Teachers
Empowered to
Advance
CHange in
MATHematics

Promoting Equity in PreK-8 Mathematics Teacher Preparation

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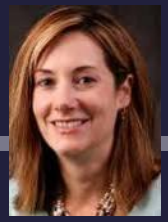
Julia Aguirre, Tonya Gau Bartell, Mary Q. Foote, Amy Roth McDuffie, Erin Turner (Co-PIs)








National Science Foundation Award No. (DRL #1228034)

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

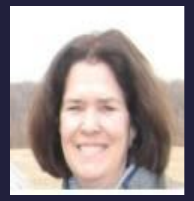
- To design and study instructional modules for preK-8 mathematics methods courses that explicitly develop prospective teachers' competencies related to *children's mathematical thinking* and *children's community/cultural/ linguistic funds of knowledge.*

- 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

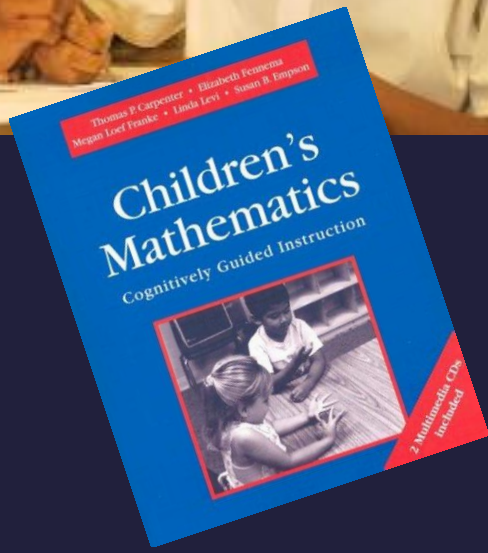
Critical Analysis of Mathematics Classroom Practice

Community Mathematics Exploration

Mathematics Learning Case Study

"Getting to Know You" Interview

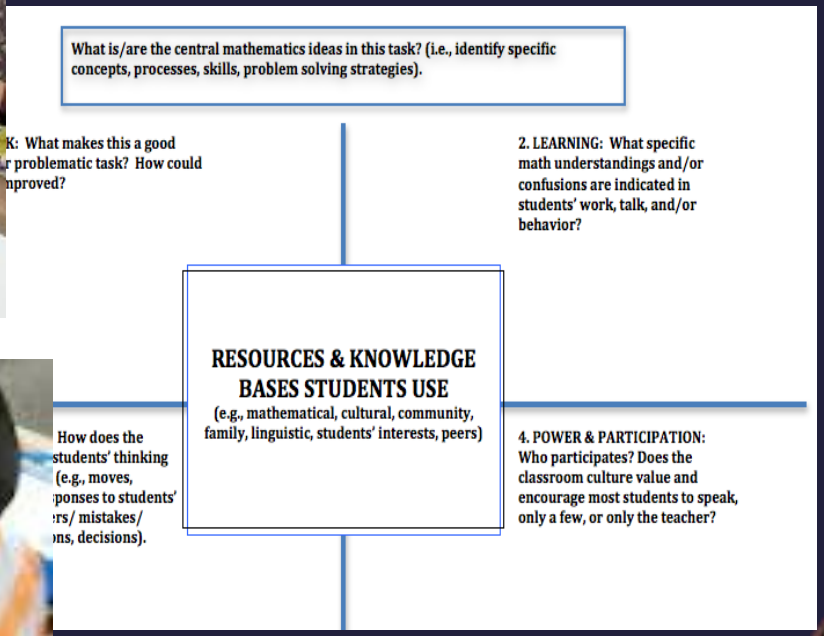
Shadowing



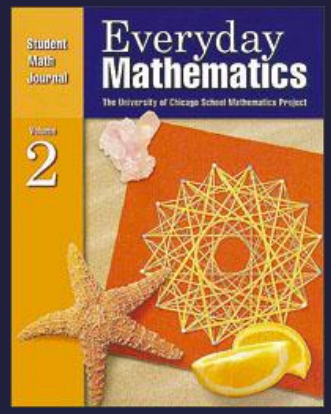
Problem Solving Interviews

Critical Analysis of Mathematics Classroom Practice

Analysis of Mathematics Lesson (observed or taught)



