Can We Talk?
Promoting discourse in the elementary classroom through problem solving

Fay Zenigami: zenigami@hawaii.edu

Seanyelle Yagi: slyagi@hawaii.edu

NCTM Annual Meeting & Exposition
San Diego, CA
April 4, 2019

University of Hawai'i at Mānoa
Curriculum Research & Development Group

Mathematical tasks and discourse

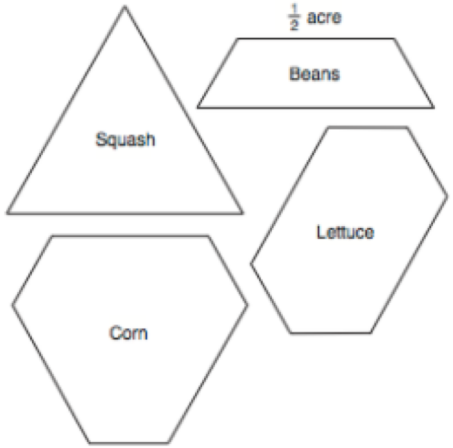
- **Mathematical tasks** and **discourse** were found to be "robust features" (p. 420) of the classroom that need to be considered in looking at relationships between teaching and learning.
- As instructional features, **mathematical tasks** and **discourse** influence learning by affecting the kind of cognitive processes in which students engage.

(Hiebert & Wearne, 1993)

Let’s do some math!

Kylie was a vegetable farmer who planted each type of vegetable in a separate plot. She had a ½ acre planted with beans. How many acres were planted with

a. Squash?
b. Corn?
c. lettuce?



What was your thinking?

- What strategies did you use to solve the problem?
- How did you decide on what order to work on the problem? Did the order matter?
- How did you determine what your unit of measure would be?

What do you notice?

- What concepts are addressed through this task?
- What new mathematical ideas might students form?
- What processes or strategies might it promote?
- How might students in mixed ability groups fare with this task?

(Clues for 9-digit problem post-its)

Directions for writing numbers on post-its:

- The smallest square number less than 10 on a post-it. (1)
- The largest square number less than 10 on another post-it. (9)
- What do you notice about 1 and 9? (solicit all responses first)
  - What are other odd numbers less than 10? (3, 5, 7)
  - What are other square numbers less than 10? (4)
- What is the difference of the largest (9) and smallest (1) square numbers less than 10? (8)
- The square root of 4. (2)
- The product of the first two prime numbers. (6 = 2 • 3)

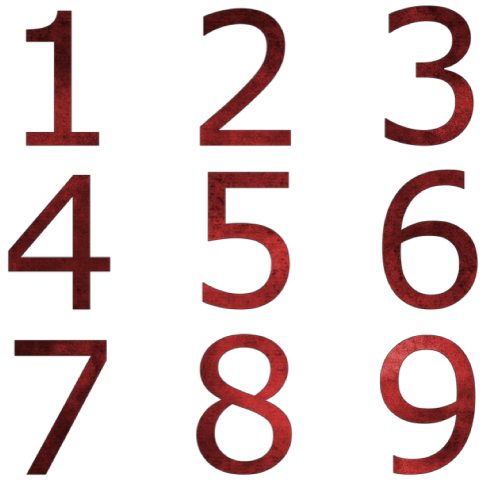
Now you're ready for the 9-digit problem.

University of Hawai'i at Mānoa
Curriculum Research & Development Group

The nine-digit problem

Use each of the digits 1 through 9 only once. Find two 3-digit numbers whose sum uses the remaining three digits.

How many solutions can you find?



University of Hawai'i at Mānoa
Curriculum Research & Development Group

What do you notice?

- How is fluency addressed through this task?
- What processes or strategies might it promote?
- What new mathematical ideas might students form?
- How might students in mixed ability groups fare with this task?

What is discourse?

Mathematical discourse includes the purposeful exchange of ideas through classroom discussion, as well as through other forms of verbal, visual, and written communication.

Mathematical Teaching Practices, NCTM, 2014, p. 29

Challenging yet accessible tasks lead students to:

- Engage in the mathematics via multiple entry points
- Employ different strategies as they work on the problem
- Draw on what they know as they work through the task
- Look for and use a solution pathway that is not previously known or apparent
- Explore and understand the nature of mathematical relationships, processes, and concepts

Problem solving processes

- Reversibility
  - The ability to reverse the direction of thinking.
- Flexibility
  - The ability to solve a problem in more than one way.
  - The ability to solve a problem using another problem's solution.
- Generalizability
  - The ability to recognize the big idea from specific cases.
  - The ability to fit a specific case to a known concept or generalization.

Hot fudge homework

Jackson was eating a gooey hot fudge sundae last night while doing his homework. He dripped some hot fudge on his homework paper. What could have been under the blobs of hot fudge? Find four possible answers. Justify your answers.

University of Hawai'i at Mānoa
Curriculum Research & Development Group

Thinking about your thinking

- Share solutions in your groups.
- Which of the 3 processes (reversibility, flexibility, generalization) are promoted by this problem?
- What question(s) might you pose to your students to engage them in the RFG processes?

Class discourse leads students to

- Explain beyond procedural steps and checking answers
- Pose questions, make conjectures, justify, and extend the problem situation
- Problem solve productively and make the processes visible to all
- Participate actively
- Listen critically

Classroom Discourse

- Teacher role: How the teacher participates in and organizes students to engage in mathematical learning
- Questioning: Who serves as the questioner in the classroom, and what kinds of questions are posed
- Explaining mathematical thinking: Who provides explanations and what kinds of explanations are offered
- Mathematical representations: How language, visual, and concrete supports are used
- Role of the students: The extent to which students' ideas are seen as central to the discourse

Hufferd-Ackles, Fuson, & Sherin, 2014

Planning for discourse

1. Solve the task yourself in different ways.
   - What misconceptions might students have? What errors might students make?
2. How will you introduce students to the activity so as not to reduce the demands of the task?
3. What specific questions will you ask so that students will
   - Make sense of the mathematical ideas that you want them to learn?
   - Make connections between the different strategies that are presented?

University of Hawai'i at Mānoa
Curriculum Research & Development Group

Taken from the Thinking Through a Lesson Protocol:
Learning Research and Development Center, 2006
University of Pittsburgh

Mahalo!
(Thank you)

zenigami@hawaii.edu

slyagi@hawaii.edu