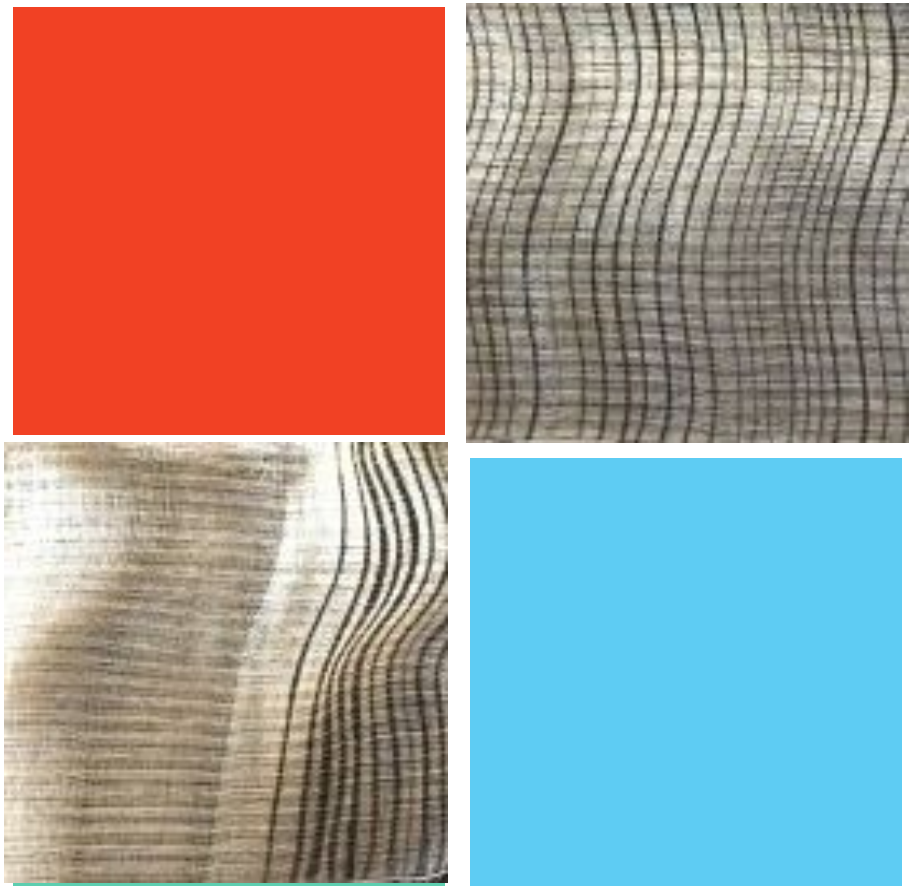

AI in the Context of Mathematics Teaching and Learning: Possibilities and Limitations

Recreational Math Group
Tuesday, June 24, 2025
Linda Ruiz Davenport

Some Possibilities . . .

Creating Mathematics Lesson Plans

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Supporting Individual Student Learning

Collecting Data on What Happens During Mathematics Instruction

Creating Mathematics Assessments

Scoring Student Work

Giving Feedback on Student Work

Creating Mathematics Lesson Plans

- What kind of lesson would AI create?

