Enhancing the Common Core with Culturally Responsive Mathematics Teaching:

Key Principles and Strategies

Julia M. Aguirre, Ph.D.
Associate Professor
University of Washington Tacoma
jaguirre@uw.edu

National Council of Teachers of Mathematics
Grades 3-8 Summer Institute
Anaheim, CA

July 29, 2015

National Science Foundation Award No. (DRL #1228034)

Quick Write:

- Culturally responsive mathematics teaching is…
- My favorite example of culturally responsive mathematics teaching in my classroom is…
- My biggest challenge with culturally responsive mathematics teaching is…

Session Outcomes

- Increased understanding of culturally responsive mathematics instruction in our math education work.

- Increased awareness of tools and resources to create math lessons that engage students in meaningful mathematics and support a positive math identity.
  - CRMT6-Lesson Analysis Tool
  - Community Math Walk
  - Resource List

Tell me about this picture.

What do you see?

Tienda Mexicana

Tell me about these pictures.

What math questions, actions, or practices might emerge from these contexts?

Teaching Situation

7th grade

Mr. C: Joaquín, where is Mario today?

Joaquín: He ain't here. He was suspended for being Mexican.

Mr. C: What did you say?

Joaquín: This school is always picking on Mexicans.

CHAT

How could we use mathematics to analyze Joaquín's claim?

Aguirre, Mayfield-Ingram & Martin (2013)

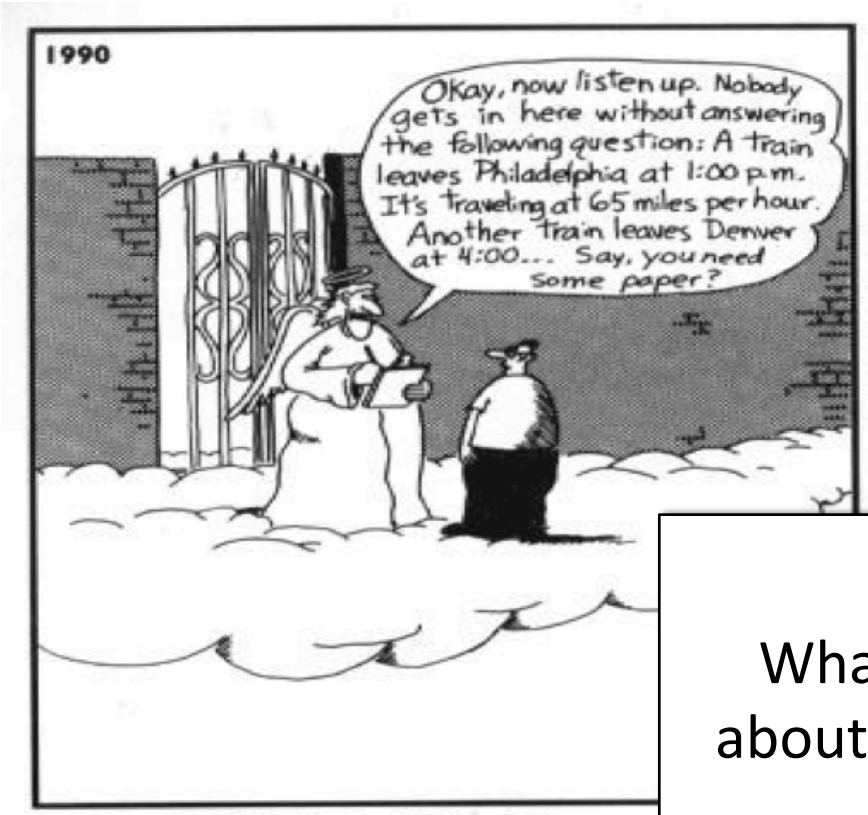
What works…

- High quality math content

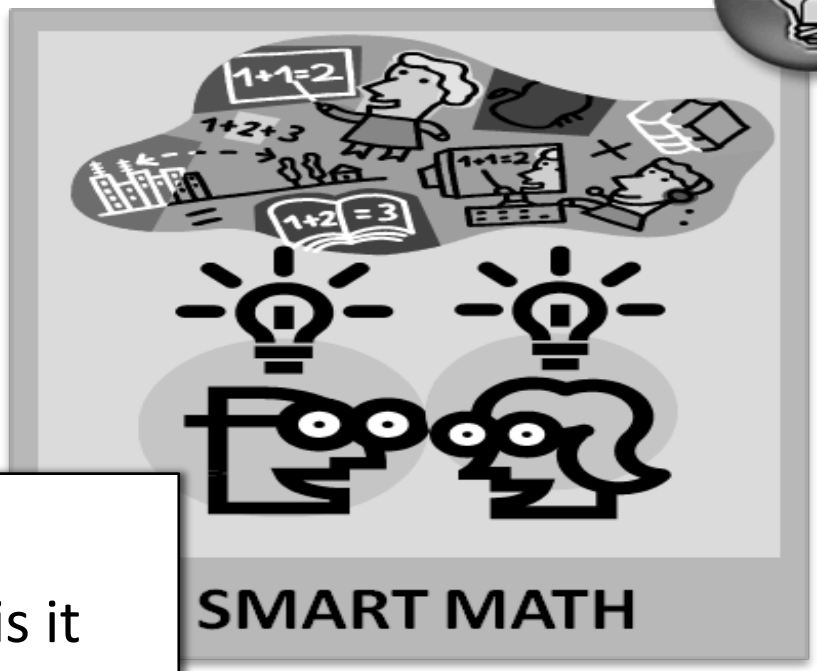
- High teacher expectations of mathematics learning for all students

