells freshly squeezed lemonade. His special recipe uses 8 lemons and 12 cups of sugar water.

He is going to set up a stand on Main street for 4th of July. He needs to make a lot of lemonade that will taste the same as his special recipe.



How can Arturo make more lemonade and be certain that it tastes the same? Record the number of lemons and the cups of sugar water Arturo could put in each batch.

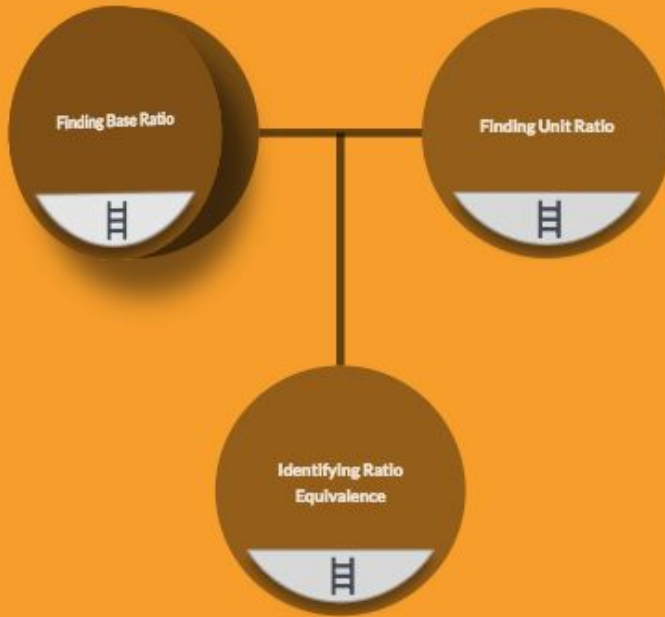
Make at least three equivalent recipes that are larger and taste the same.



Finding Base Ratio

- L5 Understands base ratio as "so much of this for so much of that"
- L4 Finds base ratio through prime factorization ⚠ ▶
- L3 Finds base ratio for two quantities (either even and odd or two odds) that are not relatively prime ⚠ ▶
- L2 Finds base ratio when common factors are powers of 2
- L1 Understands base ratio as smallest whole number equivalent ratio

6
6
6
6
6



Finding Key Ratio Relationships



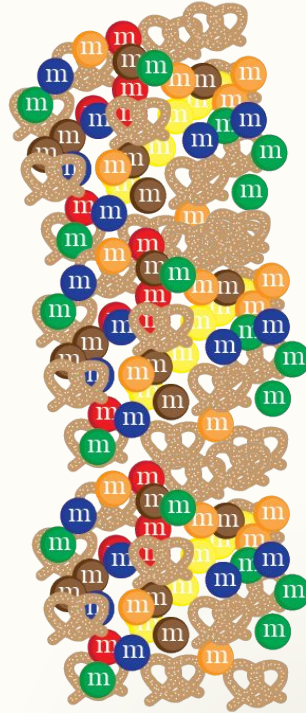
Example of a Task (Base Ratios)