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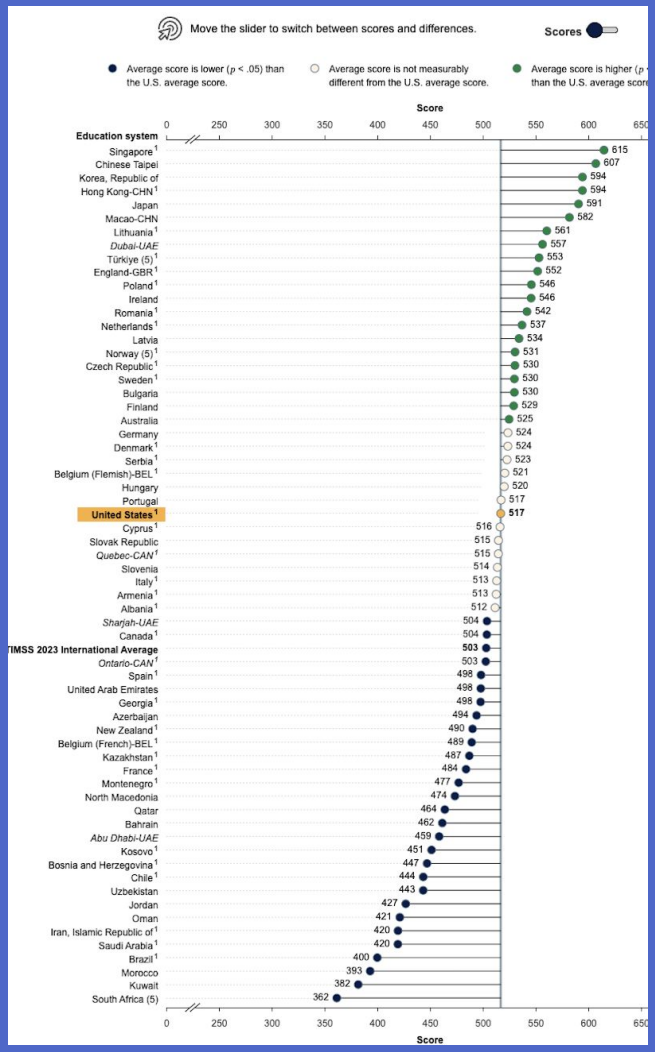
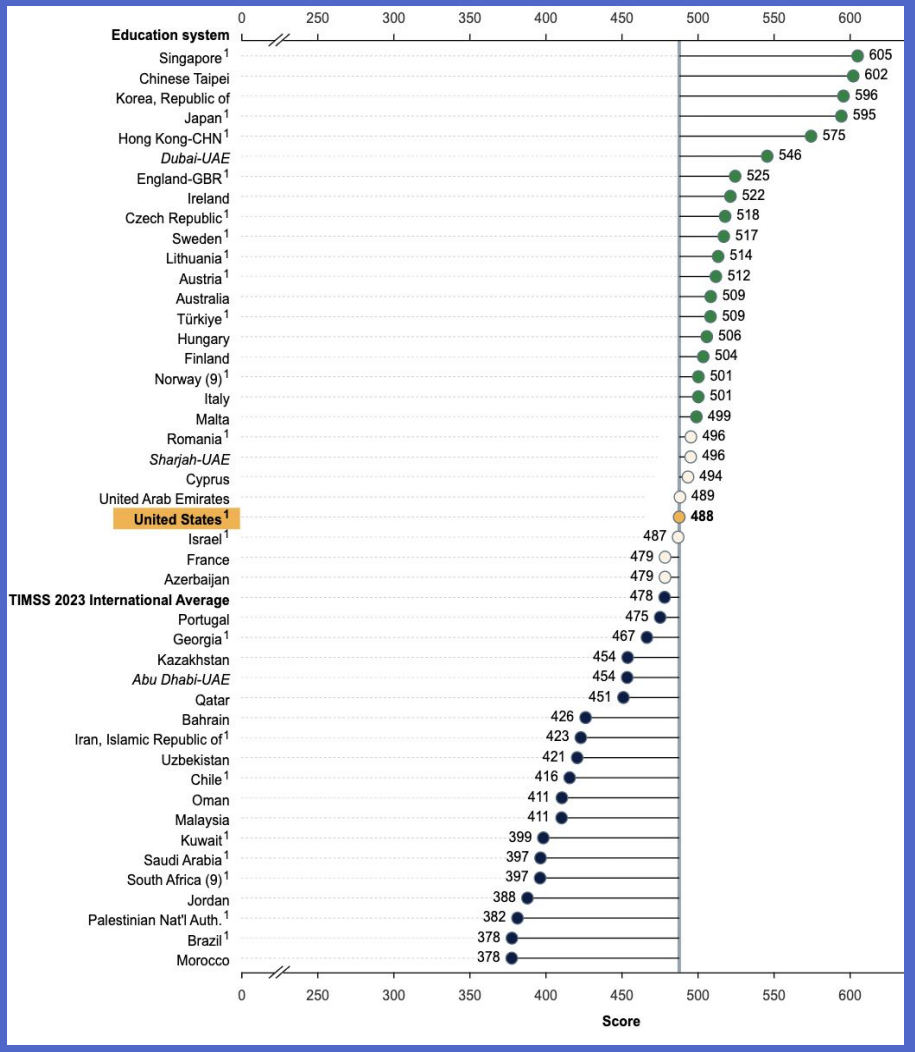
- What kind of lesson would a thoughtful well-prepared committed teacher create using strong well-aligned curriculum materials?