Video Lens



Curriculum Spaces

Community Mathematics Exploration

Community Walk

Lesson Design

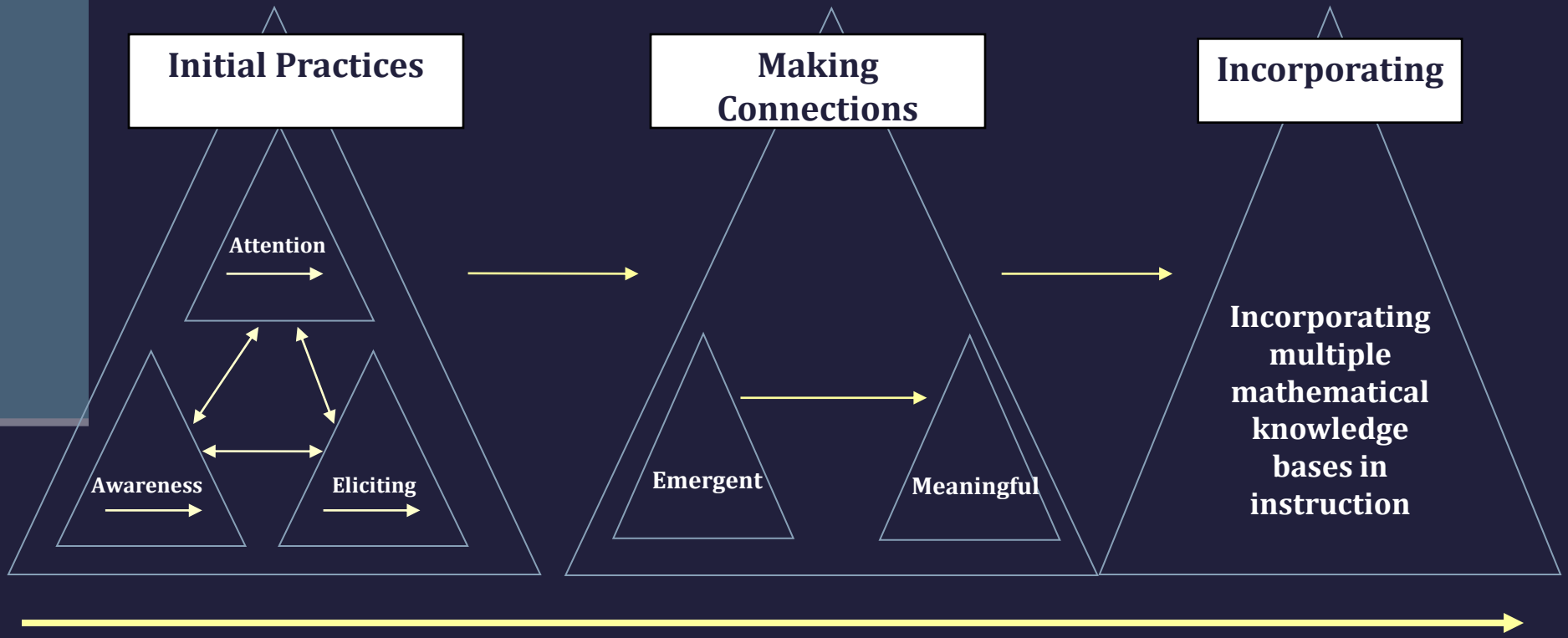
Theoretical Perspectives

- 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*,]

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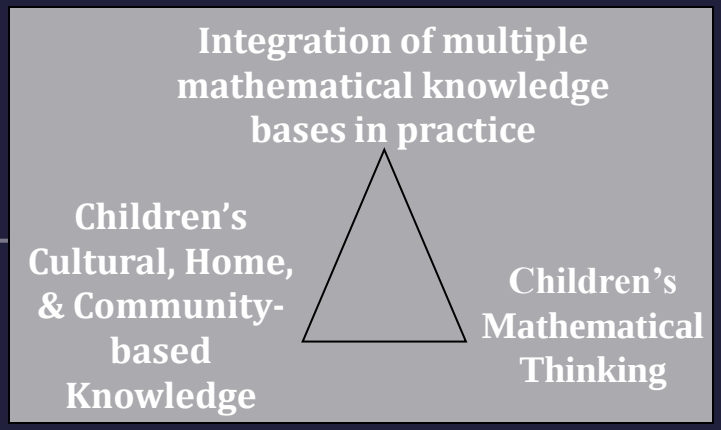

