Student Work as a Context for Student Learning

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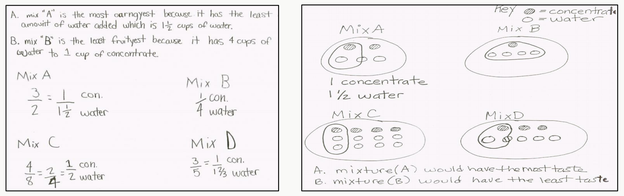
Background

- There is extensive research on the role of student work in professional learning situations for developing teachers' mathematical and pedagogical knowledge.
- Examining and critiquing the work of others is an important mathematical practice that promotes student learning. Little attention has focused on the role of student work in developing student knowledge.

Conceptual Framework

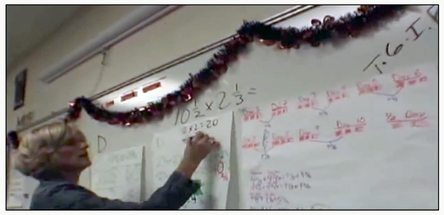
Student Generated

Student work produced by students in the class



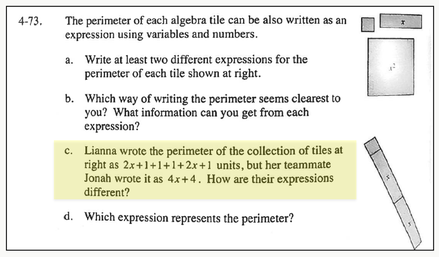
Teacher Generated

Student work purposefully imposed on the class by the teacher



Curriculum Generated

Student work embedded in curriculum materials



4-73. The perimeter of each algebra tile can be also written as an expression using variables and numbers.

a. Write at least two different expressions for the perimeter of each tile shown at right.

b. Which way of writing the perimeter seems clearest to you? What information can you get from each expression?

c. Lianna wrote the perimeter of the collection of tiles at right as $2x+1+1+2x+1$ units, but her teammate Jonah wrote it as $4x+4$. How are their expressions different?

d. Which expression represents the perimeter?

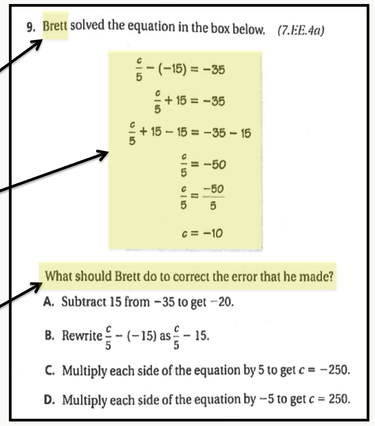
Research Question

What is the *nature* of the opportunities for students to engage in curriculum-embedded student work?

By nature, we focus on the location of the instance of student work (exposition or homework), frequency, format (written work or student talk/thinking), statement type (evaluating a conjecture, error analysis, determining the best strategy), and whether the work is primarily procedurally focused or conceptually focused.

Student Work Criteria

1. The instance mentions a person (besides the reader)
2. The instance mentions how that person thought about the problem or task
3. For each instance, the expected student activity is to analyze, critique, or reflect on the mathematical thinking of another.



9. Brett solved the equation in the box below. *(7.EE.4a)*

$$\frac{c}{5} - (-15) = -35$$
$$\frac{c}{5} + 15 = -35$$
$$\frac{c}{5} + 15 - 15 = -35 - 15$$
$$\frac{c}{5} = -50$$
$$\frac{c}{5} = \frac{-50}{5}$$
$$c = -10$$

What should Brett do to correct the error that he made?

