SPECIFYING EQUITY-IN-PRACTICE

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Improving Mathematics Teaching and Learning at Some Scale

- Achieving a research-based vision of high-quality mathematics instruction at some scale requires most teachers to significantly reorganize their current practice
  - Therefore, requires *significant learning*

- Contexts in which teachers teach profoundly influence their practices (e.g., Cobb et al., 2003)
  - Also requires reorganization of the contexts in which teachers teach

Teacher Learning Demands Inherent In Accomplishing Ambitious Reform

- Develop specific forms of teaching that privilege eliciting and building upon student thinking
- Develop sophisticated vision of what counts as high-quality mathematics teaching (Munter, 2014)
- Develop more sophisticated forms of mathematical knowledge for teaching (e.g., Hill, 2010)

- What are key equity-specific learning demands entailed in improving mathematics teaching & learning?

Research Context

- 8-year study designed to investigate what it takes to support instructional improvement in middle-grades mathematics at the scale of a large, urban US district

- Phase 1 (2007-2011)
  - 4 districts attempting to achieve ambitious teaching

- Phase II (2011-2016)
  - 2 districts

For more information on MIST, see http://vanderbi.lt/mist

Specifying equity-in-practice

- Attempts to make the complex work of teaching towards equity **visible** and **learnable**

Specifying **equity**-in-practice

- One vantage point: Opportunities to learn within a given classroom
  - (In)equity is, **in part**, a function of the quality of instruction
- Working towards equity (in the classroom) means supporting all students to participate substantially in rigorous mathematical activity and to develop productive identities as mathematics learners

Specifying equity-**in-practice**

- What teachers and students do – how they interact with one another and with content, and how those interactions support learners to participate in, learn through, and identify with mathematical activity
- (In)equity is produced in interaction
- Histories of participation matter

Two examples

① Specifying actionable dimensions of teachers' views of their students' mathematical capabilities

② Specifying forms of teaching practice that have the potential to support more students' substantial participation in rigorous mathematical activity

Specifying equity-in-practice

Specifying actionable dimensions of teachers' views of their students' mathematical capabilities

Teachers' social constructions of students matter

- "Policy coherence as intended by reformers and policymakers ultimately is achieved or denied in the subjective responses of teachers – in teachers' social constructions of students" (McLaughlin & Talbert, 1993, p. 248).

Teachers’ views of students’ mathematical capabilities

- What it means to for a student to be capable in mathematics has shifted significantly
  - Make sense of mathematical ideas
  - Share authority with the teacher in assessing what is mathematically acceptable, valid, and on what grounds
- Teachers justify engaging historically marginalized groups of students in procedural activity in terms of their perceived capabilities (e.g., Diamond et al., 2004; Jackson, 2009; Sztajn, 2003)

Conceptualizing teachers' views of students' mathematical capabilities

- Common problem of practice: differential student success in mathematics (Horn, 2007)
- Frames function to organize people's experience of any event; enable people to answer the question "what's going on here?" (Goffman, 1974)

Conceptualizing teachers' views of students' mathematical capabilities

- Particular frames offer particular representations of the 'problem,' and therefore both highlights and hides certain aspects of the situations.
  - Frames delimit what counts as potential solutions.

- When teachers *framed* student difficulty as a matter of instruction, it appeared to position them to enact more responsive instruction (Horn, 2007; Bannister, 2015).

Conceptualizing teachers' views of students' mathematical capabilities

Diagnostic framing: explaining the source of student difficulty

Prognostic framing: description of the support provided to students perceived as facing difficulty

(Bannister, 2015; Coburn, 2006; Snow & Benford, 1988; 1992)

Diagnostic framing: explaining the source of student difficulty

Interviewer: When your students don't learn as expected, what do you find are typically the reasons?

PRODUCTIVE

- Teacher 1: "I normally look first at me to see or is there something in the lesson that I didn't emphasize well enough or…I may talk to the teacher they had last year and say 'When you went over this was this something that they struggled with?'"

Related to instructional opptys

UNPRODUCTIVE

- Teacher 2: "Well I'm, you know, you're not supposed to think necessarily but I, I believe there's some innate, you know, ability in differences, you know…. math comes easier to some kids than others."

Inherent traits of students

Prognostic framing: description of the support provided to students perceived as facing difficulty

Interviewer: How do you address that challenge? In what ways, if at all, do you find you need to adjust your instruction for different groups of students?

PRODUCTIVE

- Teacher 3: "I have been working on pre-teaching certain skills to some of the students so that they can work with others in the group on solving the task."

Aimed at maintaining the rigor of learning goals

UNPRODUCTIVE

- Teacher 4: "These kids are used to be[ing] spoon-fed and they'll sit there and say, 'I don't get it.'…[U]ntil you actually sit down and show them step [by] step how to do that problem, they don't get it. They don't know how to think."