- Strong school-teacher/family-student relationships

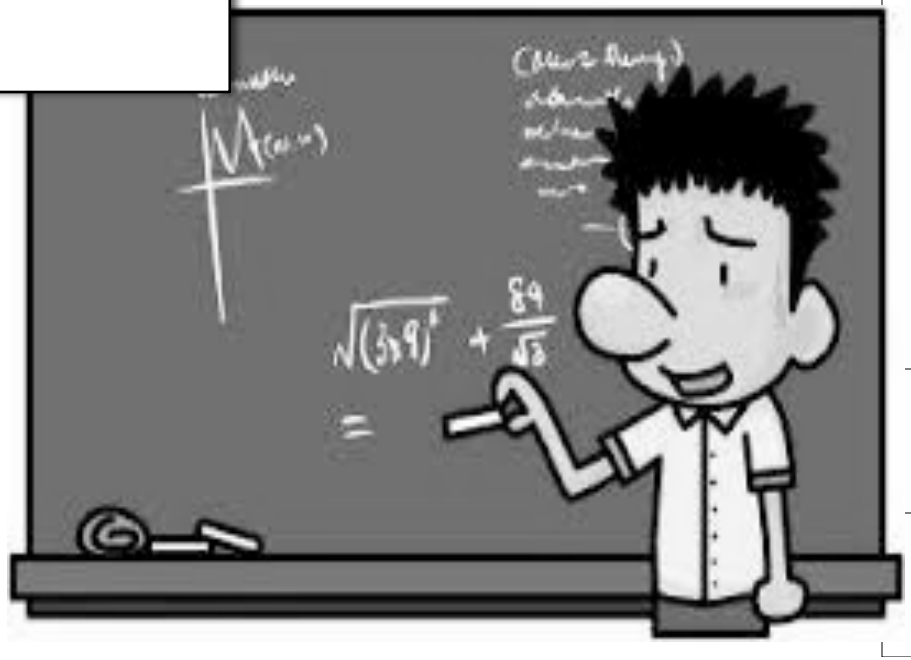
Kitchen, DePree, Celedón-Pattichis, & Brinkerhoff (2007); Civil & Menendez (2010); Celedón-Pattichis & Ramirez (2012); Boaler, 2002, 2008; Gorski (2014); Oaks, 1990; 2005.



Math phobic's nightmare



What is it about math?



Mathematics has a consequential power on our (academic) identities.

Aguirre et al, 2013; Berry, 2004;2008; Boaler 2002; Martin, 2000; 2009; Gutiérrez 2010; 2013; Zavala, 2013

Math success in middle school for African American boys (Martin, 2000; Berry, 2004; 2008)

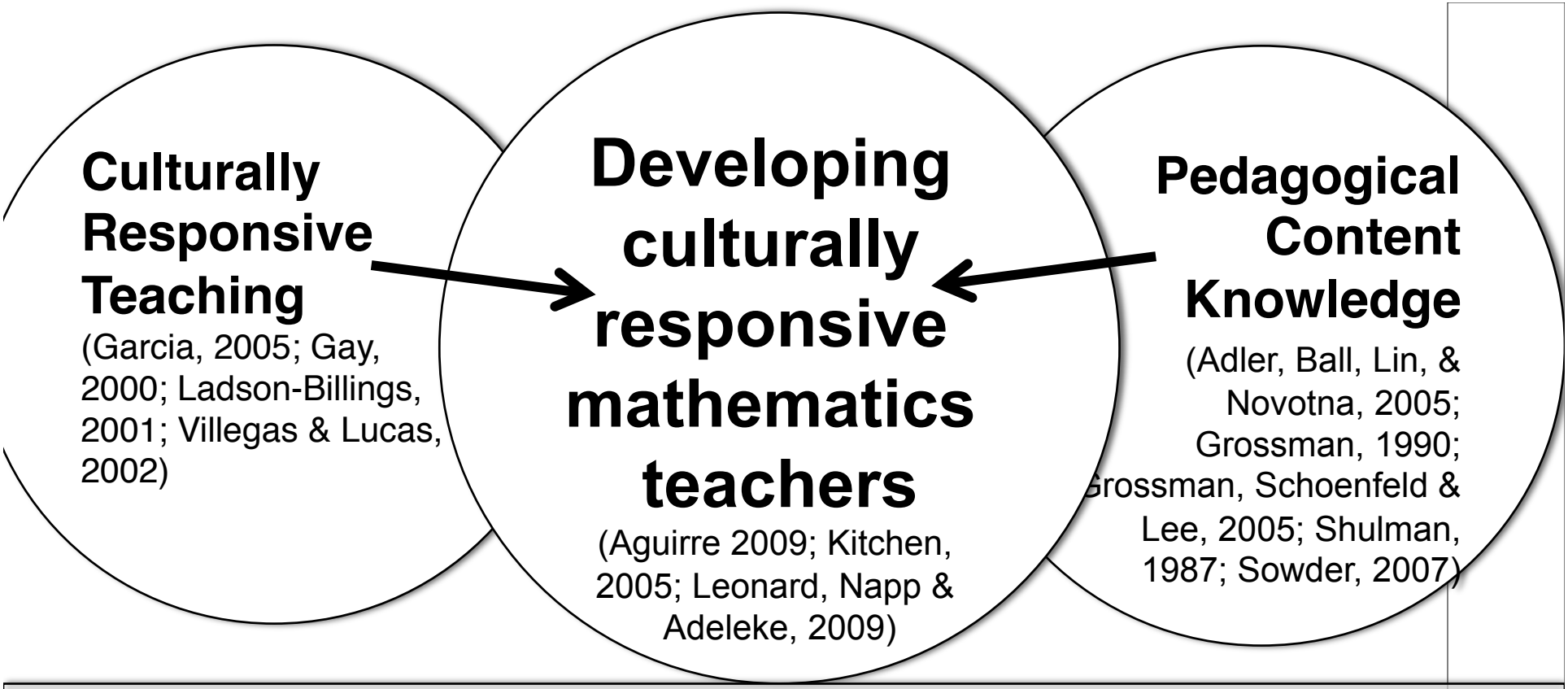
- **Family support systems**
  - Pre-school/home education experiences
  - Math resources
  - Advocacy
- **Recognition of competence**
  - Access to higher tracks (algebra 1, Academically Gifted)
- **Strong math identities**
- **Strong alternative identities**
  - academic, religious/faith, athletic
- **Strong teacher support**