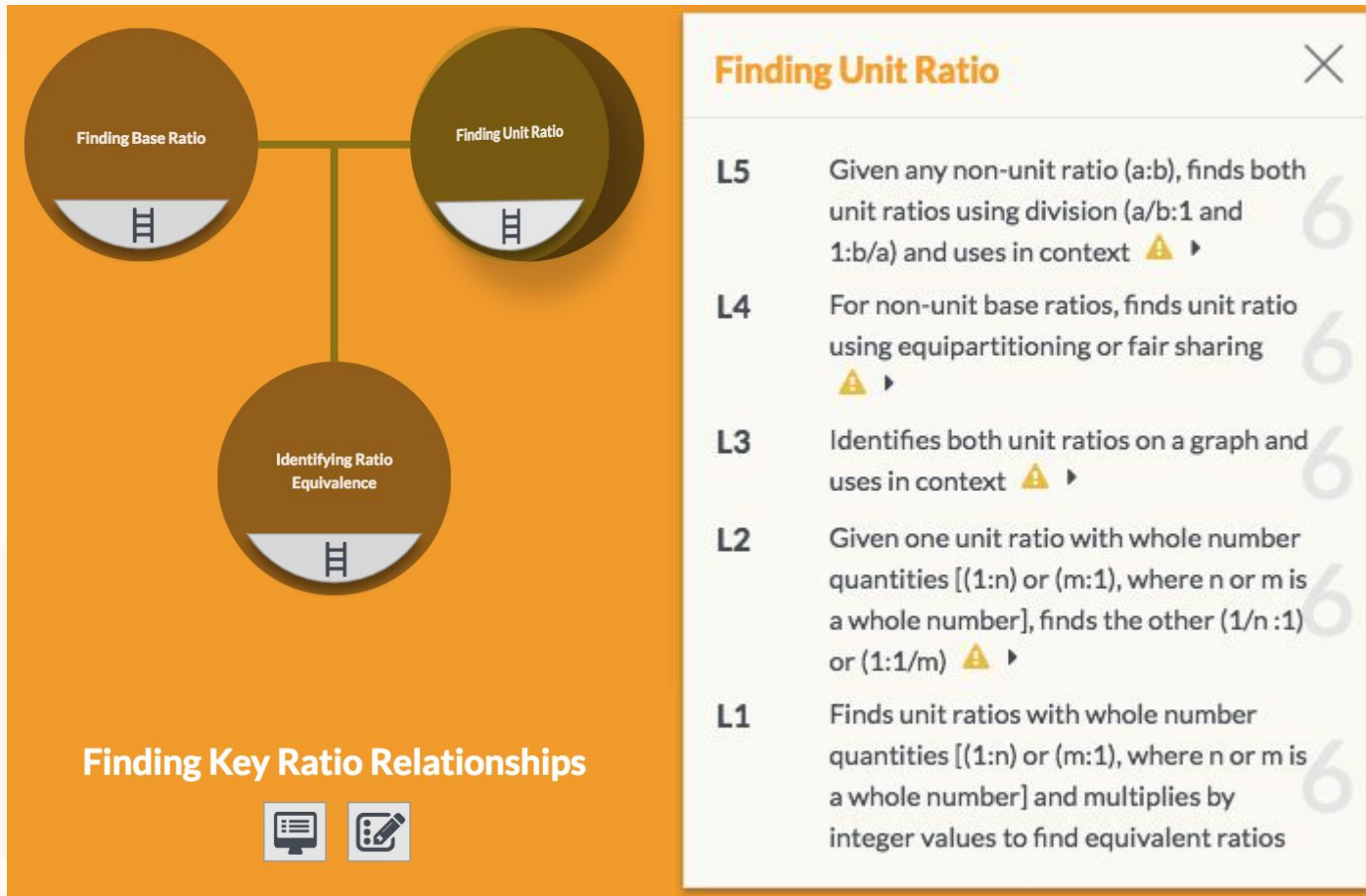
Gerald and Kazuko are leading a youth group on a day hike and are making bags of trail mix. The ingredients are M&M's and pretzels. They need to make sure everybody gets a fair share of these two ingredients.

They have a bag of 150 m&m's and a bag of 60 pretzels.

Gerald and Kazuko want to use baggies to serve smaller portions of trail mix, and keep the ratio of M&M's to pretzels the same in each baggie.

What is the smallest number of M&M's and pretzels that they could put in each baggie?





Example of a Task (Unit Ratios)

Each year NC State hosts the Krispy Kreme Challenge. Contestants are required to run 2.5 miles, then eat 12 Krispy Kreme donuts, and complete the race by running another 2.5 miles.

Two friends, Jenna and Clifton, are running against each other in the race. They can run the race distance in about the same time, so each one of them hopes to win based on their donut eating skills.

Use Jenna's and Clifton's data to find how long it would take each of them to eat 1 donut.



Jenna	
Number of Donuts	Number of Seconds
6	30

Clifton	
Number of Donuts	Number of Seconds
9	36

Leveraging Learning Trajectories in Planning Instruction

Review the LT when planning a unit.

Most lessons can assess multiple levels of an LT.