Aimed at reducing the rigor of the learning goals

Investigating Teachers' Views of Students' Mathematical Capabilities

- How do middle-grades math teachers across two districts pursuing ambitious reform explain the source(s) of students' difficulties in mathematics?
- How do the teachers describe what they do to address the problem?
- How are teachers' diagnostic and prognostic frames related to one another?

(Jackson, Gibbons, & Dunlap, accepted)

Data Source

- Semi-structured interviews (~45 min each) with 122 teachers
- Two districts, Year 5 of the study

Insight into Teachers' Views of their Students' Mathematical Capabilities

Diagnostic framing: How does a teacher explain the source(s) of students' difficulties in mathematics?

- Fixed ability
  Deficit in child &/or community
- Wavering
- Related to instructional opportunity

Prognostic framing: How does a teacher describe the goals* associated with the supports provided to address the perceived difficulties?

- Aimed at reducing the rigor of the learning goals
- "Basics first, then problem solving"
- Aimed at rigorous learning goals

Key Findings: Diagnostic Framing

- The majority of teachers suggested that at least for some of their students, the source of their difficulty was due to a deficit in the child or her community.

28% 54% 18%

N = 100

Key Findings: Prognostic Framing

- 52 of the 74 for the teachers for whom we were able to code supports described reducing the cognitive demand of learning goals for students they perceived as facing difficulties.

Aimed at reducing the rigor of the learning goals	“Basics first, then problem solving”	Aimed at rigorous learning goals
52 (70%)	8 (11%)	14 (19%)

N = 74

Key Findings: Relationships between Diagnostic and Prognostic Framings

- If a teacher articulated an *unproductive* diagnostic framing, it was more likely that s/he would articulate an *unproductive* prognostic framing (as compared to a mixed or productive prognostic framing).

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Mr. Gomez: Unproductive explanation & unproductive supports

The … apathy from the kids, [they are] completely apathetic, they could care less what they're learning ….

Unfortunately our kids, because of their background, they like somebody to tell them what to do, they like to take notes. They like … teacher led work and then independent work. … District leaders] don't like proceduralization, but it works for… these kids.

Key Findings: Relationships between Diagnostic and Prognostic Framings

- Even if teachers were to view students' performance as dependent on instructional opportunities, it did not mean that teachers described responding to students' difficulties in ways that would enable them to develop conceptual understandings of mathematics.

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Ms. Jacobi: Productive explanation yet unproductive supports

- I can tell a lot of them … are not where they should be. And that means they [need] practice. Now after [giving them the] problem on the board, I'll go around, I can figure out if they haven't started – that means they are still behind. And then I just give them a hand for the first step. I do the first step with them and I'm asking them for the next step. Then I can go back over there, if they didn't hear me I have to repeat it.

Specifying Relations Between Teachers' Views of their Students' Mathematical Capabilities & Instruction

- 4 districts, across first 4 years of study

- In all 4 districts, teachers who described productive supports were more likely to maintain the rigor of a high-level task, even when controlling for MKT and instructional vision.

(Wilhelm, 2014)

Specifying Relations Between Teachers’ Views of their Students’ Mathematical Capabilities & Instruction

- How are teachers' diagnoses of sources of students’ difficulty related to the distribution and quality of students’ mathematical discourse?
- Does the relation between teachers' diagnoses of sources of students’ difficulty and classroom discourse vary depending on student-level characteristics of the classroom?

(Wilhelm, Munter, & Jackson, in press)

Key Findings

- Students were, on average, more likely to have opportunities to participate in discussions in which students provided reasoning for their solutions if their teacher articulated productive diagnoses of sources of their difficulty.
- This relation was strongest in classrooms composed (almost) entirely of students of color.

An Interpretation of These Findings: Specifying Equity-in-Practice

- Accomplishing ambitious reform requires
  - attending to how teachers explain the source(s) of students difficulties *coordinated with*
  - supporting teachers to learn how to support students in ways that maintain rigorous goals for their learning
- This may be of *extra consequence* for classrooms serving primarily historically underserved groups of students.