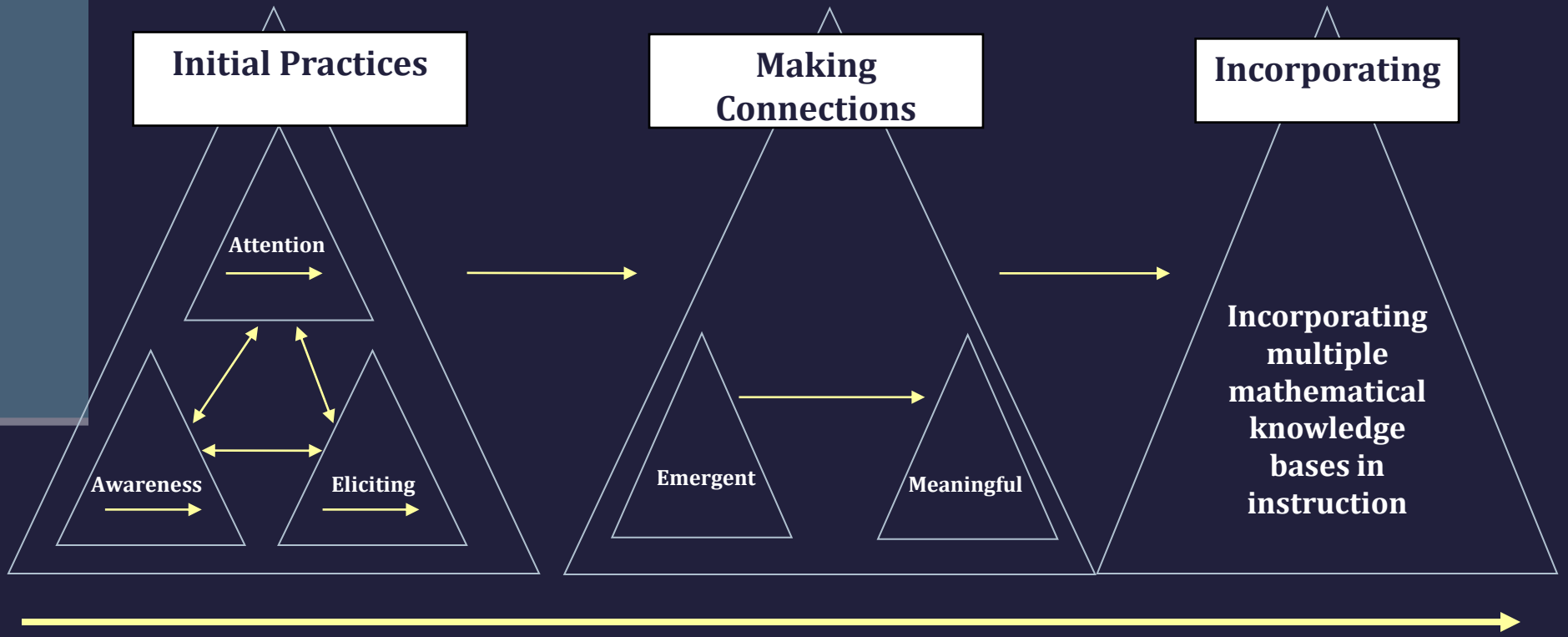

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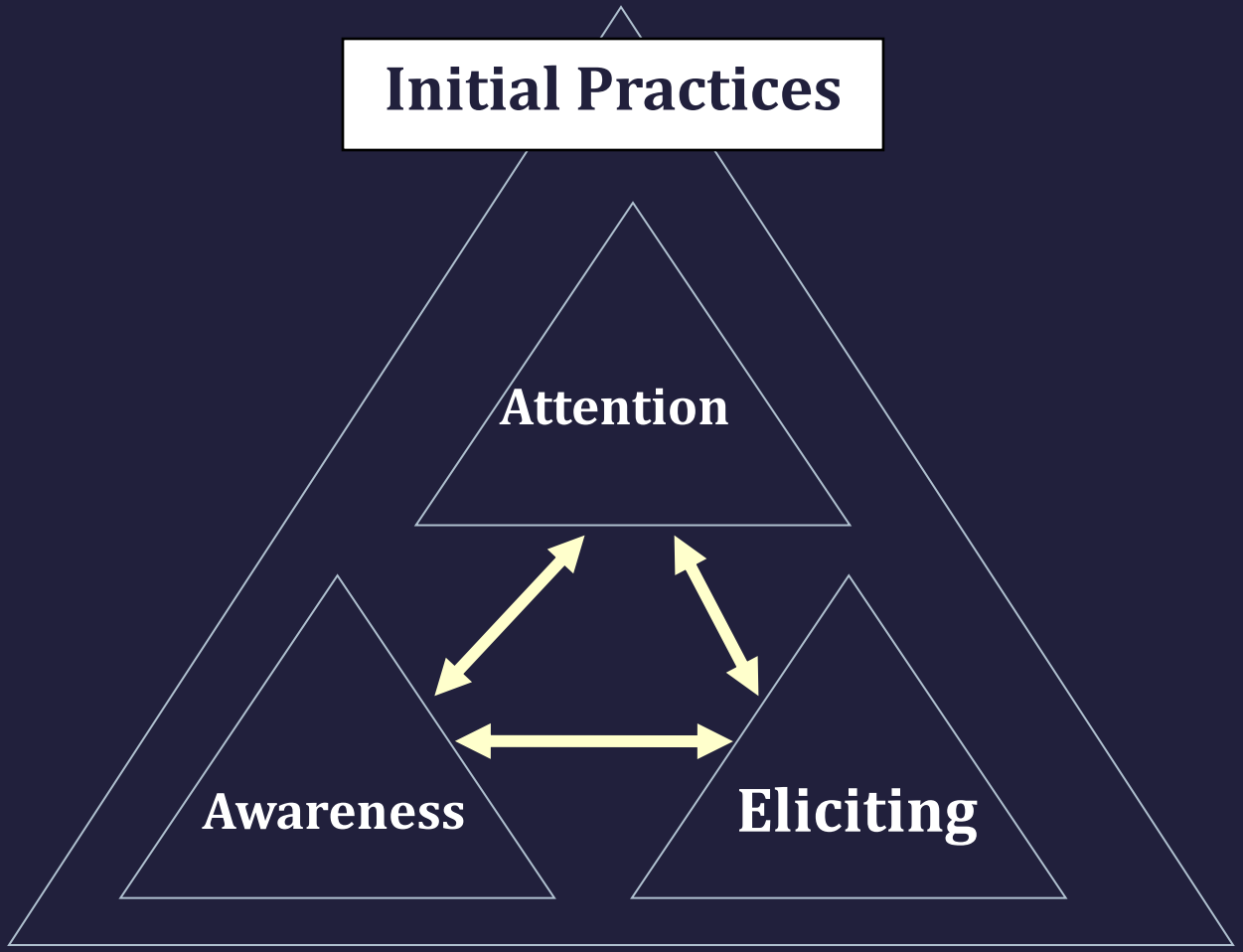