Use the LTs as a framework to implement the 5 practices (Smith & Stein 2011)

1. **Anticipate:** student behaviors or strategies that are likely to emerge
 - The levels students are likely to come in at
 - The misconceptions students are likely to have
 - The levels students are likely to need help reaching

2. **Monitor:** Use LTs as a lens for interpreting student work.

Leveraging Learning Trajectories during Instruction

3. **Select:** Prepare for student-centered discussion by choosing examples that span the LT levels.
4. **Sequence:** Have students share examples starting with the lowest levels and progressing in sophistication.

Learning Trajectories in Instruction

5. Connect: Have students compare methods “who did something similar?” or use difficulties students encountered to motivate the connections
“Who else had that difficulty, and how did you get through it?”

Some Cases of Connections:

Higher levels can present solutions to difficulties students encountered at lower levels.

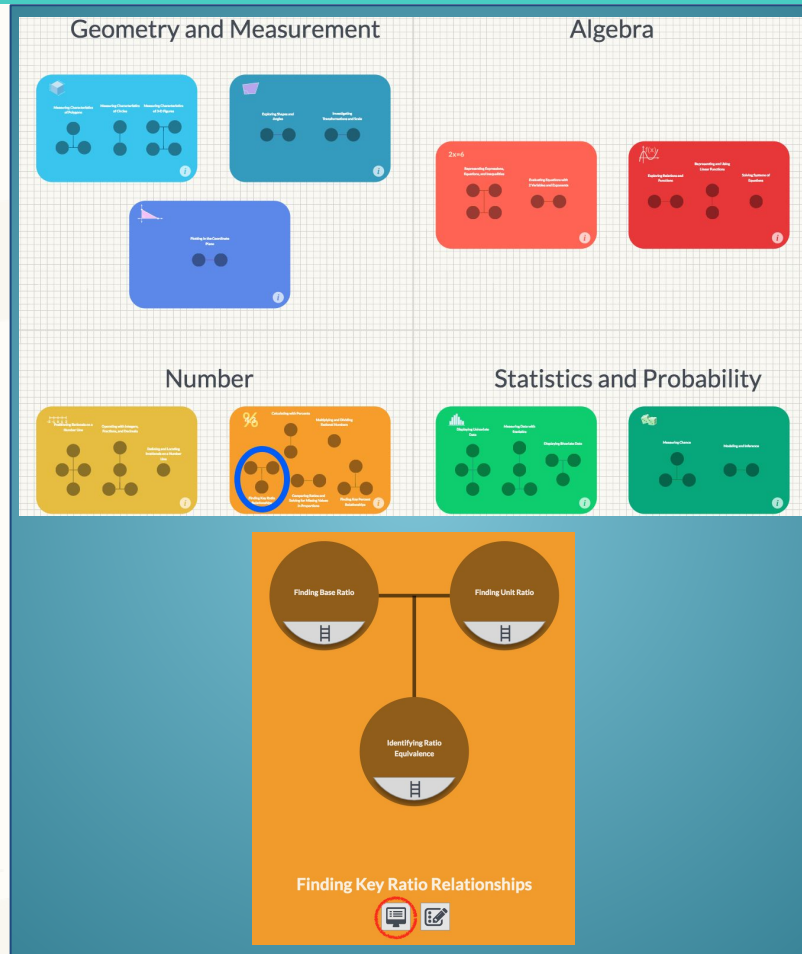
Higher levels can be generalizations.

A new case (numbers) can create the need to operate at a different level.

Accessing Resources

Visit sudds.co, and create an account.

Each cluster has linked resources.



Research Site

Relatively New: 2016-17 was its second year operating as a 6-8 school.