Specifying equity-in-practice

Identifying forms of practice that have the potential to support more students' substantial participation in rigorous mathematical activity

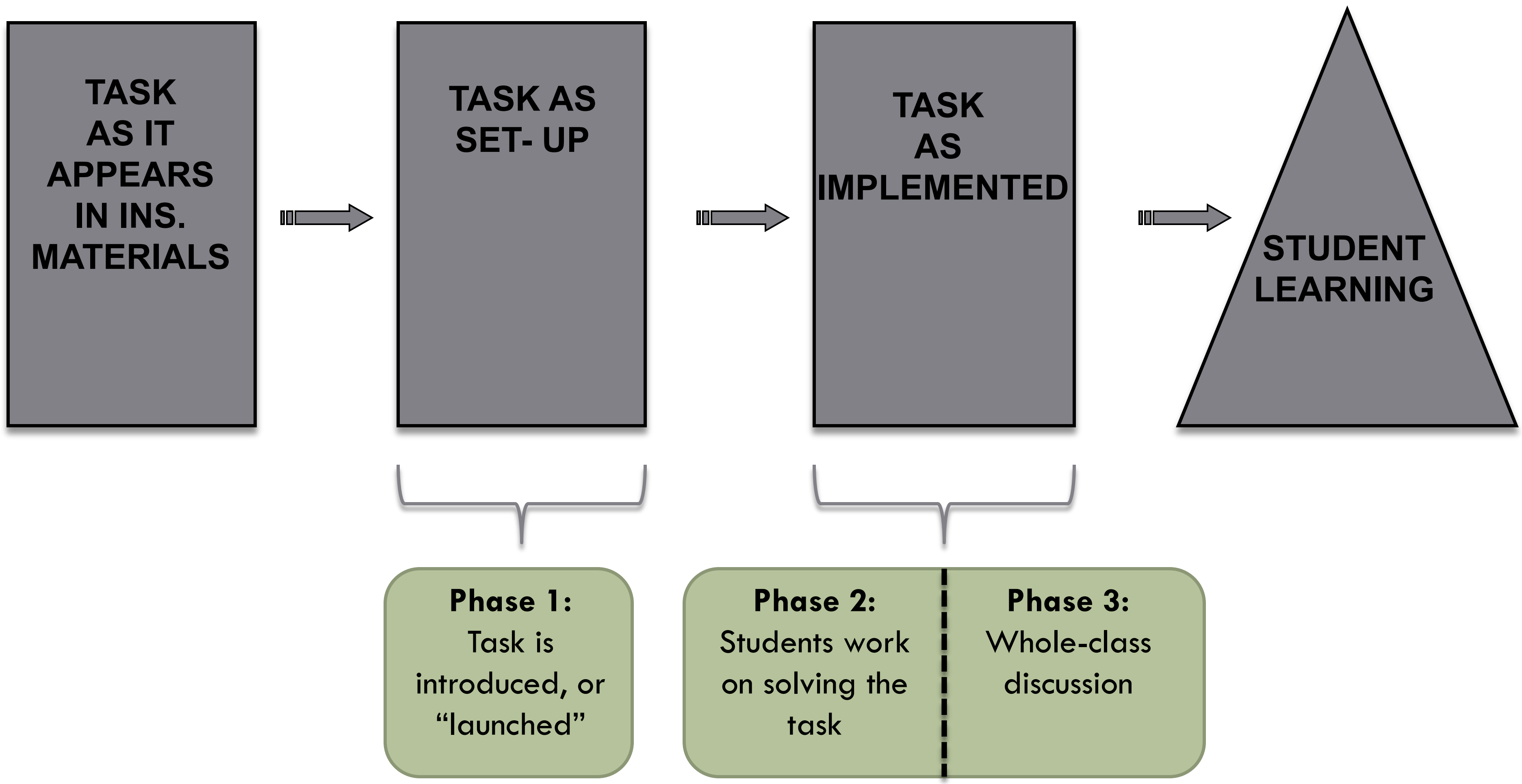
Illustrative Analysis

- What forms of practice are likely to support more students to participate in classroom activity aimed at rigorous goals for students' mathematics learning?

Data Source

- Video-recordings of classroom instruction
  - 2 consecutive days, in February, for each of 120 teachers, collected annually
  - Initially viewed a sample of 40 lessons collected in Years 1 and 2 of the project