All boys in Berry's study (2008) identified at least 1 teacher that supported them in general and <u>math in particular.</u>

Culturally Responsive Mathematics Teaching

Roots, CCSS-M Connections, and Tools

National Science Foundation Award No. (DRL #1228034)



CRMT *is* a set of specific pedagogical knowledge, dispositions, and practices that privilege mathematical thinking, cultural and linguistic funds of knowledge, and issues of power and social justice in mathematics education.

(Aguirre & Zavala, 2013)

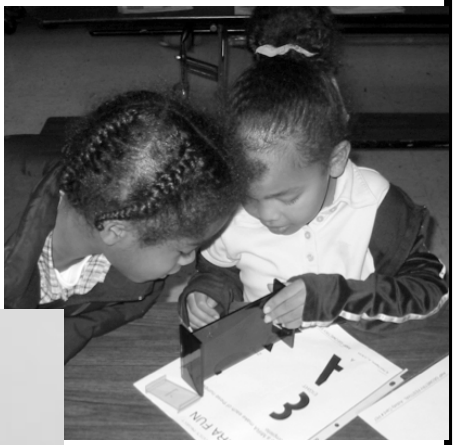
Pedagogical Content Knowledge (PCK)

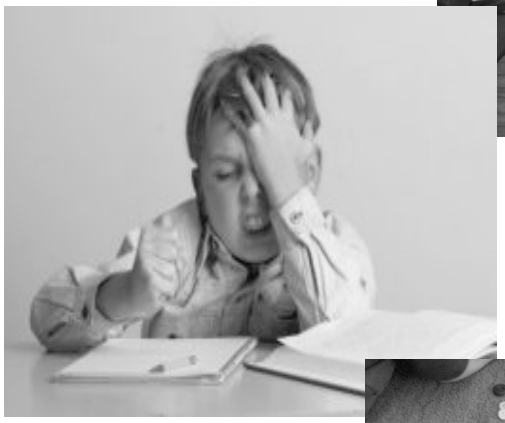
Not subject matter knowledge, but the knowledge needed to TEACH the content

Sowder, 2007)

- Knowledge & beliefs about the purposes of teaching mathematics
- Knowledge of children's mathematical understandings/ misunderstandings
- Knowledge of the curriculum & curricular materials
- Knowledge of instructional strategies and representations

Connection to Common Core:





Learning Progressions

"… Standards began with research-based learning progressions detailing what is known today about how students' mathematical knowledge, skill, and understanding develop over time."

(CCSS-M Introduction, p.4)

http://ime.math.arizona.edu/progressions

"Culturally responsive pedagogy simultaneously develops, along with academic achievement, social consciousness and critique; cultural affirmation, competence, and exchange; community-building and personal connections; individual self-worth and abilities; and an ethic of caring…

"Culturally responsive teachers have **unequivocal faith** in the human dignity and intellectual capabilities of their students."