A. Subtract 15 from −35 to get −20.

B. Rewrite $\frac{c}{5} - (-15)$ as $\frac{c}{5} - 15$.

C. Multiply each side of the equation by 5 to get $c = -250$.

D. Multiply each side of the equation by −5 to get $c = 250$.

Methods

- Examined three set of written curriculum materials, Big Ideas MATH (2014), College Preparatory Mathematics (2013), and Connected Mathematics3 (2014), units focused on similarity.
- Developed student work criteria to identify instances of student work in student materials
- Coding framework developed to address student work research questions
- Materials coded using a consensus / agreement model
- Unit of analysis is the individual problem (e.g. #14 in homework)

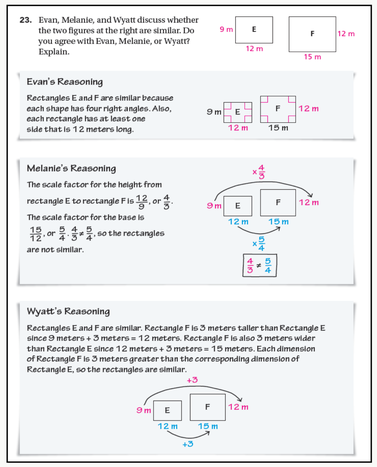
Coding Framework

LOCATION
Is the task located in…
- **Exposition/Narrative**
- **Homework**

This problem occurs in the homework section of the unit *Stretching and Shrinking*. All problems are coded as exposition or homework.

FORMAT
Does the task include…
- **Written work or verbal explanation**
- **Visual representations (e.g. diagrams, tables)**

This problem includes an explanation and a visual representation (diagram). All problems could include any combination of these two subcategories.



23. Evan, Melanie, and Wyatt discuss whether the two figures at the right are similar. Do you agree with Evan, Melanie, or Wyatt? Explain.

Evan's Reasoning

Rectangles E and F are similar because each shape has four right angles. Also, each rectangle has at least one side that is 12 meters long.

Melanie's Reasoning

The scale factor for the height from rectangle E to rectangle F is $\frac{12}{9}$, or $\frac{4}{3}$.

The scale factor for the base is $\frac{15}{12}$, or $\frac{5}{4} \cdot \frac{4}{3} \neq \frac{5}{4}$, so the rectangles are not similar.

Wyatt's Reasoning

Rectangles E and F are similar. Rectangle F is 3 meters taller than Rectangle E since 9 meters + 3 meters = 12 meters. Rectangle F is also 3 meters wider than Rectangle E since 12 meters + 3 meters = 15 meters. Each dimension of Rectangle F is 3 meters greater than the corresponding dimension of Rectangle E, so the rectangles are similar.

MATHEMATICAL TASK DESCRIPTION
Does the task include…
- **Evaluating a conjecture or reasoning**
- **Finding errors**
- **Comparing different strategies**
- **Determining what the student did or thought to solve the problem**

This problem includes evaluating reasoning and comparing different strategies. All problems could include any combination of these three subcategories. This list is not completely exhaustive.

EMPHASIS ON MATH UNDERSTANDING
Does the task primarily emphasize…
- **Methods, procedures, and approaches**
- **Insights, connections, and relationships**

This problem primarily focuses on the **relationship** between similar figures. Problems typically are coded as one of the two categories, but in some cases can be coded as both.

Preliminary Results

Frequency of CGSW

Narrative/Exposition

- College Preparatory Mathematics:100% (9/9)
- Big Ideas MATH: 0% (0/5)
- Connected Mathematics3:76% (13/17)

Homework

- College Preparatory Mathematics: 3% (2/65)
- Big Ideas MATH: 2% (3/168)
- Connected Mathematics3: 7% (11/164)

Location

- *College Preparatory Mathematics* almost all in class.
- Big Ideas MATH all in homework
- Connected Mathematics3 mixed in both homework and in class

Determine what the student did to solve the problem

- Predominantly in College Preparatory Math
- Two instances in Connected Mathematic3

Emphasis on Math Understanding

- About 1/3 categorized as focusing on methods, procedures, and approaches
- About 2/3 categorized as focusing on insights, connections, and relationships
- Few items were collectively double coded.

Comparing Different Strategies

- Few instances in College Preparatory Mathematics and Big Ideas
- More frequent in Connected Mathematics3

Limitations

- Small sample size – only looked at units on similarity
- Only looked at one unit from three sets of Grade 7 materials
- Lack of research on Curriculum-Generated Student Work to the analytic framework

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Future Work

- Further refinement of analytic framework
- Studying the role and impact of CGSW in classrooms, how teachers use it, any effects on student learning
- Are there other types of CGSW beyond similarity?
- Does framework and criteria extend to other types of student work (e.g. teacher- and student-generated)?

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