Technology Rich: SmartBoards and 1-1 chromebooks

Diverse Population: 52% White, 27% African American, 10% Hispanic, 1% Asian or Native American

Diverse Abilities: 50% of students come from a high poverty school that is one of the lowest performing schools in the county, 50% come from a “top five” school

6th Grade Ratio Curriculum

Cluster	Curriculum Description
Cluster 4: Finding Key Ratio Relationships	Problem-based approach building from ratio equivalence to base ratios and unit ratios
Cluster 5: Comparing ratios and finding missing values in proportions.	Project-based approach built around distracted driving statistics (“Arrive Alive”)
*Lessons were designed using the LTs as a foundation	

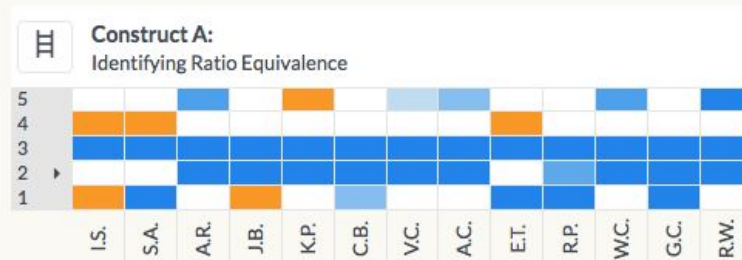
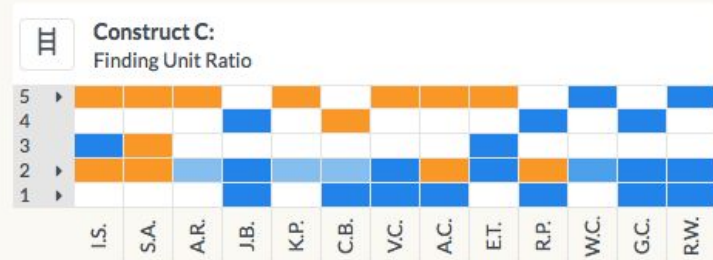
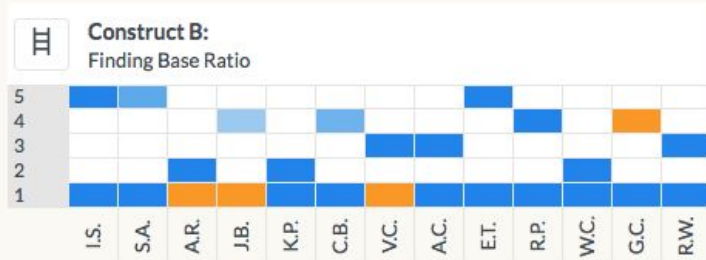
Implementing the Unit



Using Assessment Data

- Assessments given a few days before a unit test
- Teachers developed “Data Review” sheets for students to work through
- Teachers pull small groups for targeted instruction
- Students revise work in pairs or small groups and reassess
- Selected tasks are presented and discussed in a whole group setting
- Selected tasks are incorporated into teacher assessments/spiral reviews

Class Report



Key:



Observations - Teacher Use of Reports

Targeting Items:

- “I noticed a lot of you had trouble on this one...”
- “On Construct B, what level do we need to work on?”

Observations - Teacher Use of Reports

Connecting Ideas

- “She doesn’t have enough cups of watermelon, so her juice is going to be less than the original juice mix. How many cups of each fruit does she need, in order to make less tropical punch that still tastes the same. Again, we are back to Arturo and his lemonade. Remember his sister, Monique wanted to make less lemonade, but wanted it to have the same flavor.”

Observations - Teacher Use of Reports

Sharing Student Thinking:

T: “All right we have 32 to 20 is our ratio, give me a thumbs up if 8 to 5 is equivalent thumbs down if it's not. [Student], why is it equivalent?”

S: “Because $8 * 4$ is 32 and $5 * 4$ is 20”

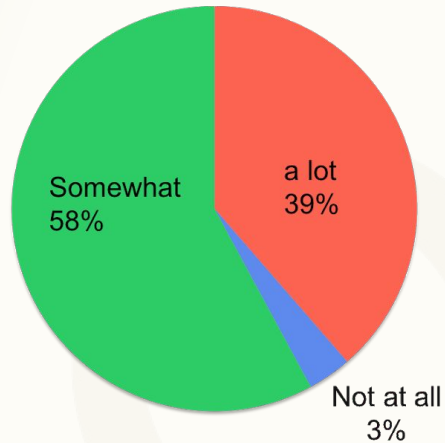
T: “All right I can use the same number the same value to get from 8 to 32 and from 5 to 20 so they are equivalent ratios.”