(Geneva Gay, 2000, pp. 43-44)

CRMT connection to Common Core:

Not explicitly addressed in Common Core Main Document

Application of CCSS for English Learners
(separate document)

ALL STUDENTS…

p.4 CCSS-M

"It is also beyond the scope of the Standards to define the full range of supports appropriate for English language learners and for students with special needs. At the same time, **all students must have the opportunity to learn and meet the same high standards** if they are to access the knowledge and skills necessary in their post-school lives…

No set of grade-specific standards can fully reflect the great variety in abilities, needs, learning rates, and achievement levels of students in any given classroom. **However, the Standards do provide clear signposts along the way to the goal of college and career readiness for all students.**"

ACCESS & OPPORTUNITY TO LEARN → COLLEGE & CAREER READINESS

EQUITY CONCERNS about CCSS-M

- **Deficit frame of some students' learning by research-base about math learning progressions/trajectories**
  - Latin@, Black, Native American, poor children have documented "immature" and "maladaptive" strategies; skill deficiencies
    (Clements & Sarama, 2007; National Research Council, 2001; Loveless, 2008)

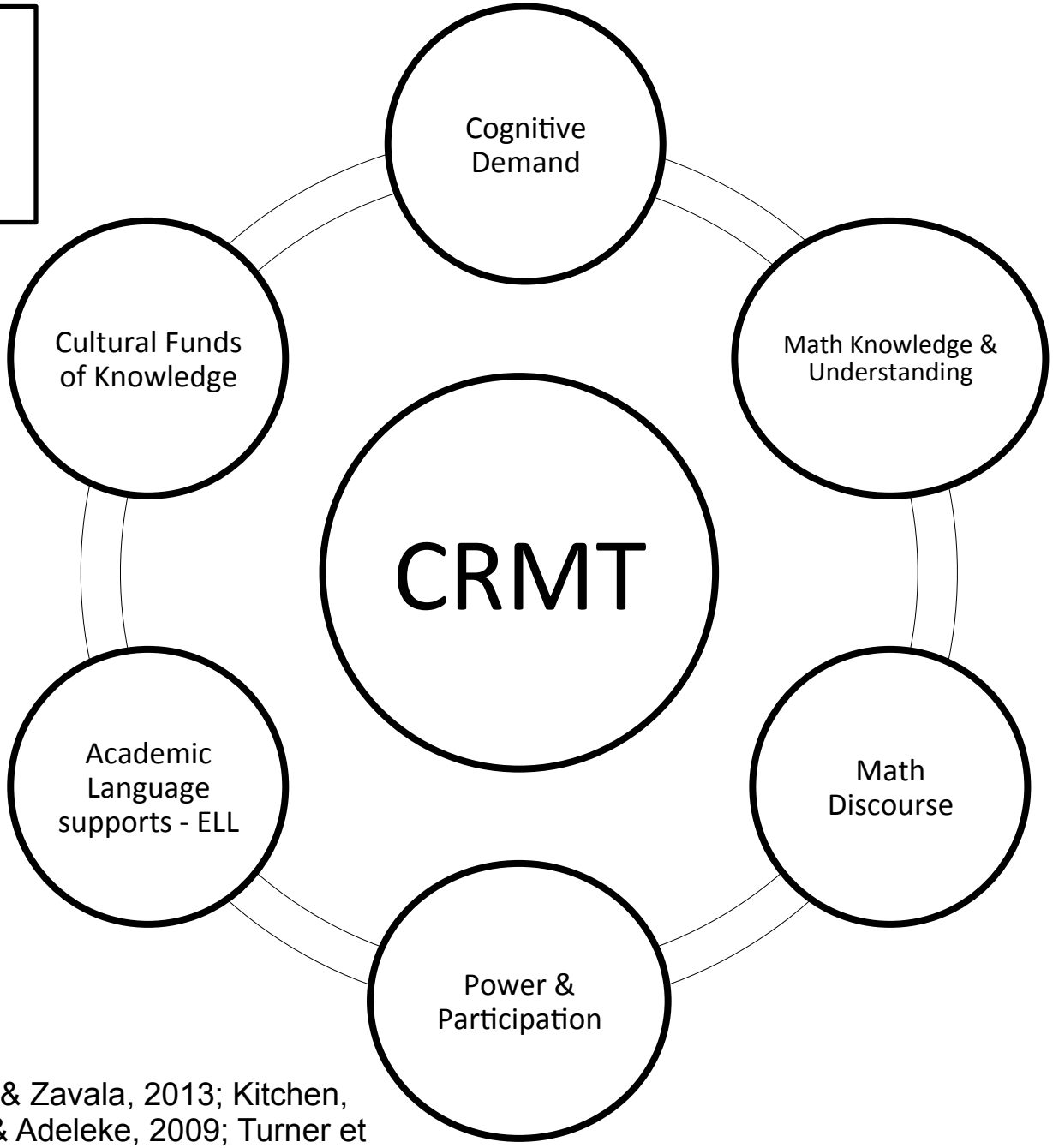
- **Continued focus on achievement measured only by large-scale standardized tests**

- **Silence on the structural inequities and institutional constraints that affect learning of, access to, and advancement in mathematics**

- TODOS mathematics for all http://www.todos-math.org/
- Benjamin Banneker Association http://bannekermath.org/wordpress/ccss-statement
- Women and mathematics education http://www.wme-usa.org/home

CRMT TOOLS & RESOURCES

CULTURALLY RESPONSIVE MATHEMATICS TEACHING



(Aguirre 2009; Aguirre & Zavala, 2013; Kitchen, 2005; Leonard, Napp & Adeleke, 2009; Turner et al, 2012, Aguirre, et al, 2012)