Which would result in a stronger lesson plan that contributes to student learning?

BTW, how did U.S. students perform on international mathematics assessments in 2023?





What Do We know About Mathematics Lessons That Successfully Support Student Learning?

- Lessons that engage all students in mathematics content standards

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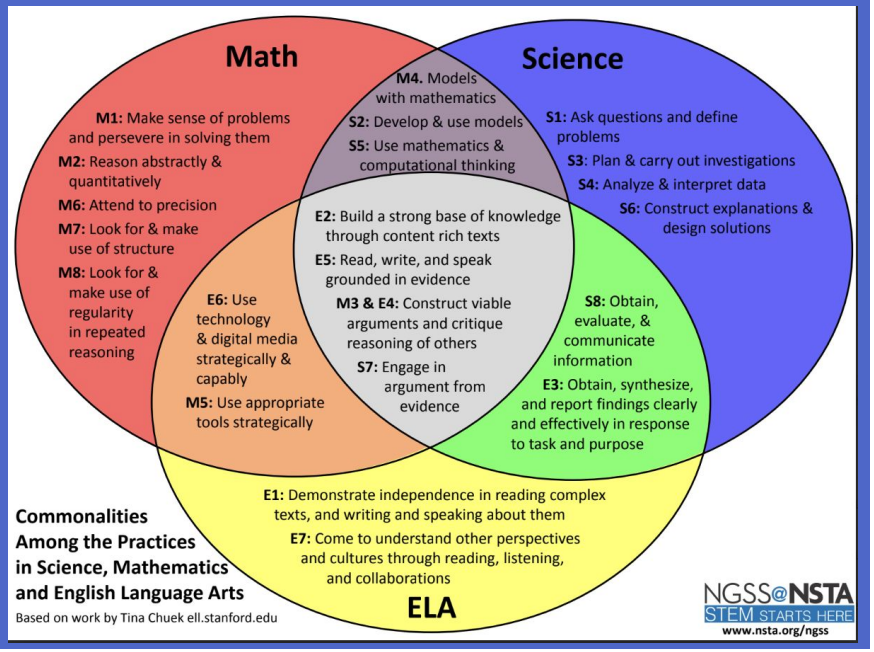
- Lessons that engage all students in mathematics practice standards

The Number System **6.NS**

A. Apply and extend previous understandings of multiplication and division to divide fractions by fractions.

1. 6.NS.A.1

Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem. *For example, create a story context for (2/3) ÷ (3/4) and use a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that (2/3) ÷ (3/4) = 8/9 because 3/4 of 8/9 is 2/3. (In general, (a/b) ÷ (c/d) = ad/bc.) How much chocolate will each person get if 3 people share 1/2 lb of chocolate equally? How many 3/4-cup servings are in 2/3 of a cup of yogurt? How wide is a rectangular strip of land with length 3/4 mi and area 1/2 square mi?*