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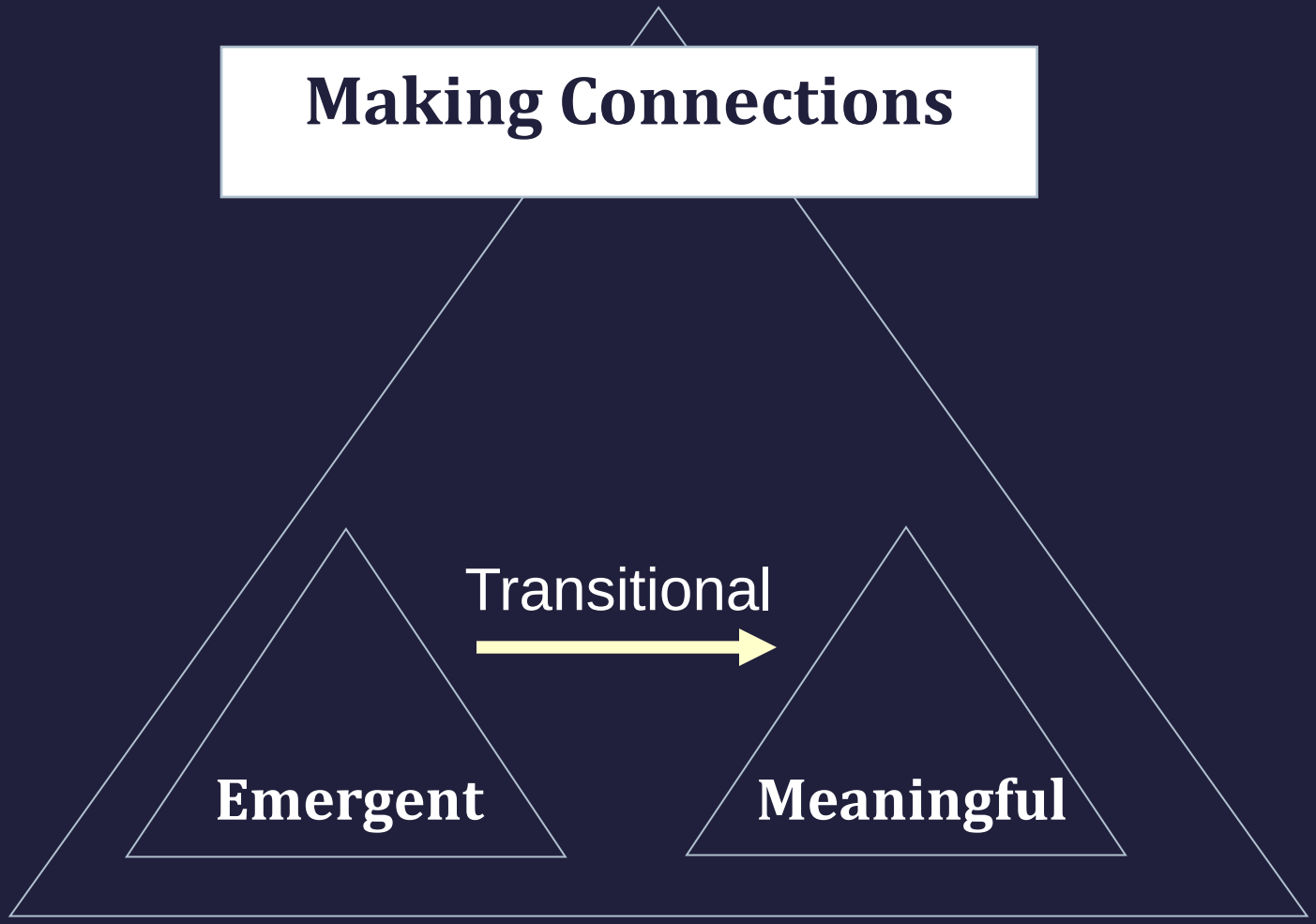
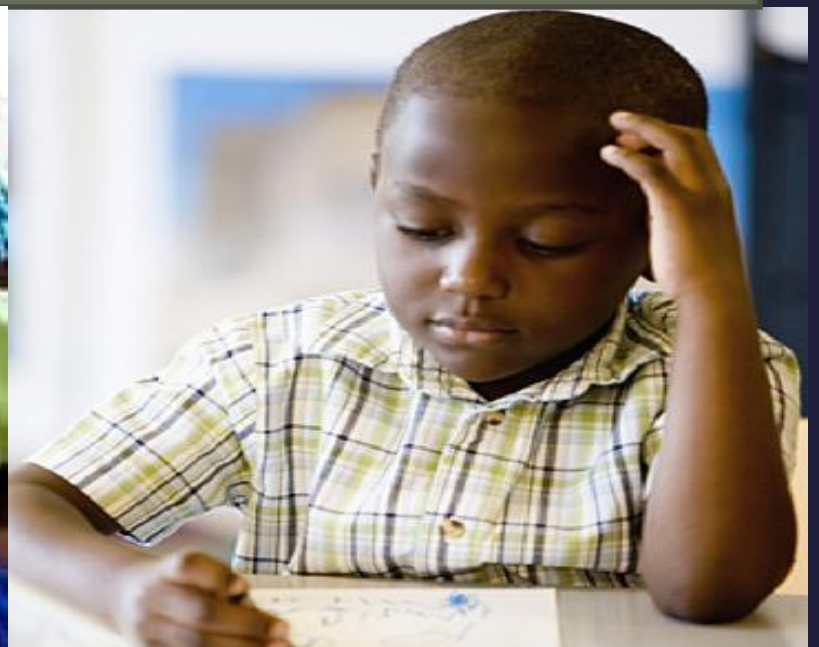
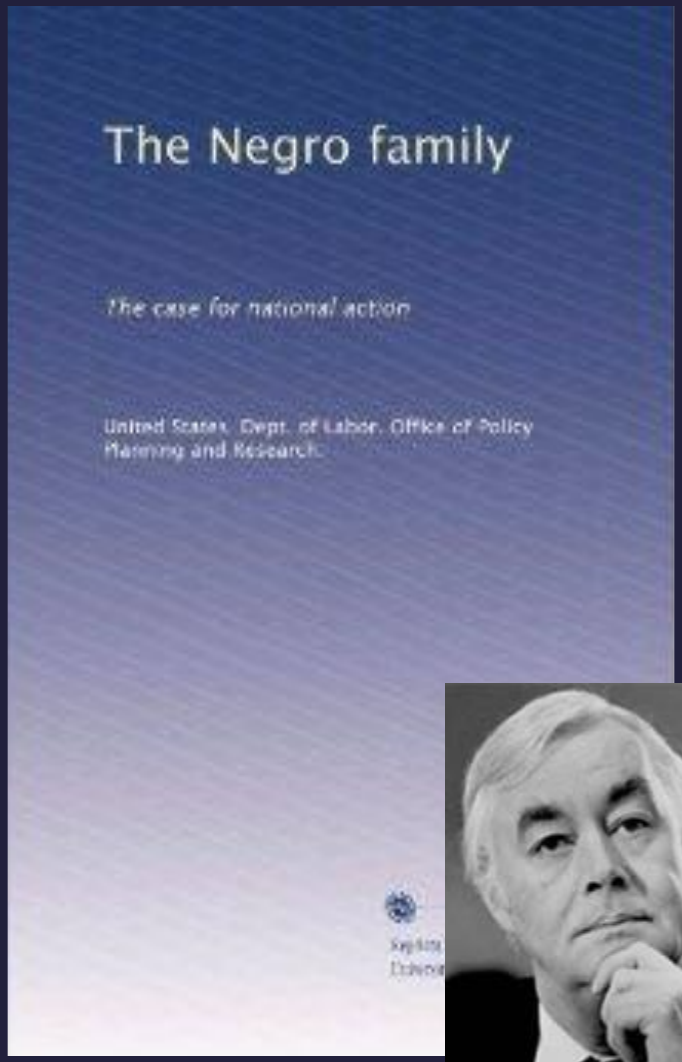