Enhance instruction with CRMT-Lesson Analysis Tool

- Use during lesson or unit planning
- Use to reflect upon a specific lesson
- Use as a peer observation/reflection tool of a lesson

	Category	Guiding Question
1	Cognitive Demand	How does my lesson enable students to closely explore and analyze math/science concepts(s), procedure(s), and reasoning strategies?
2	Depth of knowledge and understanding	How does my lesson make student thinking/understanding visible and deep?
3	Mathematical Discourse	How does my lesson create opportunities to discuss math in meaningful and rigorous ways (e.g. debate math ideas/solution strategies, use math terminology, develop explanations, communicate reasoning, and/or make generalizations)?
4	Power & Participation	How does my lesson distribute math knowledge authority, value student math/science contributions, and address status differences among students?
5	Academic Language Supports	How does my lesson provide academic language support for English Language Learners?
6	Cultural & Community-based funds of knowledge	How does my lesson help students connect mathematics with relevant/authentic situations in their lives? How does my lesson support students' use of mathematics to understand, critique, and change an important equity or social justice issue in their lives?

Cognitive Demand

MP1: Make sense of problems and persevere in solving them

MP2: Reason abstractly and quantitatively

"The kind and level of thinking required of students in order to successfully engage with and solve the task."

(p.11, Stein et al, 2000)

LOWER LEVEL

Reproduction; no meaning-making; emphasis on correct answer; no explanation; no ambiguity

HIGHER LEVEL

Meaning-making; understanding why; multiple representation; high analysis; high ambiguity; requires explanation;

MEMORIZATION TASKS

PROCEDURES WITHOUT CONNECTIONS

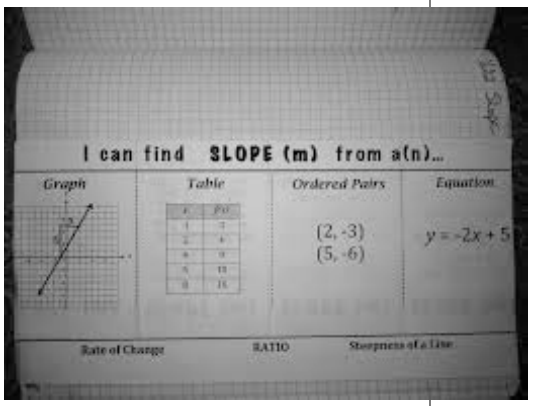
PROCEDURES WITH CONNECTIONS

DOING MATHEMATICS

Smith & Stein (1998), Stein et al (2000)

Depth of Knowledge and Understanding

- Draw on student thinking/ reasoning
- Analyze multiple strategies
- Make connections across multiple representations
- Provide explanations and justifications



Carpenter et al (1999); Carpenter et al (2003); Turner et al (2008); Turner et al. (2009)

Discourse

MP3: Construct viable arguments and critique the reasoning of others

MP6: Attention to precision

Includes ways students communicate with and about mathematics through speaking, writing, gestures, representations, drawings

- Argumentation
- Justification
- Negotiation of Meanings
- Registers
- Specialized vocabulary

Celedón-Pattichis & Turner (2012); Herbel-Eisemann & Cirillo (2009); Moschkovich (1999; 2002; 2007; 2012); Turner & Celedón-Pattichis (2011)

Power & Participation

MP3: Construct viable arguments and critique the reasoning of others

RESPECTFULLY

Focus attention on student engagement, participation and status in the math classroom

- Wide distribution of math authority in the classroom
- All contributions are respected and valued.
- Participation structures minimize status issues (i.e. complex instruction)

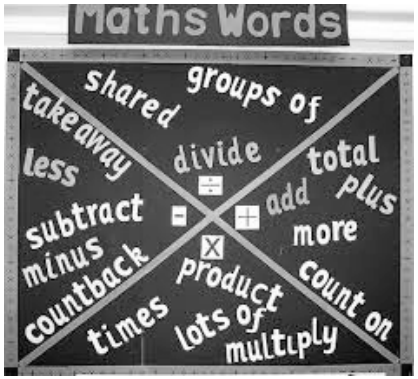
Featherstone et al. (2011); Horn (2012); Spencer (2005); Turner et al, (2010)

Academic Language Supports for ELL

MP3: Construct viable arguments and critique the reasoning of others

MP6: Attention to precision

Deliberate and continuous use of language supports to engage in math discourse and sense-making



- Revoicing
- Use of cognates
- Realia
- Graphic organizers
- Strategic grouping

VOCABULARY WORD	COGNATE	VOCABULARY WORD	COGNATE
angle	el ángulo	congruent	congruente
acute triangle	el triángulo agudo	cylinder	el cilindro
capacity	la capacidad	decimal	el decimal
circumference	la circunferencia	diameter	el diámetro

Aguirre et al, 2012; Aguirre & Bunch, 2012; Khisty, 1995; Khisty & Chval, 2002; Chval & Chavez, 2012; Celedón-Pattichis & Ramirez, 2012; Gutiérrez, 2002; Moschkovich 2007; 2012; Turner et al, 2012.