Setting Up Complex Tasks

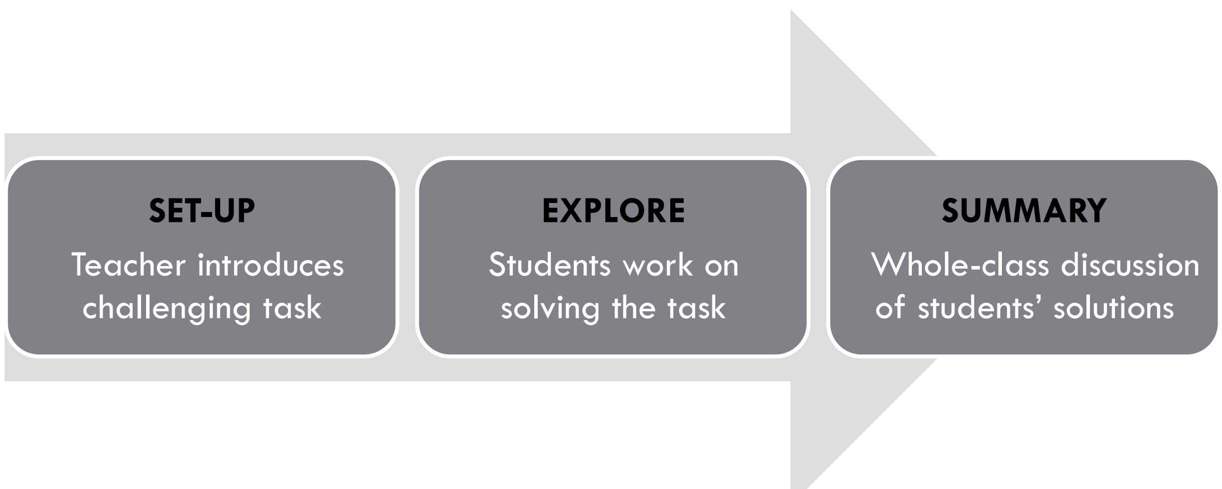


Mathematical Tasks Framework (Stein, Grover, & Henningsen, 1996)

Why the Set-Up Matters

- Impacts the work of students
  - Solving the task
  - Participating in the concluding whole-class discussion

- Impacts the work of teachers
  - Planning for the concluding whole-class discussion



Example of a Complex Task: Dollars for Dancing

Three students at a school are raising dollars for the school's Valentines Dance. All three decide to raise their money by having a dance marathon in the cafeteria the week before the real dance. They will collect pledges for the number of hours that they dance, and then they will give the money to the student council to get a good DJ for the Valentines Dance.

Rosalba's plan is to ask teachers to pledge $3 per hour that she dances.

Nathan's plan is to ask teachers to give $5 plus $1 for every hour he dances.

James's plan is to ask teachers to give $8 plus $0.50 for every hour he dances.

Adapted from *Connected Mathematics Project 2* (Lappan, Fey, Fitzgerald, Friel, & Phillips, 2009)

Part A. Create at least three different ways to show how to compare the amounts of money that the students can earn from their plans if they each get one teacher to pledge.

Part B. Explain how the hourly pledge amount is represented in each of your ways from Part A.

Part C. For each of your ways in Part A explain how the fixed amount in Nathan's plan and in James's plans is represented.

Part D. For each of the ways in Part A show how you could find the amount of money collected by each student if they could dance for 24 hours.

Part E. Who has the best plan? Justify your answer.

Adapted from *Connected Mathematics Project 2* (Lappan, Fey, Fitzgerald, Friel, & Phillips, 2009)

What is important to discuss in the setup so that all students can productively engage in solving the task?

Key Contextual Features

What is important to discuss in the setup so that all students can productively engage in solving the task?

Key Mathematical Relationships

Four Aspects of High-Quality Set-Ups

- Explicit attention to contextual features of scenario
- Explicit attention to key mathematical ideas and/or relationships as represented in the task statement
- Student participation is aimed at developing common or compatible language ("taken-as-shared understandings," Cobb et al.) to describe key aspects
- Cognitive demand is maintained

Investigating Relationships Between Setting Up Tasks and Concluding Whole Class Discussions

- What is the nature of the set-up phase of instruction?
  - To what extent do teachers attend to contextual features and/or key mathematical ideas of a task statement?
  - To what extent do teachers maintain the cognitive demand during the setup, especially when they attend to the contextual features and/or key mathematical ideas of the task?

- In what ways is the quality of the set-up related to the quality of the concluding whole-class discussion?

(Jackson, Garrison, Wilson, Gibbons, & Shahan, 2013)

Data Source

- Video-recordings of two consecutive days of classroom instruction
  - Year 3 (2010-2011)
  - Year 4 (2011-2012)
- Coded using the Expanded Instructional Quality Assessment (IQA; Boston, 2012)
- Resulted in 460 coded lessons for 165 teachers across 4 districts

In what ways is the quality of the set-up related to the quality of the concluding whole-class discussion?

Key Findings:

- Attending to **mathematical relationships** in taken-as-shared ways in the set-up was significantly, positively related to the quality of the concluding whole-class discussion
- Students were significantly more likely to make connections to one another's ideas and to provide conceptual evidence for their reasoning in the whole-class discussion when taken-as-shared understandings of the **contextual features** of the scenario were established in the setup

Moving Forward: Specifying Equity-in-Practice

- Design studies aimed at generating practice-specific theory regarding:
  - How to support teachers to develop more productive views of their students' mathematical capabilities
    - Forms of practice that enable students facing difficulty to substantially participate in more rigorous mathematical activity
- Close studies of teachers who are particularly accomplished in supporting students facing difficulty
- Attention to the broader context

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