(Re)orienting Thinking about Black Children in a Math Methods Course





Now speaking, Tonya Bartell


Orientation

Martin, 2000

Malloy, 2009

Milner, 2003

Foster, 1990

Siddle-Walker, 1996

Gay, 2010

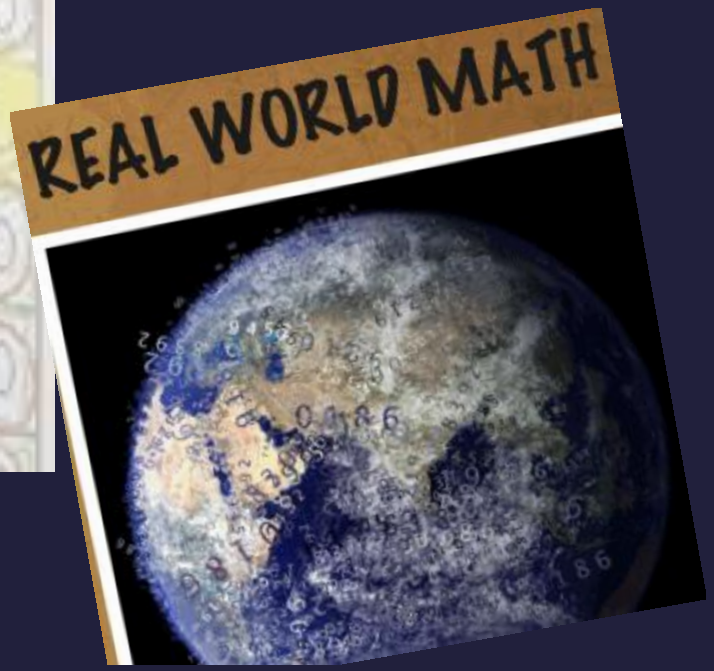
Ladson-Billings, 1994

Leonard, 2008

Irvine, 1983

Matthews, 2003

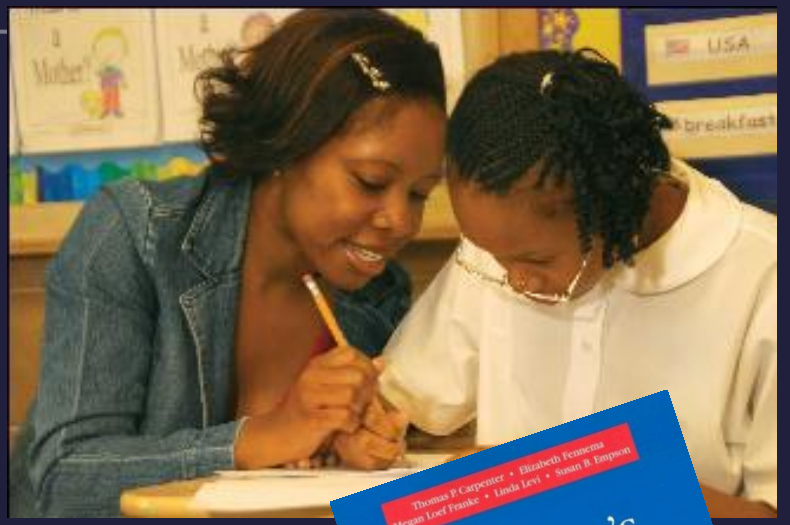
Mathematics Learning Case Study Module



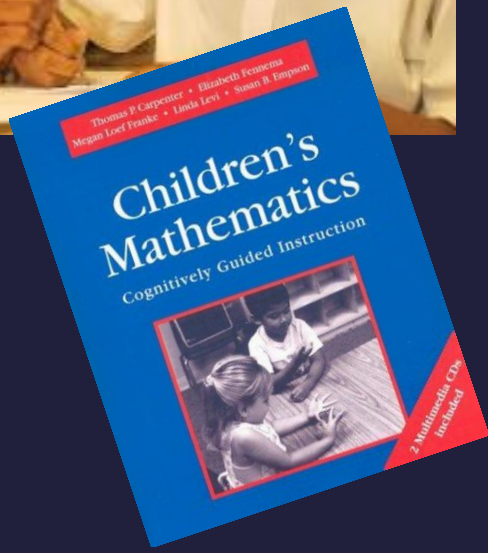
Community Mathematics Exploration Module

Mathematics Learning Case Study

"Getting to Know You" Interview



Shadowing

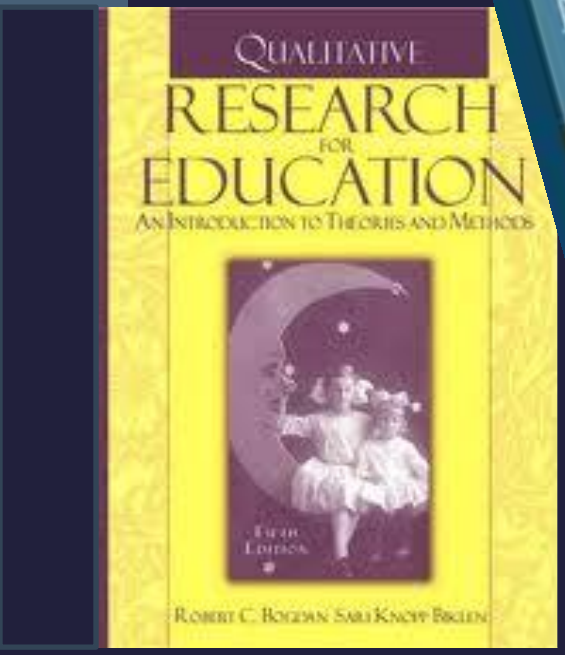


Problem Solving Interviews

Community Mathematics Exploration

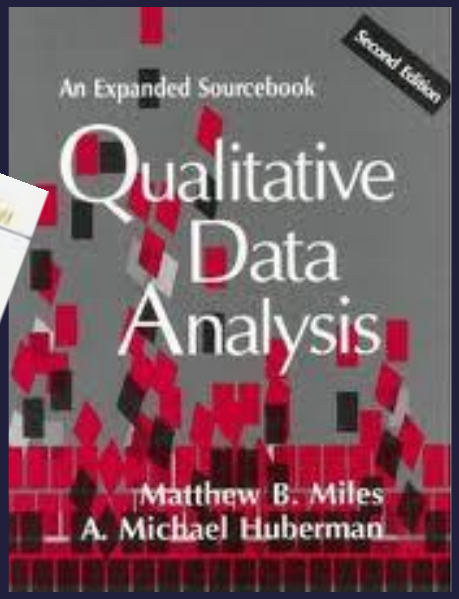
Community Walk

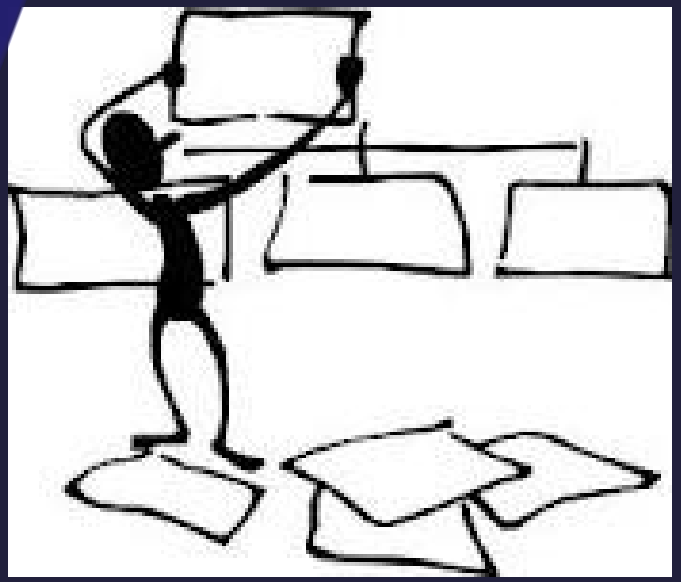
Lesson Design


Qualitative
Research
for
Education
An Introduction to Theories and Methods
Robert C. Bogdan Sari Knopp Biklen