Community Knowledge

Families engage in and communicate with mathematics

Informal Knowledge/Funds of Knowledge: people have and produce math knowledge outside of school tied to specific cultural/ community practices (e.g. home repair, banking, game-playing, cooking, shopping, sports, sewing, party-planning, painting, gardening, budgeting, music, dance, health care etc.)

Aguirre et al, 2013; Civil (2002; 2007); Foote (2009); Gonzalez et al,(2001); Perkins & Flores (2007); Simic-Muller, et al (2009) Taylor (2009); Wager (2012)

Community Knowledge

Families engage in and communicate with mathematics

Immigrant families may also hold mathematical funds of knowledge learned from schooling in home countries (i.e. ways of counting/procedures; decimal point placement; symbolic representations)

United States 4,232.56

4.232,56 **Cambodia**

United States

59/8 = 7 3/8

Various countries in central, south America

59 : 8 = 7 + 3 : 8

US Textbooks

$\angle ABC$

Mexican Textbooks

$\widehat{ABC}$

Wright & Li (2008)

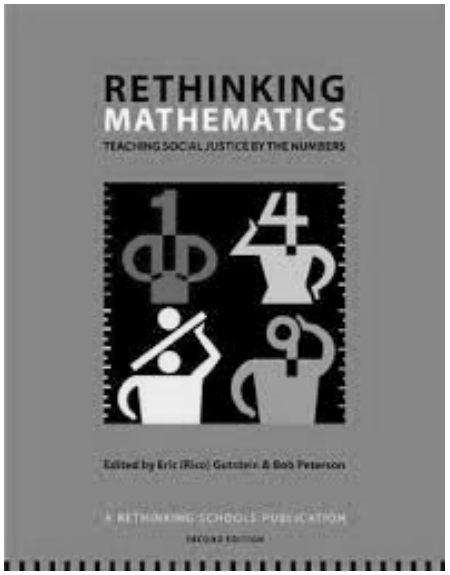
Perkins & Flores (2007)

Community/Critical Knowledge

- To use math as an analytical tool to understand power relations, decisions, social issues, complex problems, and sociopolitical context of reality.

MP4: Model with mathematics

- To use mathematics to foster positive change, civic engagement for the public good and/or take action to challenge injustices.
  - Environmental issues
  - Racial profiling
  - Safe neighborhoods
  - School overcrowding
  - Teen drug use
  - School suspensions
  - Voting fraud
  - Wage disparities
  - Lottery
  - Body image

