Opportunities for Student Explanations

TRU Math: Six Dimensions for Analysis

- **Mathematical Focus**: Is the mathematics discussed focused, coherent, and connected?
- **Cognitive Demand**: Do the student have the opportunity to engage in productive struggle?
- **Access**: Where has opportunities to engage in the classroom discourse? Is attention paid to each student’s contributions?
- **Agency, Accountability, and Authority**: How are students ideas taken up and attributed in the classroom?
- **Uses of Assessment**: How is student thinking elicited and built upon?
- **Development of Robust Understanding of Algebra (see right)**: Are students learning specific aspects of interpreting, representing, and explaining when creating contextual algebra problems?

### Methods and Design

#### Classroom Data

- Recorded 7-8 lessons from two 8th grade algebra classes in Michigan and California using field notes and video.

#### Student Data

- Students complete pre- and post-assessments consisting of tasks that provide opportunities for students to explain and justify reasoning.

#### TRU Math Explanation Rubrics

- **Teacher Instruction and Explanations**
  - Clarify the reason for each statement.
  - Make a connection between steps in a problem.
- **Teacher Explanations**
  - Explicit or implicit reference to the “why” of math.
- **Student Explanations in Whole Class Discussion**
  - Students generate initial explanations that refer to only a problem.
  - Students generate initial explanations using procedures and/or conceptual reasoning.

### Classroom Profiles of Explanations

#### Classroom A

- Students are able to... (details)

#### Classroom B

- Students are able to... (details)

### Classroom Examples

- **Approach for Student Explanations**
  - Provide clear and complete explanations.
  - Use precise mathematical language.
  - Show understanding of the problem.

- **Teacher Instruction and Explanations**
  - Clarify the reason for each statement.
  - Make a connection between steps in a problem.
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### Assessment Results and Examples

- Students in both classes made modest gains in their explanation scores: Class A from 11.5% to 14.6% and Class B from 17.1% to 23.6% of explanations correct. The number of attempted explanations also increased in both classes.

### Robust Student Understanding

- Five criteria are used to assess growth in students’ abilities to solve contextual problems in algebra and capture the quality of classroom interactions:
  1. **Interpreting Context**: Students are able to interpret a problem statement to make sense of the problem situation.
  2. **Identifying Relevant Quantities and Relationships**: Students are able to identify which quantities are relevant to the problem situations.
  3. **Representing Mathematical Relations**: Students are able to articulate the mathematical relationships between quantities.
  4. **Interpreting and Make Connections**: Students are able to interpret and make connections between representations.
  5. **Explaining and Justifying Reasoning**: Students are able to clearly and thoroughly explain and justify their reasoning.

### Preliminary Findings and Future Work

- To illustrate the work of ATC, we show how we can capture elements of classroom interactions related to explanations and justifications and build profiles of two algebra classrooms using teacher-referenced and student-referenced recordings.

- **TRU Math** is designed to capture variation in classroom interactions and instruction. Our goal is for the scheme to be sensitive enough to capture variation while reflecting the hypotheses we have regarding practices that lead to robust algebraic understanding.

- We plan to use the scheme to create profiles of large numbers of algebra 1 classrooms to provide empirical support for classroom interactions that support the development of robust algebraic understanding.