Promoting Equity in PreK-8 Mathematics Teacher Preparation

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Overview of Presentation

- Overview of our Project
- Description of Instructional Modules
- Frameworks Guiding our Work

Sample Analyses
- Reorienting Thinking about Black Children
- Critical Analysis of Mathematics Classroom Practice

Now speaking, Erin Turner
Focus on Equity

- Prospective teachers need different (more equity focused) preparation in learning to teach mathematics

- “Acknowledge and deal with challenges” presented by the NCTM Equity Principle (Sowder, 2007)

- What does culturally responsive teaching look like in mathematics? (Grossman, Schoenfeld, & Lee, 2005)
TEACH MATH Project Goals

To design and study instructional modules for preK-8 mathematics methods courses that explicitly develop prospective teachers’ competencies related to children’s mathematical thinking and children’s community/cultural/linguistic funds of knowledge.

To support and study early career teachers’ practices related to connecting to children’s multiple mathematical knowledge bases in their mathematics teaching.
TEACH MATH Research Sites

- **Urban**
  - J. Aguirre: University of Washington Tacoma
  - M. Foote: Queens College, CUNY

- **Mixture of Urban, Suburban, and Rural**
  - C. Drake and T. Bartell: Michigan State University
  - A. Roth McDuffie: Washington State University Tri-Cities

- **Borderlands**
  - E. Turner: University of Arizona

*Note: Primary collaborators are named for each site, but many others contribute from these sites.*
Instructional Modules for PreK-8 Mathematics Methods Courses

Mathematics Learning Case Study
Critical Analysis of Mathematics Classroom Practice
Community Mathematics Exploration
Mathematics Learning Case Study

“Getting to Know You” Interview

Shadowing

Problem Solving Interviews
Critical Analysis of Mathematics Classroom Practice

Analysis of Mathematics Lesson (observed or taught)

1. WHAT ARE THE CENTRAL MATHEMATICS IDEAS IN THIS TASK? (I.E., IDENTIFY SPECIFIC CONCEPTS, PROCESSES, SKILLS, PROBLEM SOLVING STRATEGIES.)

2. LEARNING: WHAT SPECIFIC MATH UNDERSTANDINGS AND/OR CONCLUSIONS ARE INDICATED IN STUDENTS’ WORK, TALK, AND/OR BEHAVIOR?

RESOURCES & KNOWLEDGE BASES STUDENTS USE (E.G., MATHEMATICAL, CULTURAL, COMMUNITY, FAMILY, LINGUISTIC, STUDENTS’ INTERESTS, PEERS)

4. POWER & PARTICIPATION: WHO PARTICIPATES? DOES THE CLASSROOM CULTURE VALUE AND ENCOURAGE MOST STUDENTS TO SPEAK, ONLY A FEW, OR ONLY THE TEACHER?

Video Lens

Curriculum Spaces
Community Mathematics Exploration

Community Walk

Lesson Design
Theoretical Perspectives

- Teacher learning as situated sociocultural practice, and a process of identity development (Lave & Wenger, 1991; Wenger, 1998)

- We see learning to plan and implement lessons that attend to and build upon children’s multiple mathematics knowledge bases as an ambitious, equity-oriented practice that develops dynamically, over time and across spaces (Kazemi et al, 2007; Aguirre, 2009; Turner et al., 2012; Gutierrez, 2009)
PST’s **Learning Trajectory** for engaging children’s multiple mathematical knowledge bases

[For more on this trajectory, see Turner, Drake, Roth McDuffie, Aguirre, Bartell, & Foote, 2012 *JMTE,*]
PST’s Learning Trajectory for engaging children’s multiple mathematical knowledge bases

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PST’s *Learning Trajectory* for engaging children’s multiple mathematical knowledge bases

- **Making Connections**
  - **Emergent**
  - **Transitional**
  - **Meaningful**
(Re)orienting Thinking about Black Children in a Math Methods Course
The Negro family

The case for national action

United States, Dept. of Labor, Office of Policy Planning and Research

Now speaking, Tonya Bartell
Re-orientation
Mathematics Learning Case Study Module

Community Mathematics Exploration Module
Mathematics Learning Case Study

“Getting to Know You” Interview

Shadowing

Problem Solving Interviews
Community Mathematics Exploration

Lesson Design

Community Walk
Emerging Themes

Deficit Perspectives 7 of 17

Reframed Interpretations 11 of 17

Positive Experience 13 of 17
Tara
Jay
Tara is saving money to buy her brother a present. The present costs 7 dollars. She has 4 dollars so far. How many more dollars does Tara need to buy the present?

\[7 + 4 = 11\]

\[4 + ? = 7\]
Jay
I realize that some of this could be related to a limited budget, however I am a huge proponent of living a healthy lifestyle and would be very interested in teaching students about ways to eat healthy for cheap and take care of their bodies.
Discussion

FRAGILE
HANDLE WITH CARE

NOW
Analysis of Curriculum Spaces
Ball & Cohen, 1996
First Space
Individuals’ home, community & peer networks