Observations - Student Use of Reports

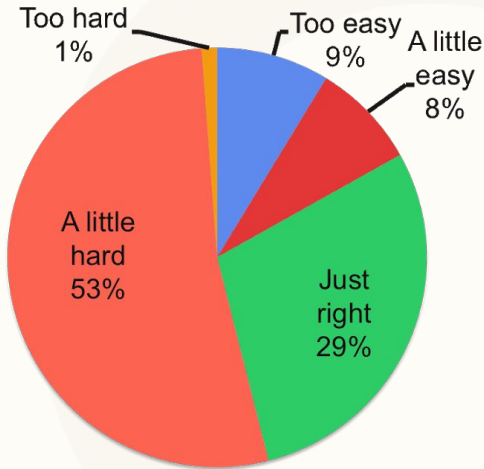
- Students were observed using the language of the trajectories to plan future efforts
 - “I noticed that I improved on finding unit ratios and identifying ratio equivalence, I improved a little on finding base ratio.”
 - “I will do more work on unit ratio”
- Students appreciated being able to revise answers and see the dials update
- Students had trouble reconciling the lower grades they were receiving on diagnostic assessments
 - Teachers needed to work with students to help them see these grades as different.

Student Feedback

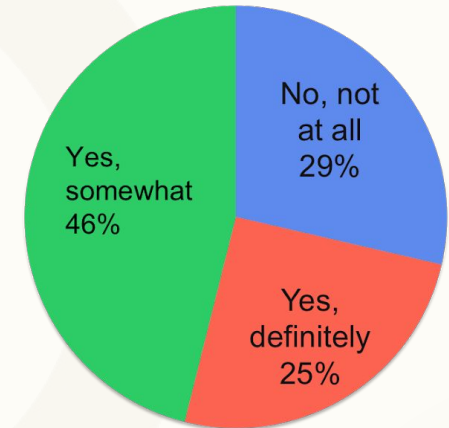
Did the test cover things you learned in class?



For me the test was ...

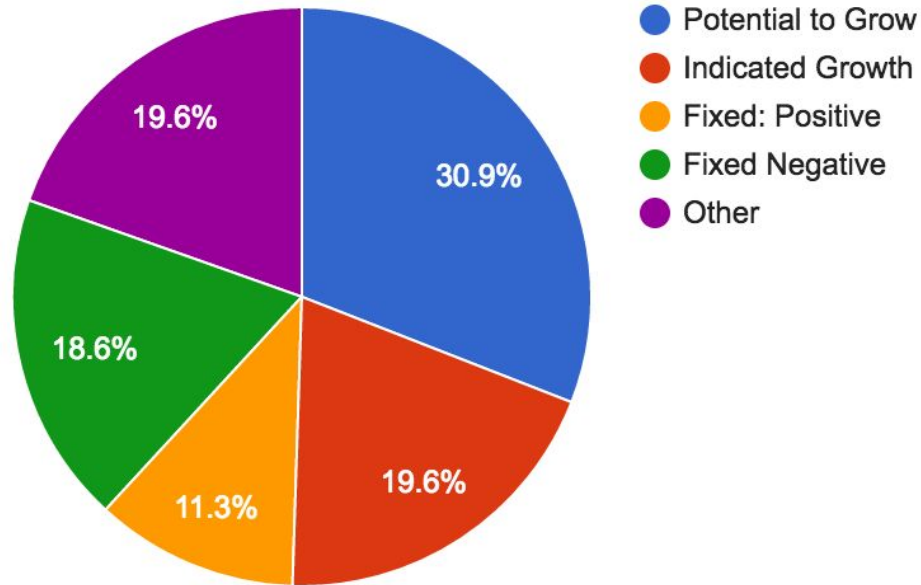


Did this report provide you with information that was useful?