- **Lessons that include the Mathematics Teaching Practices**

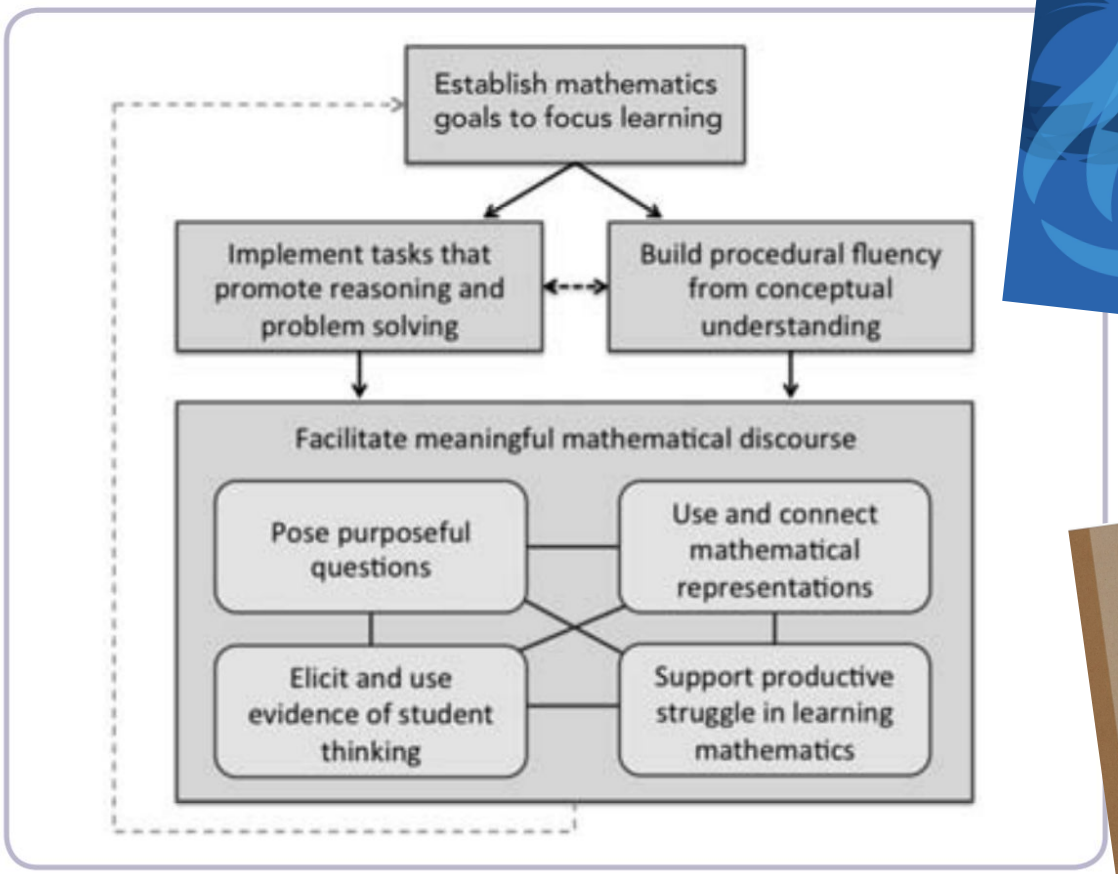


Fig. 10.1. A framework for mathematics teaching that highlights the relationships between and among the eight effective teaching practices

• Build Procedural Fluency From Conceptual Understanding

Build procedural fluency from conceptual understanding Teacher and student actions	
What are *teachers* doing?	**What are *students* doing?**
Providing students with opportunities to use their own reasoning strategies and methods for solving problems. Asking students to discuss and explain why the procedures that they are using work to solve particular problems. Connecting student-generated strategies and methods to more efficient procedures as appropriate.	Making sure that they understand and can explain the mathematical basis for the procedures that they are using. Demonstrating flexible use of strategies and methods while reflecting on which procedures seem to work best for specific types of problems. Determining whether specific approaches generalize to a broad class of problems.

Principles to Actions

Build procedural fluency from conceptual understanding Teacher and student actions, *continued*	
What are *teachers* doing?	**What are *students* doing?**
Using visual models to support students' understanding of general methods. Providing students with opportunities for distributed practice of procedures.	Striving to use procedures appropriately and efficiently.

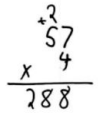
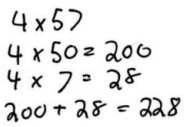
David's solution	Anna's solution
	
I multiplied 7 and 4 and got 28. I put down the 8 and carried the 2. Then I added the 2 and the 5 and got 7 and multiplied it by 4 and got 28. I put down the 28 and got 288.	I did it in parts. First I multiplied 4 x 50 and got 200. Then I multiplied 4 and 7 and got 28. Then I just added those two parts together to get the answer.

Fig. 17. David's and Anna's solutions to a multiplication problem. Adapted from Russell (2000).

Number Talks

Creating Mathematics Lesson Plans

- What kind of lesson would AI create?

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- What kind of lesson would a thoughtful well-prepared committed teacher create using strong well-aligned curriculum materials?