Second Space
Work, school, church

Third Space

Moje, 2004
Analysis

- Analyzed 24 lessons – 3 each from 8 different elementary mathematics curriculum series

- Introduction to fractions, single-digit multiplication, and multi-digit addition

- Considering what we know about children’s learning of mathematics, where were the spaces for connecting to (including eliciting, building on, etc.) children’s MMKB?
Curriculum Spaces

Opportunities in the written curriculum lesson for children’s MMKB to emerge
Real-World Connections

- Replace – Real-world objects replace another manipulative
- Single Space – A single real-world connection is made by the textbook
- Open Space – Children have space to make their own real-world connections to the mathematics
- No Math - No math is discussed in the connection (e.g., a connection to a social studies concept)

Spaces for students to create/develop solution strategies and make sense of mathematics

- Before - Space occurs before teacher/textbook presents a strategy
- After - Space occurs after teacher/textbook presents a strategy

Each of the above codes could occur either with supports for the teacher or without.

Spaces for students to discuss/explain their mathematical strategies

- Open space for students to discuss/explain their own strategy
- Space for students to discuss/explain a strategy presented by the teacher/textbook.
Findings

- Specific design features that open or close potential spaces for exploring and discussing

- Significant differences existed among the curriculum spaces in the main lesson and the lesson peripherals (e.g., teaching notes, differentiation activities, homework).
Practice

- Tool for scaffolding PSTs in perceiving and mobilizing spaces within different curriculum materials

- Strategies for opening spaces:
  - Re-arrange the lesson – Peripheral becomes main
  - Open tasks by focusing on design features (e.g., number choice; focus on multiple strategies and representations)
  - Elicit authentic real-world connections
OBJECTIVE:

- “To guide the exploration of a variety of strategies to solve equal-grouping division number stories” (UCSMP, 2007, p. 406)

MATH MESSAGE: “A box holds 6 chocolate candies. How many boxes area needed to hold 134 chocolate candies?” (p. 407)

TEACHER DIRECTIONS:

- “Ask several students to give their solutions to the Math Message problem and to describe their strategies. [Information about “four possible strategies” is provided.]” (p. 407-408)
- “Tell students that there are many ways to solve equal-grouping division problems. One strategy, multiples-of-10, is introduced in this lesson” (p. 408)
- Extended scripting of explanation of multiples strategy, with examples (p. 408-410)
- “Encourage students to use a variety of strategies to solve the problems on journal pages 142 and 143” (p. 410)
**Solving Division Problems**

For Problems 1–6, fill in the multiples-of-10 list if it is helpful. If you prefer to solve the division problems in another way, show your work.

1. Josie’s class baked 64 cookies for the school bake sale. Students put 4 cookies in each bag. How many bags of 4 cookies did they make?

<table>
<thead>
<tr>
<th>10 [40]</th>
<th>20 [80]</th>
<th>30 [120]</th>
<th>40 [160]</th>
<th>50 [200]</th>
</tr>
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<tbody>
<tr>
<td>40</td>
<td>80</td>
<td>120</td>
<td>160</td>
<td>200</td>
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</table>
   
   **Number model:** \( 64 ÷ 4 = 16 \)
   
   **Answer:** 16 bags

2. The community center bought 276 cans of soda for a picnic. How many 6-packs is that?

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<tbody>
<tr>
<td>60</td>
<td>120</td>
<td>180</td>
<td>240</td>
<td>300</td>
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</table>
   
   **Number model:** \( 276 ÷ 6 = 46 \)
   
   **Answer:** 46 6-packs

3. Each lunch table at Johnson Elementary School seats 5 people. How many tables are needed to seat 191 people?

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<td>50</td>
<td>100</td>
<td>150</td>
<td>200</td>
<td>250</td>
</tr>
</tbody>
</table>
   
   **Number model:** \( 191 ÷ 5 \rightarrow 38 \text{ R}1 \)
   
   **Answer:** 39 tables

*Math Journal 1, p. 142*
Opening space in the *EDM* lesson

- Omit explanation of the multiples strategy and/or the scaffolded worksheet that directs/requires students to use a single strategy

- Focus on one problem with multiple number choices:

  Jose’s class baked _____ cookies for the school bake sale. Students put _____ cookies in each bag. How many bags did they make?

  (24, 4) (64, 4) (180, 6) (276, 6) (191, 5)

- Elicit and connect to authentic connections (may or may not include the context given in the published curriculum materials)
Integration of multiple mathematical knowledge bases in practice

Children’s Cultural, Home, & Community-based Knowledge

Children’s Mathematical Thinking

EDUCATIVE

LARGE-SCALE ENACTMENT

Read

Adapt

Enact
Conclusions & Implications

- Evidence that PSTs can develop these ambitious, equity oriented teaching practices
- PSTs’ multiple entry points suggest that keeping the practice integrated (rather than isolating constructs) is beneficial
- Continue to identify leverage points for PST learning
For more information
TEACH MATH Website:
http://mathconnect.hs.iastate.edu

Thank you
TEACH Math Publications