Promoting Student Agency

Mindset Indicators from Student Feedback



Student Quotes

"I was a little upset as to when I looked at my test scores. But I thought it was cool that I could look at my test scores, This way I can know what i did wrong so that I can work on it"

"I need to work more on finding equivalent ratios"

"i would like to retry the test when i learn a little more"

"It told me exactly i mean EXACTLY what i got wrong and helped me understand"

Teacher Quote

"I was in the top 25% of 6th grade math teachers in the state for growth! I share this with you to say thank you! I truly believe that SUDDS was a key variable (if you will) to the students' success last year. I am so grateful that I was/am able to be a part of SUDDS. I have learned so much about math instruction and my kids have been pushed so far with SUDDS' higher order thinking. So, Thank you!"

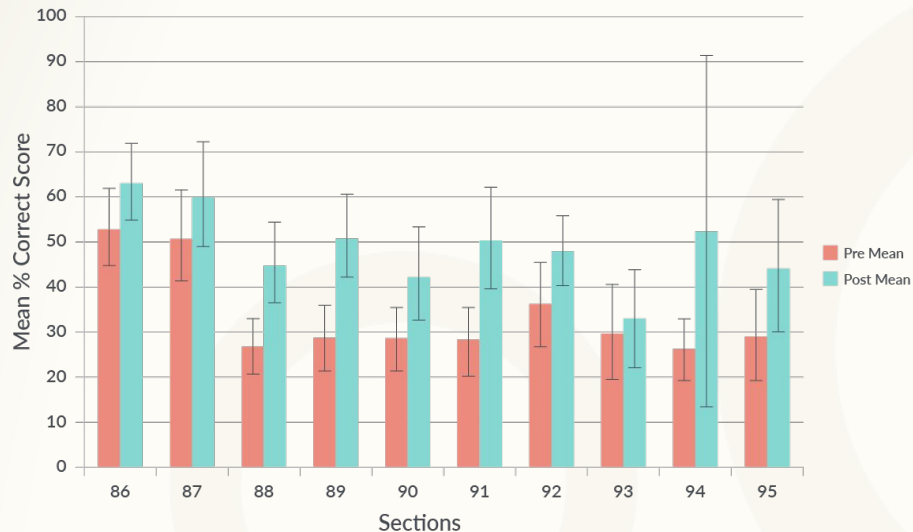
-Teacher who participated in the Ratio Study

Learning Gains by Cluster

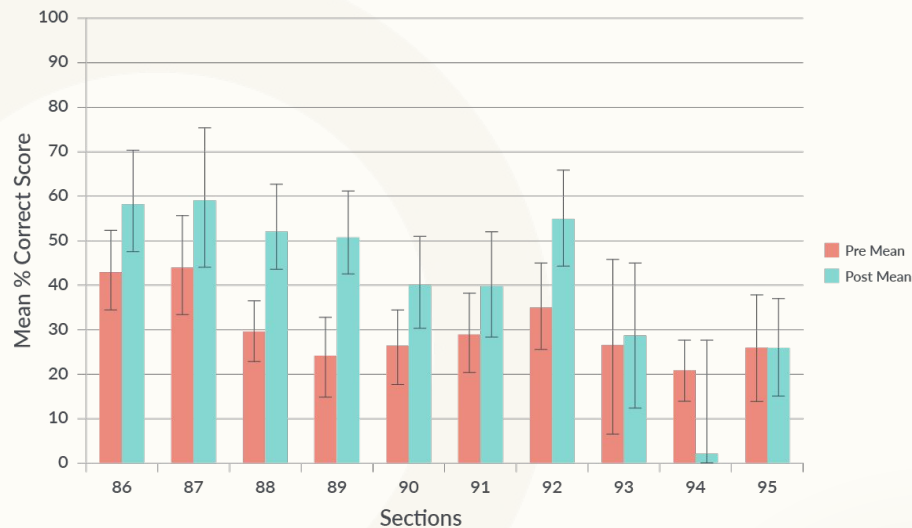
	Pre-Test Mean (%)	Post-Test Mean (%)	Gain (%)
Cluster 4	35.6	50.2	+14.6
Cluster 5	31.6	47.1	+15.5