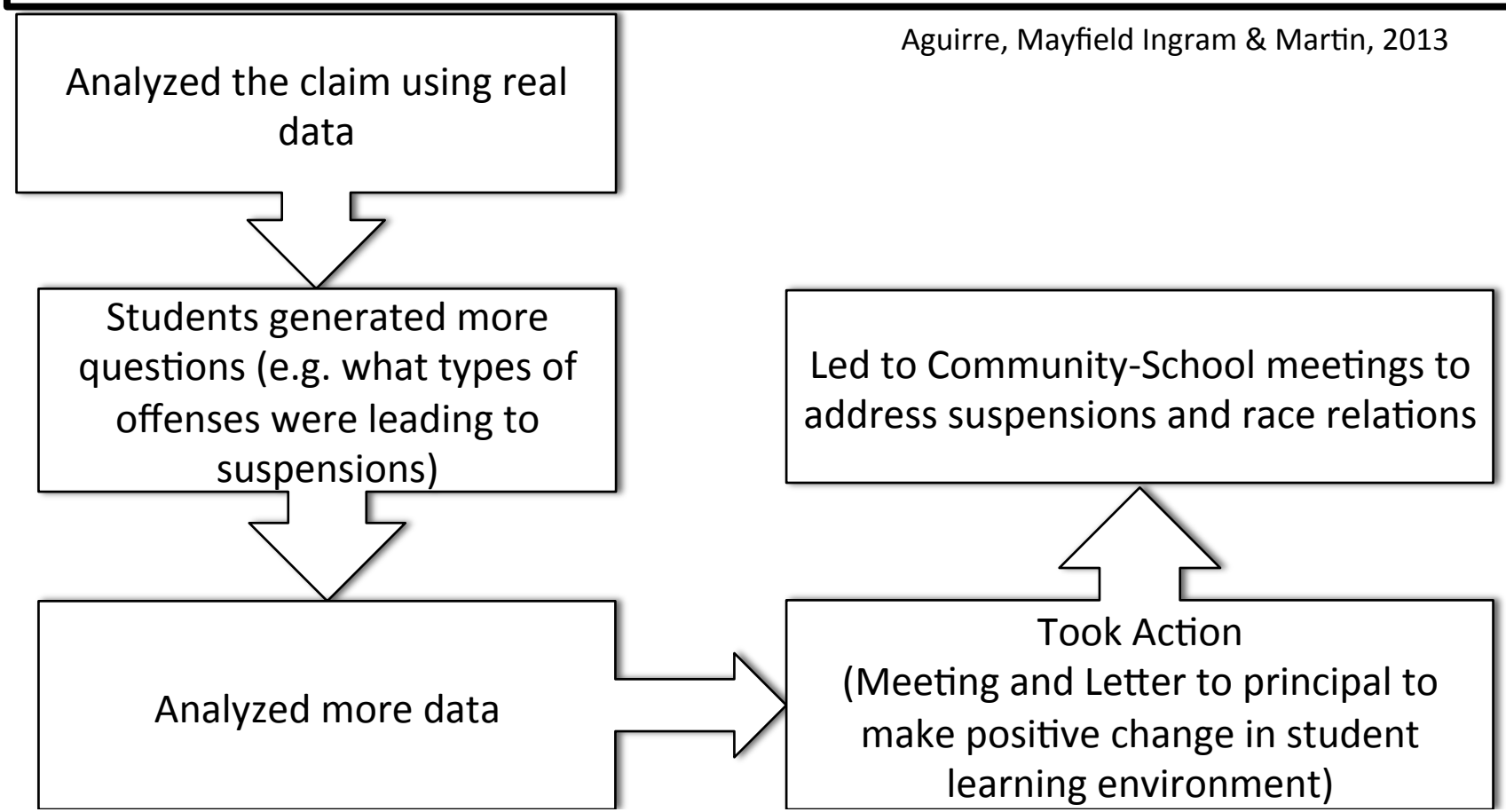


Aguirre, Mayfield Ingram & Martin (2013) Aguirre & Zavala (2013) Gutstein, (2006); Gutstein & Peterson, 2005; 2013) Turner & Strawhun (2005; 2007); Rubel et al, 2009; Rubel & Chu (2012); Wager & Stinson (2012)

“He was suspended for being Mexican.”

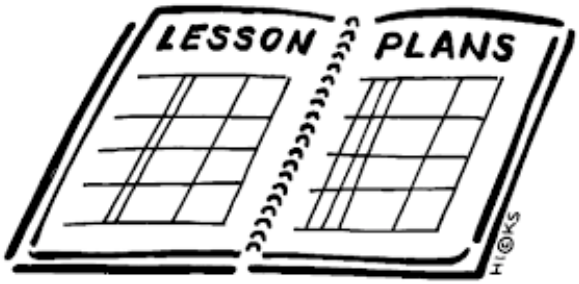
“Last week I heard one of my students say this in class when describing why a friend of his was recently suspended. If this is true, I want to address the injustice immediately because I refuse to work in a racist school. Before I complain to my principal I need to have data ready.”

Aguirre, Mayfield Ingram & Martin, 2013



Community Math Walk

Identify mathematical practices and mathematical funds of knowledge in students' communities by interviewing students and going on a **Community Walk/Visit.** Design a standards-based lesson that connects to these community/family practices



Aguirre et al (2012); Bartell et al (2010)
Turner et al (2012); Turner et al (2014)

Las Socias Tienda (Bilingual Spanish/English)

Grandma is visiting from Mexico. She'd like you to do her shopping. She has given you $40 ($70). Is this enough? Explain your reasoning in at least 2 ways. Here is Grandma's shopping list for the Mexican Grocery Store.

La lista de abuela #1:

chiles chipotles – 3	*$3.00/can*
enchilada sauce – 2	*$3.00/can*
pinto beans - 2	*$1.25/small can*
pinto beans – 5	*$3.00/large can*
salsa picante (hot) – 1	*$1.65/can*
pacaya - 1	*$5.50/can*
arroz (rice) - 2	*$2.50/bag*

La lista de abuela #2:

paper plates – 3	*$5.00/package*
paper cups – 2	*$6.00/package*
napkins – 5	*$4.00/package*
straws – 2	*$5.00/package*
table cloth – 1	*$10.00*

3rd grade lesson

Las Socias Lesson Overview

- LAUNCH: Two students role play scenario between *abuela* (grandmother*)* and grandchild in Spanish. Teacher follows up skit and explains in English the task using the grocery list items and checking for any confusions about the context.

- EXPLORE: Students can select their list and work in groups to solve the task.

- SUMMARIZE: Ask students to identify math concepts used in their solutions. Remind student that this situation is similar to a problem their classmate brought to class. How could they help their classmate? Ask students to consider how their solutions might help others in this situation. Ask students to comment on the strengths and weaknesses of group work.

Las Socias Tienda – Connecting to CFoK

- Talked with students
  - (10/24 Latino- Mexican descent)
- Interviewed store owner
- Task reflected **authentic** math practices and items in setting
- Role play family interaction (Abuela, child)
- Showcase L1(Spanish) as a math resource in lesson launch and math tasks

"We chose the shopping list for the tienda because the students shop there frequently... We thought the idea of Grandma's shopping list would be especially engaging for the students. We took pictures of the goods to be bought, and the real items would be used for the lesson, in order to be more authentic."

Las Socias Tienda – Cognitive Demand & Depth of Student Knowledge

- Task demanded multiple strategies
  - "Explain your reasoning in at least 2 ways"
- Intentional number choice
- Explicit encouragement of multiplicative (rather than additive) thinking
  - "Can you use multiplication to explain this in another way?"