Which would result in a stronger lesson plan that contributes to student learning?

Let's Examine Mathematics Lesson Plans: AI

Lesson Plan: Dividing by a Fraction

Grade Level: 5–7
Duration: 45–60 minutes
Objective:
Students will understand and apply the concept of dividing by a fraction using visual models and the "Keep-Change-Flip" algorithm.

Standards Addressed

CCSS.MATH.CONTENT.5.NF.B.7
Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions.

Materials Needed:

- Whiteboard and markers
- Fraction strips or area models (optional: printed or virtual)
- Student notebooks
- Colored pencils
- Word problem handouts
- Anchor chart (optional)

Lesson Steps:

1. Warm-Up (5–10 minutes)

Objective: Activate prior knowledge of fractions and division.

- Ask: *"What does it mean to divide?"*
- Quick review: dividing whole numbers, dividing a whole number by a unit fraction (e.g., 4 ÷ ½).
- Pose a question: *"If you have 4 pizzas and you give each person ½ of a pizza, how many people can you serve?"*

2. Explore with Visual Models (10–15 minutes)

Objective: Understand the meaning of dividing by a fraction using visual representation.

- Use fraction strips or draw a rectangle on the board representing 1 whole.
- Example: *"Let's divide 1 whole into ⅓-size parts. How many parts do we get?"* → Show that 1 ÷ ⅓ = 3
- Let students try a few:
  - 2 ÷ ½
  - 3 ÷ ⅓
  - 4 ÷ ¼

3. Introduce the Algorithm (10 minutes)

Objective: Teach the "Keep-Change-Flip" method (also known as "Invert and Multiply").

- Explain:
  - Keep the first number.
  - Change the division sign to multiplication.
  - Flip the second fraction (find the reciprocal).
- Example:
  - 3 ÷ ½ = 3 × 2/1 = 6
- Model several examples together.

4. Guided Practice (10 minutes)

Objective: Practice using the algorithm and confirm with visuals.

- Students work in pairs or small groups to solve:
  - 2 ÷ ⅓
  - 5 ÷ ¼
  - ⅔ ÷ ½
  - 1½ ÷ ¾

Encourage them to draw a visual for at least one problem.

5. Independent Practice (10–15 minutes)

- Worksheet with mixed problems:
  - Solve using Keep-Change-Flip
  - Identify real-world context problems
  - Include a challenge: e.g., "Write your own word problem for 3 ÷ ½."

6. Exit Ticket (5 minutes)

Objective: Assess individual understanding quickly.

- Example problems:
  - 4 ÷ ⅓ = ?
  - Draw a picture to show 2 ÷ ½
  - Word problem: *"You have 3 cups of juice. Each serving is ¼ cup. How many servings?"*

Let's Examine Mathematics Lesson Plans: Teacher

Imagine you have a new puppy!!!

You have 7 cups of dog food.

You use two-thirds of a cup of food at each meal.

What do you notice?

What do you wonder?

What do you *NOTICE?*

- They're feeding the dog
- They have 7 cups of dog food
- They use 2/3 of a cup at each meal
- The puppy is carrying his own bowl
- The puppy is wearing a bandana