Learning Gains by Cluster and Section

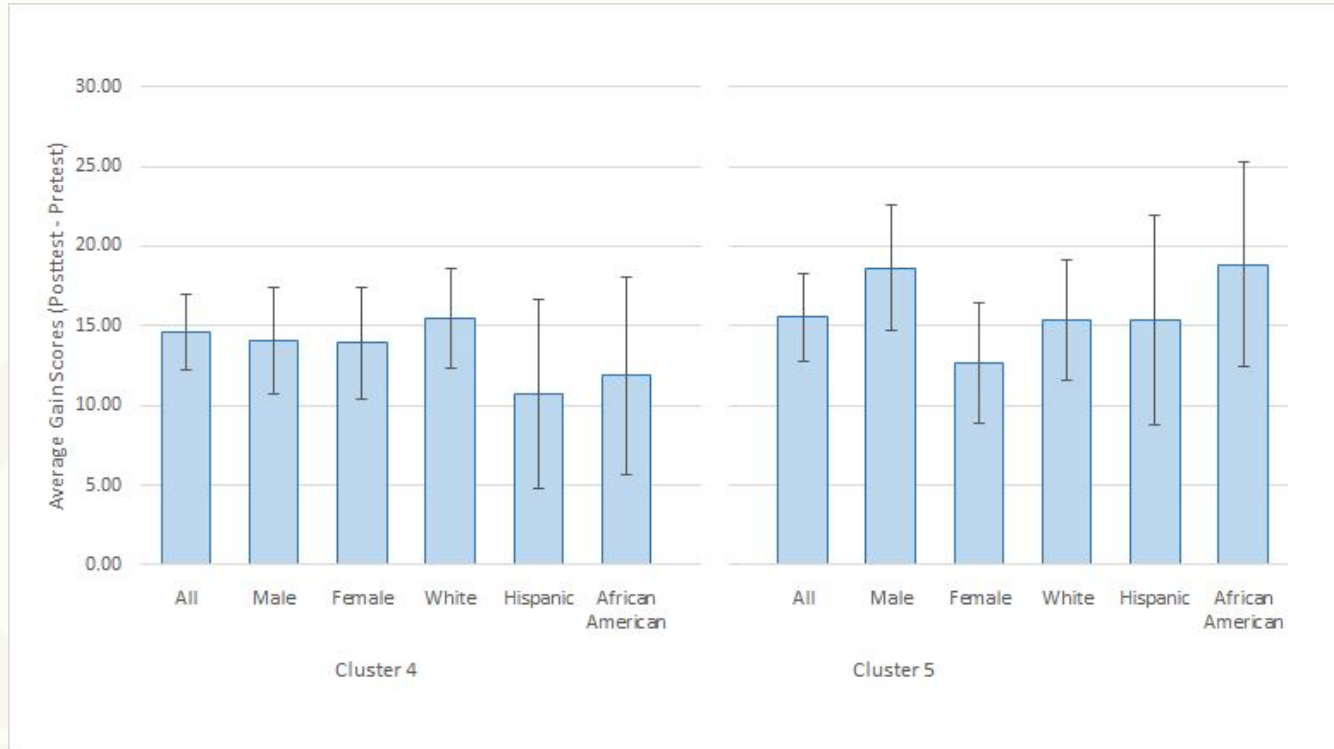
Cluster 4 Pretest / Posttest Comparison by Section



Cluster 5 Pretest / Posttest Comparison by Section



Learning Gains by Cluster and Subgroup



Confrey et al. (under review)

Looking Back, Planning Ahead

In PLCs, teachers made plans for revising the curriculum in subsequent years. Supplementing unit ratio tasks, and changing the order of units.

(Ratios, Patterns, Algebra)

The research team developed additional materials for unit ratio, as well as supplemental review content for students and teachers to use as needed.

Takeaways

- An objective measure of student learning is needed to evaluate resources and instructional choices.
- Curriculum and assessments aligned to LTs help teachers to understand student thinking.
- Students want and benefit from specific and actionable feedback.
- Diagnostic assessment data can be used to adapt instruction and document continuous improvement.

Partner With Us

We are looking for partners for the 2018-2019 school year.