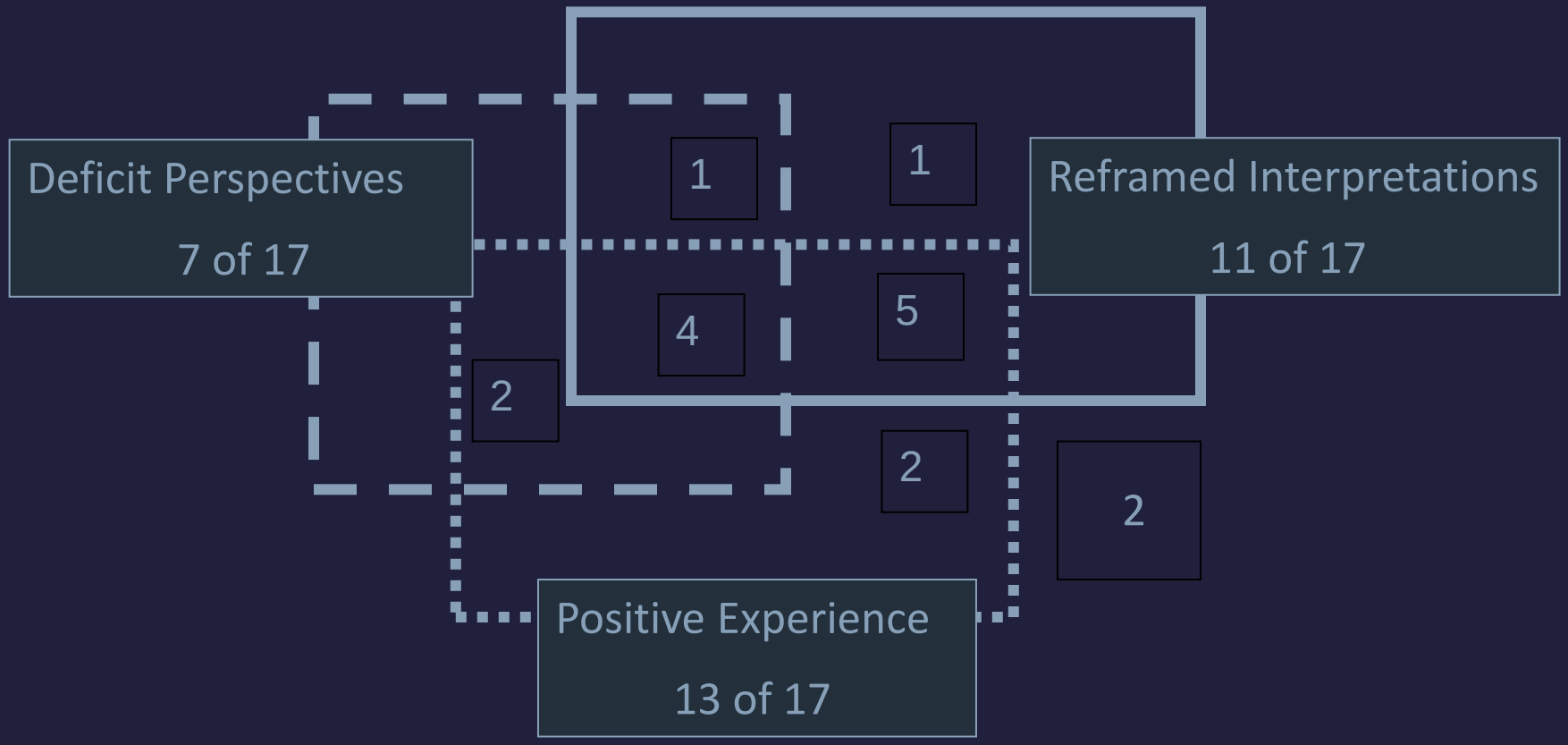

D. Jean Clandinin
F. Michael Connelly
Narrative Inquiry


Second Edition
Basics of Qualitative Research
Anselm Strauss
Juliet Corbin


An Expanded Sourcebook
Second Edition
Qualitative Data Analysis
Matthew B. Miles
A. Michael Huberman