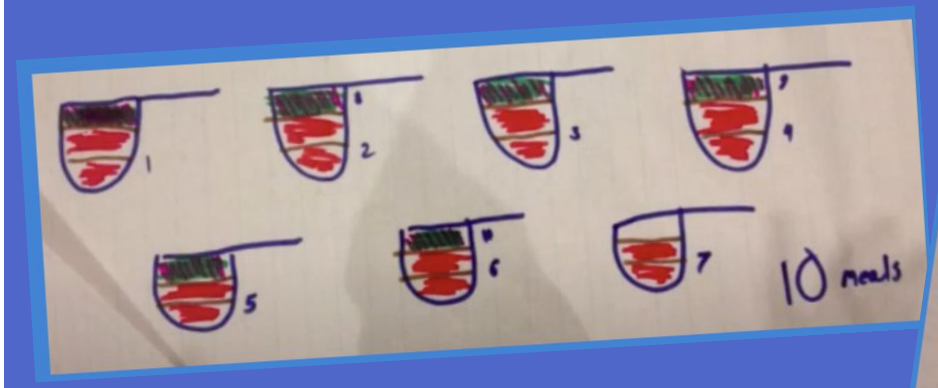
What do you *WONDER?*

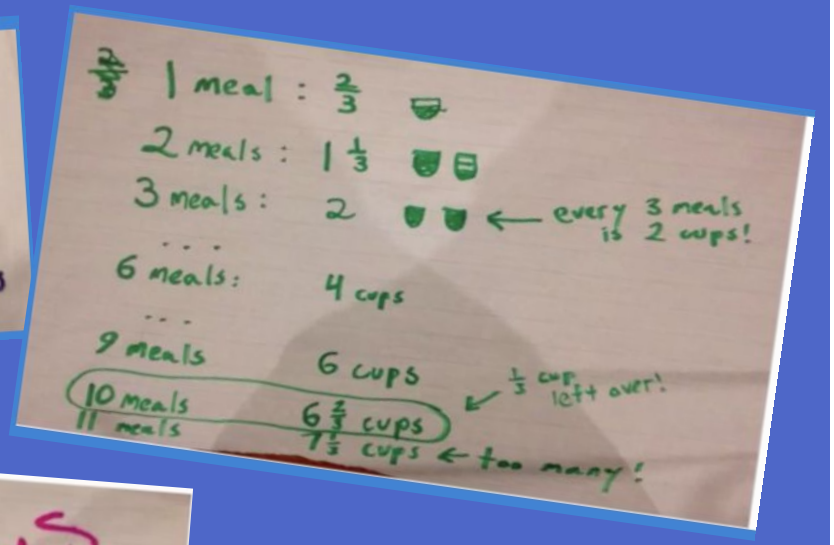
- How many meals does the dog eat each day?
- How long will the 7 cups of food last?
- Do they always use the same amount of food every time?
- Why is the puppy carrying the bowl?
- Why do they use 2/3 of a cup of food at each meal?

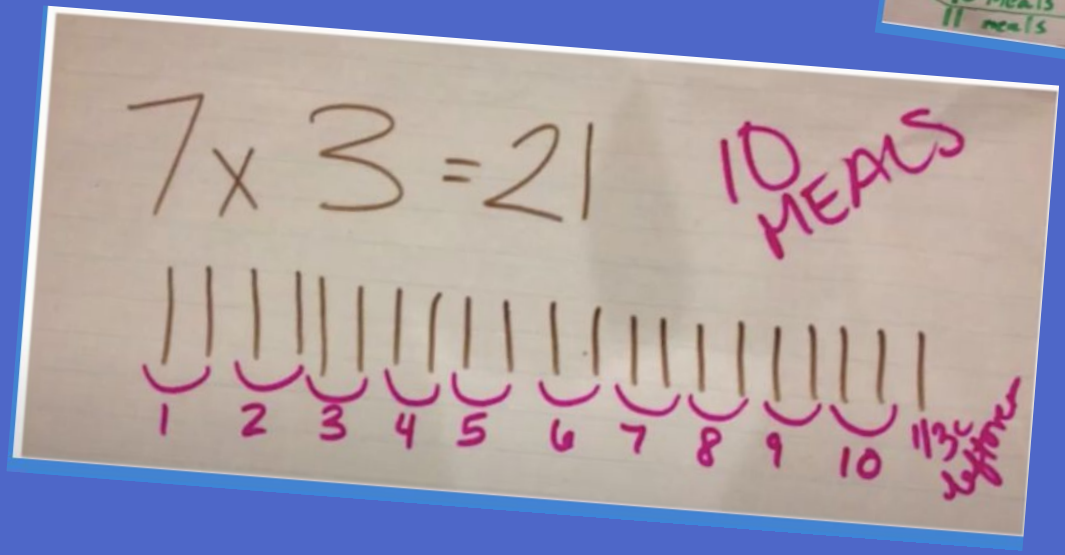
About how many meals will the dog food last?

- Definitely more than 7 meals
- Maybe about 10 meals
- Seven and two-thirds
- Definitely less than 14 meals
- Definitely less than 20 meals
- More than 5 meals
- Maybe about 15 meals
- Definitely less than 21 meals

Students get into small groups to work together to find out how long the dog food lasts.