"We liked the idea of creating 2 shopping lists with different items. This enabled 1 list with "easy" price points of round numbers to multiply, and another with more "challenging" price points and letting students choose their list/level of difficulty…"

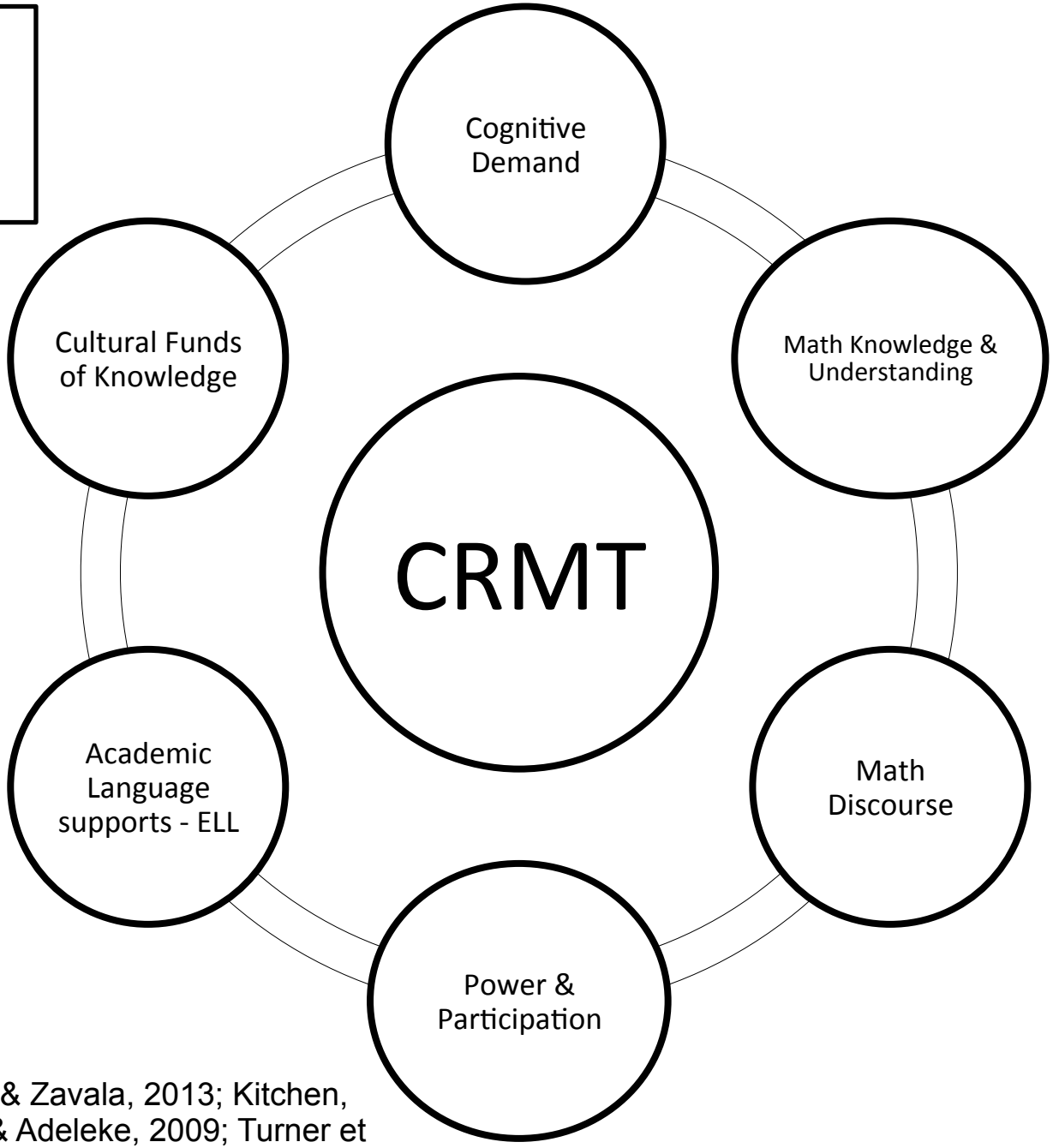
Focus question

Las Socias Tienda –Power & Participation

- Multiple entry points
- Students worked in small groups
- Launched the task in L1 and English
- Paid explicit attention to status issues in task development

"We kept the items on the list distinctly different so it would not appear as if one were an "easy" list for "low" kids, as 2 lists with same goods, but different quantities surely would have."

CULTURALLY RESPONSIVE MATHEMATICS TEACHING



(Aguirre 2009; Aguirre & Zavala, 2013; Kitchen, 2005; Leonard, Napp & Adeleke, 2009; Turner et al, 2012, Aguirre, et al, 2012)

Wrap-Up Reflection

- What did you learn about culturally responsive mathematics teaching? New insights/ wonderings?

- What might be one CRMT strategy or focal area you might try or strengthen this year?

Final Thoughts

- CRMT embraces common core essentials and expands them to include attention to:
  - **Power and status** (in participation and discourse)
  - **Academic language needs of ELLs** (in cognitive demand, discourse, precision)
  - **Cultural funds of knowledge and social justice** (in problem-solving and modeling)
- CRMT can positively transform inequitable systems and structures to promote mathematical advancement of students.
- CRMT can leverage positive change on multiple levels: individual, class, institution, state.

Julia Aguirre
jaguirre@uw.edu

THANK YOU!!

Teachers Empowered to Advance CHange in MATHematics