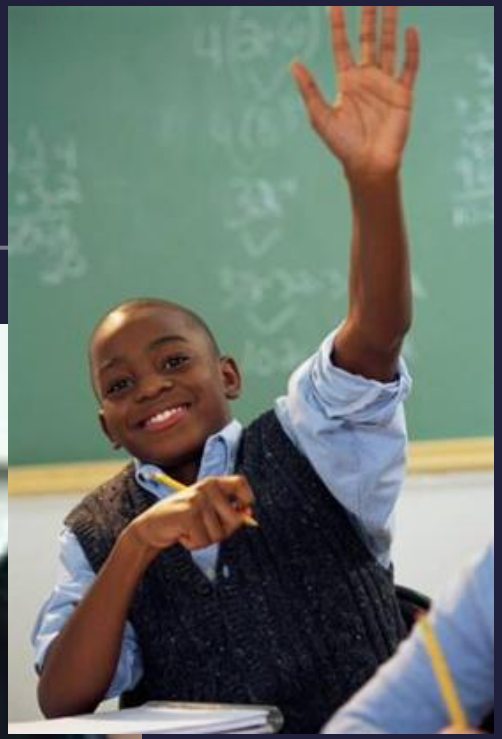


Emerging Themes



Tara

Jay



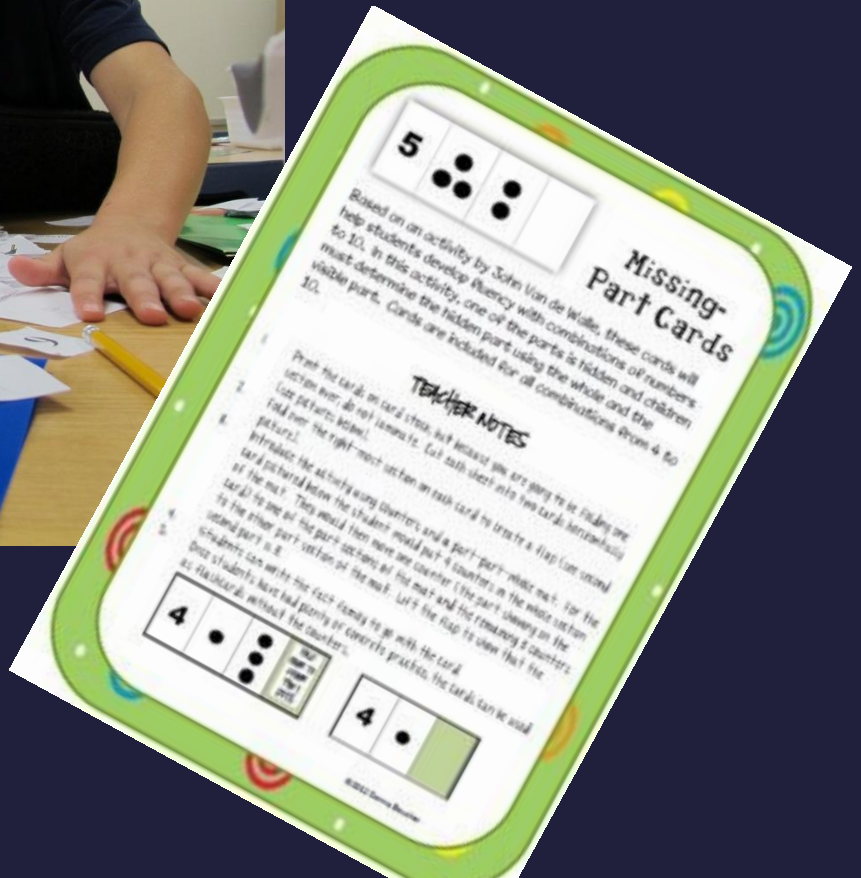
Jay

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

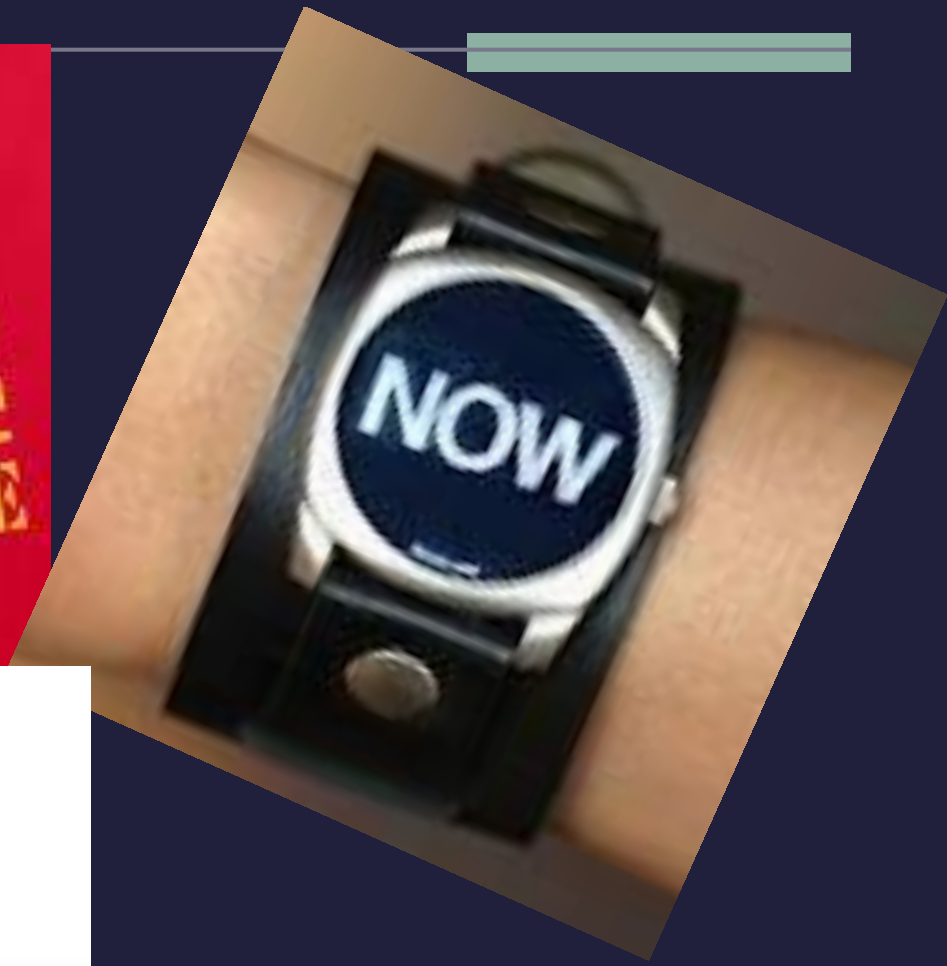
Jay

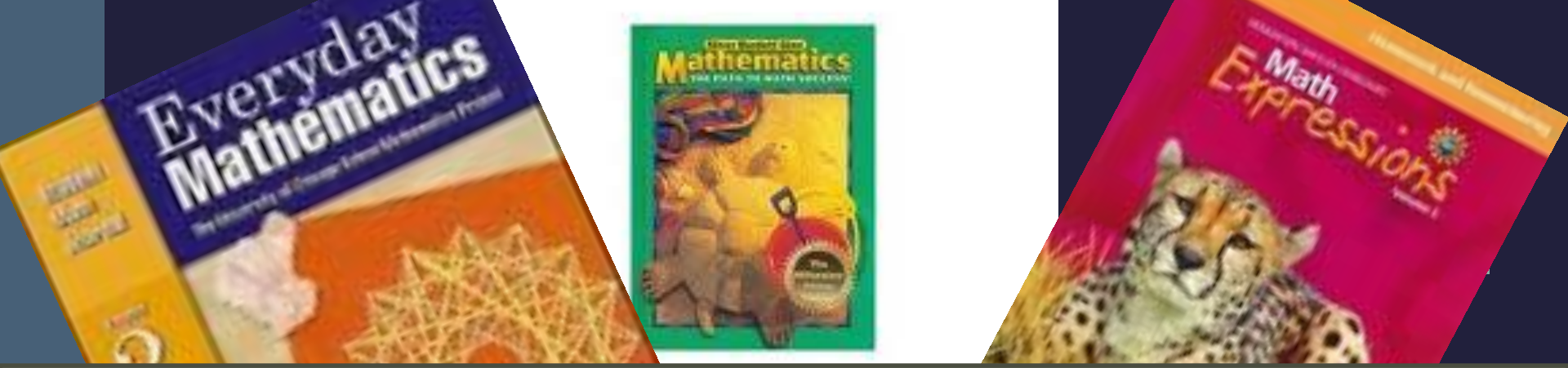

5
Missing Part Cards
Based on an activity by John Van de Walle, these cards will help students develop fluency with combinations of numbers to 10. In this activity, one of the parts is hidden and children must determine the hidden part using the whole and the visible part. Cards are included for all combinations from 4 to 10.
TEACHER NOTES
4
4

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.