Contact us: sudds_group@ncsu.edu

Explore the SUDDS Learning Map: www.sudds.co

Learn more at the SUDDS Website: sudds.ced.ncsu.edu



An Example: Percent Standards

Percents are addressed by two common core standards:

6.RP.A.3.c- Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means $30/100$ times the quantity): Solve problems involving finding the whole, given a part and the percent.

7.RP.A.3- Use proportional relationships to solve multistep ratio and percent problems. *Examples: Simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.*

An Example: Mini Golf Marbleslides

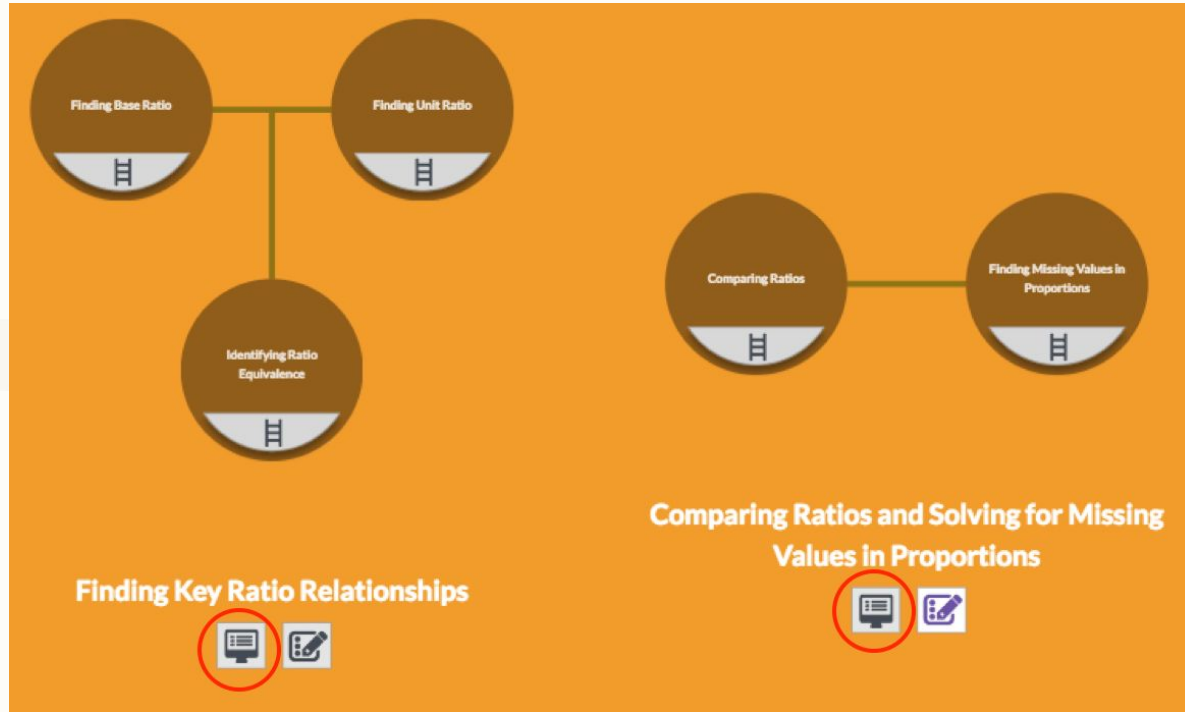
One of my favorite desmos activities: student.desmos.com (Code: 222CV)

Related to standards:

6.NS.C.6.c- Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane.

6.NS.C.8- Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or same second coordinate.

Access Ratio Unit on the Map



Slide title

- Vivamus sagittis lacus vel augue laoreet rutrum faucibus dolor auctor. Maecenas faucibus mollis interdum. Donec id elit non mi porta gravida at eget metus. Nulla vitae elit libero, a pharetra augue. Lorem ipsum dolor sit amet, consectetur adipiscing elit.
- Cras mattis consectetur purus sit amet fermentum. Donec id elit non mi porta gravida at eget metus.
- Donec ullamcorper nulla non metus auctor fringilla. Curabitur blandit tempus porttitor. Maecenas sed diam eget risus varius blandit sit amet non magna. Maecenas faucibus mollis interdum.