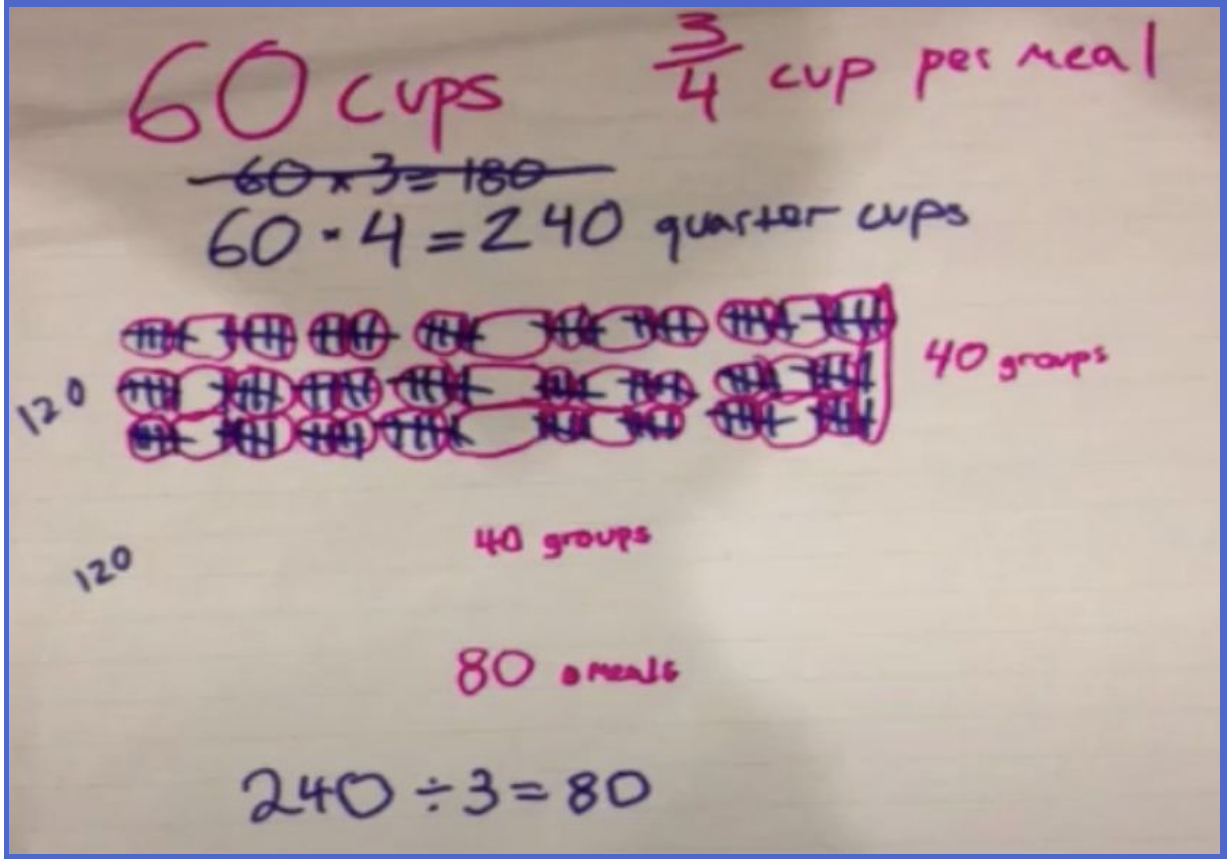




While they work, the teacher circulates, asks the kinds of questions that help surface their thinking, and thinks about in what order groups will present their work to the whole class.

Students try out their or someone else's strategy on a more complicated but similar situation . . .

What if you had 60 cups of dog food and you used ¾ cup of dog food for each meal?



So why do we multiply by 4? Why do we divide by 3? Discuss in your small groups? Would this always work?

$$(60 * 4) \div 3 = 80$$

$$\frac{60}{1} \div \frac{3}{4} = \frac{60}{1} * \frac{4}{3} = \frac{80}{1}$$

How do these mathematics lessons compare?

AI Plan: Strengths?

Teacher Plan: Strengths?