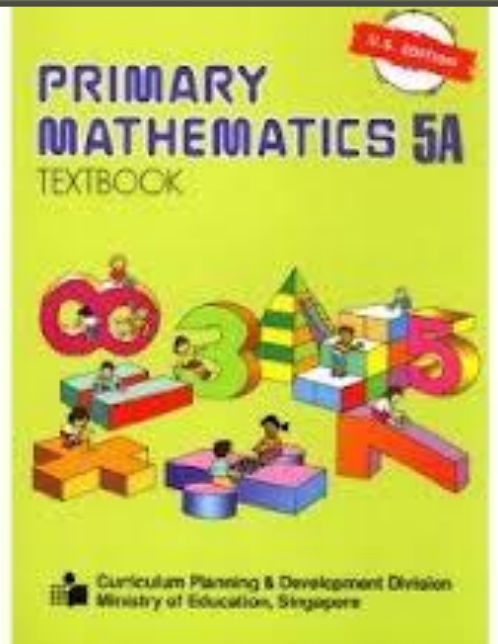
Tara

Discussion





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

An example: *EDM*, Grade 4

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)

Student Page

Date: Time:

LESSON 6-2 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. Josh'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?

10 [4s] = 40
20 [4s] = 80
30 [4s] = 120
40 [4s] = 160
50 [4s] = 200

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?

10 [6s] = 60
20 [6s] = 120
30 [6s] = 180
40 [6s] = 240
50 [6s] = 300

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?

10 [5s] = 50
20 [5s] = 100
30 [5s] = 150
40 [5s] = 200
50 [5s] = 250

Number model: 191 ÷ 5 → 38 R1

Answer: 39 tables

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 sale. Students put _____ cookies in each bag. How many bags did they make?

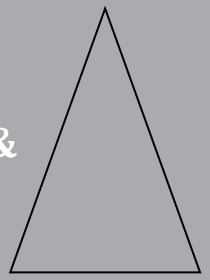
  bake

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

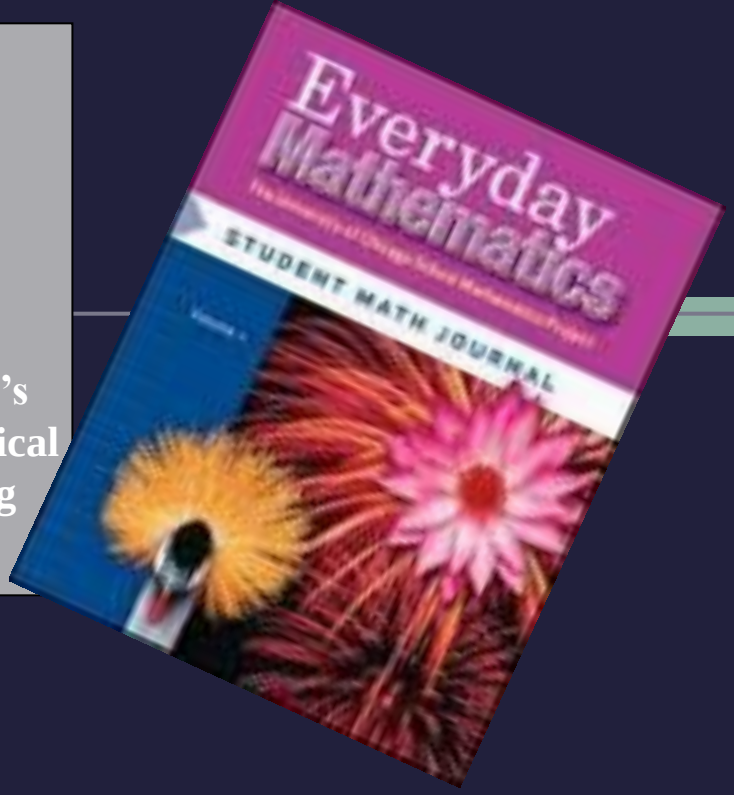
- Elicit and connect to authentic connections (may or may not include the context given in the published curriculum materials)

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

Teachers
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MATHematics

Thank you

For more information

TEACH MATH Website:

http://mathconnect.hs.iastate.edu

National Science Foundation Award No. (DRL#1020155)

TEACH Math Publications

- Bartell, T. G., Foote, M. Q., Drake, C., Roth McDuffie, A., Turner, E. E., & Aguirre, J. M. (2013). Developing teachers of Black children: (Re)orienting thinking in an elementary mathematics methods course. In J. Leonard & D. B. Martin (Eds.), The brilliance of Black children in mathematics: Beyond the numbers and toward a new discourse (pp.343-367). Charlotte, NC: Information Age.

- Turner, E. E., Drake, C., Roth McDuffie, A., Aguirre, J, Bartell, T. G. & Foote, M. Q. (2012). Promoting equity in mathematics teacher preparation: A framework for advancing teacher learning of children's multiple mathematics knowledge bases. *Journal of Mathematics Teacher Education, 15*, 67-82. DOI 10.1007/s10857-011-9196-6

TEACH Math Publications

- Aguirre, J., Turner, E., Bartell, T. G., Drake, C., Foote, M. Q., & Roth McDuffie, A. (2012). Analyzing effective mathematics lessons for English learners: A multiple mathematical lens approach. In S. Celedón-Pattichis & N. Ramirez (Eds.), *Beyond good teaching: Advancing mathematics education for ELLs* (pp. 207-222). Reston, VA: NCTM.

- Aguirre, J., Turner, E., Bartell, T., Craig, C. K., Foote, M. Q., Roth McDuffie, A., Drake, C. (in press). Making connections in practice: Developing prospective teachers' capacities to connect children's mathematical thinking and community funds of knowledge in mathematics instruction. To appear in *Journal of Teacher Education.*