The Language Arts of Teaching and Learning Mathematics for Equity

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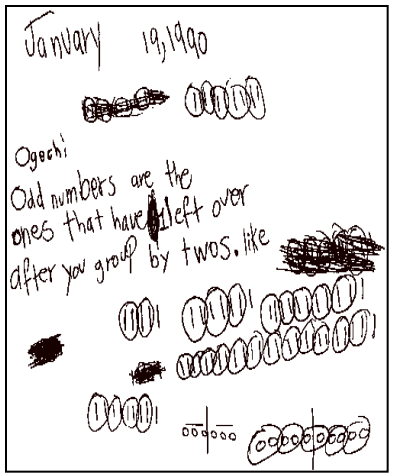
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Overview

- The problem of mathematical proficiency and its links to the whole of elementary teachers' practice
- Language arts as a tool for developing proficiency
- Attending to equity and proficiency by focusing on specific aspects of language

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What are Central Problems of Mathematics Education?

- Ineffective curriculum: Too many students not learning mathematics well enough for
  - Continued mathematics study
  - Use in everyday settings
  - Workplace
- Pervasive inequality: Unequal distribution of mathematical success by race, social class
- Lack of capacity for improvement
  - Public understanding, support, investment
  - Teacher development and support
  - Teacher educator development and resources

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Attending to Equity in Developing Proficiency

- Broadening what it means to be successful in mathematics and the space to do so
- Assigning competence: whose mathematical work is acknowledged, made public

References: Cohen & Lotan (2000), Boaler (2004)

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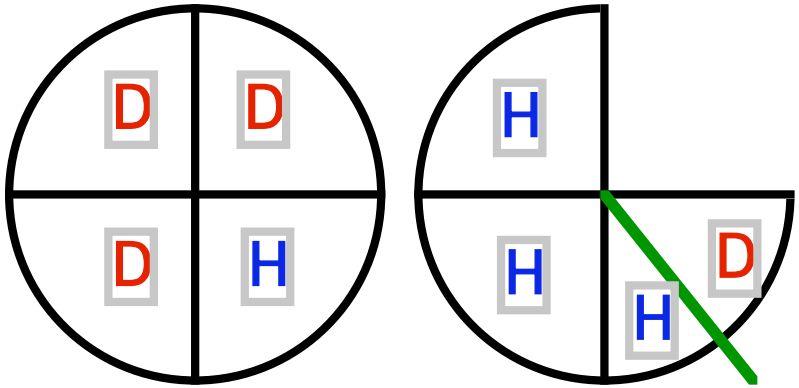
A Closer Look

$$1\frac{3}{4} \div \frac{1}{2}$$

1. Calculate the answer.
2. Write a story problem, or describe a situation, that corresponds to the calculation. Make sure the answer to your story is the same as the answer to your calculation.

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I have two pizzas. My friend eats one quarter of one of the pizzas. I have one and three quarters pizzas left. Then I split it evenly between two of my other friends. Each person gets three and a half pieces of pizza.



1. Explain why this story does not correspond to the problem.
2. Why do you think this error is so common?

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Possible Explanations for this Common Difficulty

- Word problems are difficult
- Division of fractions has no real use
- Focus on procedures without attention to meaning and explanation
- Confounding of everyday and mathematical meanings of “half”
- Challenges of representation and language

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Language Arts of Mathematics: A First Visit to a Classroom

- Context: Grade 3 students, multicultural and multilingual class, on third day of school, mathematics lesson
- Working on a "word problem" – "reading" in mathematics class
- Use this to develop a frame for language use in math class that addresses mathematical proficiency with attention to equity

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Mathematics Problem

I have pennies, nickels, and dimes in my pocket. If I pull out three coins, how much money could I have?

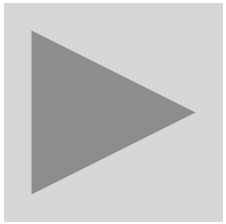
What might be some of the language challenges for third graders in a multi-lingual class?

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Viewing Focus

What do you notice about language in this segment:

- reading
- writing
- listening
- speaking



and about the students' and teacher's roles with respect to language?

(Keep in mind that this is the third day of school.)

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What Is Involved in Becoming Proficient in Mathematics?

Learning that mathematics offers tools for getting answers and solving word problems,

but that it is also more than simply getting answers and solving word problems.

Three specific language arts:

- Listening mathematically
- "Drafting" and revising mathematical ideas and solutions
- Explaining mathematical ideas and solutions

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Attending to Equity in Developing Mathematical Proficiency

- Attending to the relationships between everyday and mathematical language
- Care with “contexts” (everyday and mathematical)
- Explaining as central, and making explicit what it means to explain

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A Second Visit to the Classroom

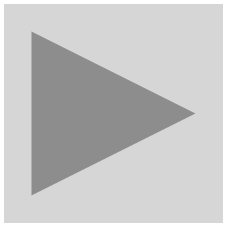
- Same class, later in the school year
- Working on fractions
- Look to see examples (or not) of the three language arts (listening, drafting, explaining)
- Look for practices attentive (or not) to equity (everyday and mathematical language, care with contexts, explicitness about explanation)

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Mathematics Problem

Which is more: 4/4 or 4/8?

What might be some of the language challenges for third graders in a multi-lingual class?



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Discussion of Classroom Episode

Three specific language arts:

- Listening mathematically
- "Drafting" and revising mathematical ideas and solutions
- Explaining mathematical ideas and solutions

Three specific practices attentive to equity:

- Attending to the relationships between everyday and mathematical language
- Care with contexts
- Explaining as central, and making explicit what it means to explain

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Listening Mathematically

- Attending to others' ideas
- Asking for clarification
- Referring to others' ideas in agreeing or making new points

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"Drafting" and Revising Mathematical Ideas

- Role of error in developing mathematical work
- Experimental drawing and speaking
- Using representations
- Making "conjectures"
- Revising ideas
- Writing in pen in notebooks

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Explaining Mathematical Ideas

- Convincing yourself, convincing others
- Use of language (definitions)
- Use of drawings (and other representations) and making correspondences to ideas
- Making clear what things mean and why they make sense; showing why something is correct or “true”

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Three Specific Foci for Attending to Equity

- Attending to the relationship between everyday and mathematical language
  - When everyday language assists, when it interferes
  - Concern for definitions
- Care with "contexts"
  - Critical eye to when contexts create barriers or confusion and when they use children's experience to create connections and competence
- Explaining as central, and making explicit what it means to explain
  - Requesting justification
  - Creating culture of explanation and justification to classmates

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Conclusions

- Attending to specific aspects of language arts offers elementary teachers a way to connect in new ways their work with students across the two subjects

- Attending to specific aspects of language arts offers opportunities to broaden:
  - What it means to be successful in mathematics
  - The tasks and discourse that can scaffold and support the equitable development of proficiency
  - How individuals' competence is noticed, acknowledged, and used for collective work

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