The Algebra Teaching Study: Classroom Practices that Lead to Robust Understanding

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Research Goals

1. Identify the instructional practices that result in students' robust mathematical understanding in Algebra I.
2. Develop an observation scheme that allows for large-scale evaluation of algebra instruction as it produces student learning.

Project Development Strands

- Analyzing videotapes of highly skilled teachers' practice
- Analyzing "word problems" in reform and traditional curricula, and standardized tests
- Analyzing existing observational schemes

Conceptual Framework

- What does Robust Mathematical Understanding of Algebra 1 look like?
- How is Robust Mathematical Understanding of Algebra 1 developed in the classroom?

- Developing codes and rubrics for a classroom observation scheme
- Developing sets of Algebraically Rich Tasks (ARTs)

Current Data Collection (Year 2 of 3)

- Piloting the ACTION Scheme through classroom observation, videotaping, and teacher interviews: 8 visits per teacher, for 10 teachers at 7 schools
- Collecting start-of-year and end-of-year student assessment data with ARTs in all classrooms (tasks were piloted in Year 1)
- Interviewing randomly selected students from each classroom on assessment tasks

Ongoing Questions

- What grain size is appropriate to capture algebraic understandings, in both our scheme and our assessment rubrics?
- How do we use our scheme in classrooms without making teachers feel too strongly evaluated and judged?

The ACTION Scheme

Algebra **C**lassroom **T**eaching **I**nstrument for **O**bserving **N**orms

Mode	Scheme Codes for Each Mode	
Task Introduction	*Teacher Behavior:* •Task Preparation: Mathematics •Task Preparation: Problem Context •Task Preparation: Classroom Dynamics	*Task:* •Opportunities for Alternative Solution Paths •Robustness of Task (as presented) •Using Multiple Algebraic Representations •Problem Context
Mathematical Discussion (Whole Class)	*Teacher Behavior:* •Richness of Mathematics •Teacher's Mathematical Integrity •**Soliciting Student Reasoning** •Assessing Whole Class Understanding •Pacing of Discussion •Opportunities for Deeper Mathematical Conversations •Addressing/Engaging Misconceptions	*Student Behavior:* •Participation •Risks •Student Explanations
Student Work Time (Small Group)	*Teacher Behavior:* •Monitoring Individual Student Progress •Scaffolding/Support •Distribution of Time/Availability •Time for Task(s)	*Student Behavior:* •Engagement/Participation •Productive Collaboration •Sense-making: Mathematics •Sense-making: Context
Student Work Time (Individual)	*Teacher Behavior:* •Monitoring Individual Student Progress •Scaffolding/Support •Distribution of Time/Availability •Time for Task(s)	*Student Behavior:* •Engagement/Participation •Asking for Help
Post-Lesson	*Overall:* • Classroom Management • Student Enactment of Lesson Goals •Quality of Goals for Students' Mathematical Understanding •Overall Assessment of Whole Class Understanding • Maintaining Cognitive Demand • Homework	

Sample Coding Rubric:

Mathematical Discussion (MD)				
		Level of Emphasis		
	Description	Low: 1	Average: 3	High: 5
Teacher Behavior				
3	**Soliciting Student Reasoning**	Teacher does not solicit student ideas, or only asks for answers, not reasoning or justification.	Teacher asks students to provide some reasoning and explanation about mathematical ideas, but student participation is mostly limited to student-teacher interactions.	Teacher presses students for reasoning and justification of ideas/ solutions, building the discussion using student ideas, and pressing students to question/ analyze each other's reasoning.

*Please ask to see our binder to view the entire ACTION scheme

Robust Mathematical Understanding

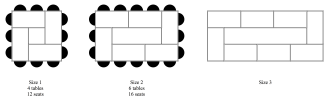
The extent to which students are able to:

1. Navigate the language in a problem statement in order to make sense of the problem situation.
2. Determine what mathematical knowledge is relevant for working on problem situations, and draw upon it as necessary.
3. Construct or choose useful/appropriate mathematical representations for problem situations, use those representations flexibly, and move between them as necessary.
4. Check the results of their mathematical operations with regard to plausibility, both in terms of the mathematical operations performed and with regard to the contexts from which the mathematics was derived.
5. Clearly and thoroughly explain and justify their reasoning.

Assessing Student Growth

Arranging Tables

A company supplies tables for business meetings. Each table is a rectangle and can seat one person on its short edge, and two people on its long edge, like the figures on the right.
The diagrams below show how these tables can be made into arrangements for different numbers of people. The different arrangements are numbered, like the figures below.
No one sits inside the arrangements of tables.



Size 1
4 tables
12 seats

Size 2
8 tables
16 seats

Size 3

Adapted from Mathematics Assessment Resource Service, http://www.noycefdn.org/resources.php, copyright 2003.

(2) How many people can sit around a Size 13 arrangement? Please explain.

(3) Write an equation for the number of people who can sit at a Size *S* arrangement. Explain how you know your equation will work.

(4) What size arrangement is needed for 75 people? Explain how you know your answer is right.

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(4) What size arrangement is needed for 75 people? Explain how you know your answer is right.

*Please ask to see our binder to find our additional tasks, including ones that draw on standardized test items.