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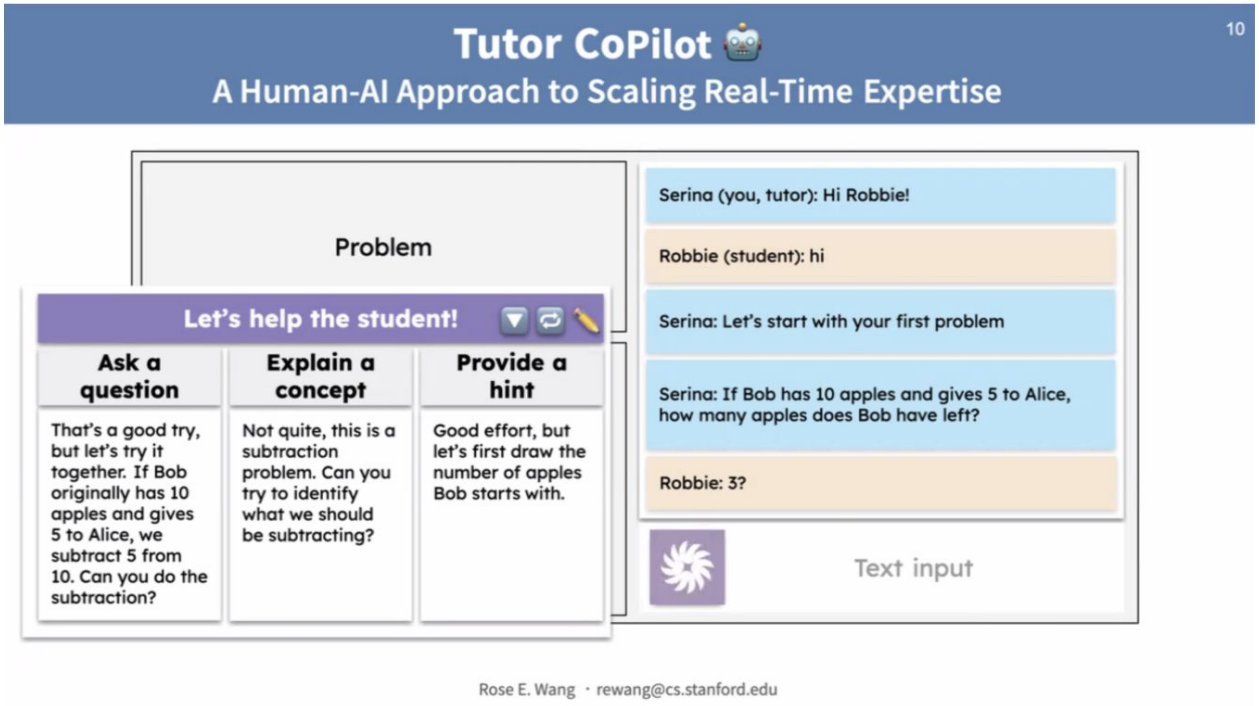
AI Plan: Limitations?

Teacher Plan: Limitations?

What About Supporting Individual Students?

AI Example from Tutor CoPilot



What About Supporting Individual Students?

Teacher Example: If I have 10 apples and I give 5 of them to you, how many do I have left?

Teacher: Let's think about this problem together. How many do you think I have left?

Student: 3

Teacher: Tell me why you think 3.

Student: I just guessed.

Teacher: How could we find out?

[Student draws 10 apples and crosses out 5] 5 apples left!

Teacher: What if I had 12 apples and I gave you 3?

Student: Um, that would be 9!

Teacher: How did you figure that out?

Student: Well, I knew if you had 12 and gave me 2, you would have 10. But you gave me 3, so that would mean you only had 9!

Supporting Individual Mathematics Learners

- What kind of support does AI provide?

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- What kind of support does a thoughtful well-prepared committed teacher provide?

Which would result in a more robust understanding of important mathematical concepts and procedures?

In what ways *might* AI provide meaningful support?

Creating Mathematics Lesson Plans

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Giving Feedback on Student Work

3 min trailer from Counted Out:
https://www.youtube.com/watch?v=M5a2la9WTtY

Thanks for all your thoughts!

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