

MAKING MATHEMATICS FAMILIAR: INCREASING INTEREST AND ACHIEVEMENT THROUGH CULTURAL RELEVANCE

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Explore and
Share Ideas
on the
CRMT
Padlet

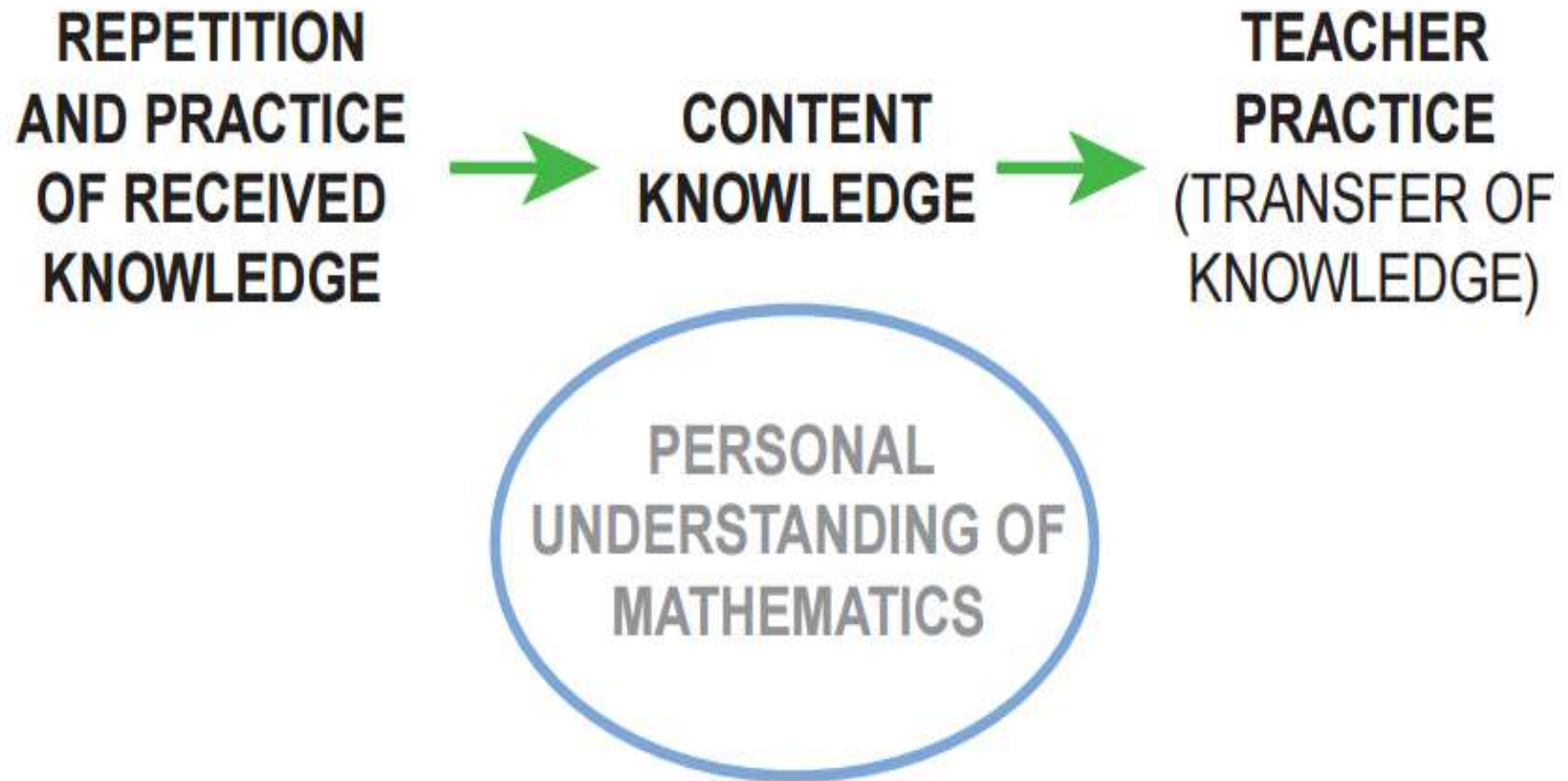


<https://padlet.com/ellismathed/crmt>

Session Goals

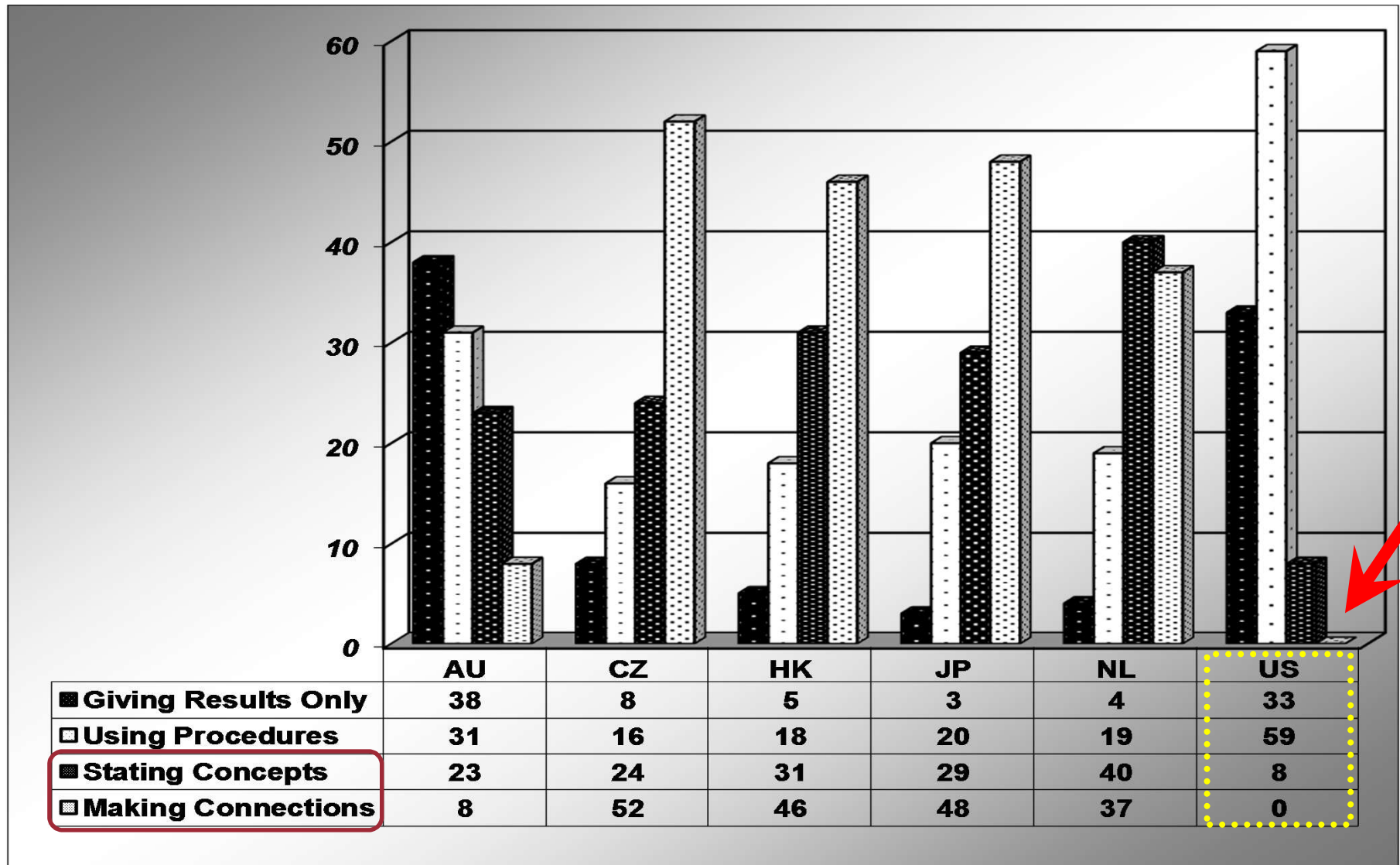
- Know more about why culturally responsive mathematics teaching (CRMT) is needed
- Learn about a tool for supporting the use of culturally relevant teaching
- Consider examples of CRMT
- Reflect on the challenges and opportunities of learning to use CRMT

Historical Practices of U.S. School Mathematics



(Ellis, 2003)

Focus of U.S. Math Lessons



<http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2003013>

School Math...and Real World Math

<http://robertkaplinsky.com/what-does-it-mean-to-understand-mathematics/>

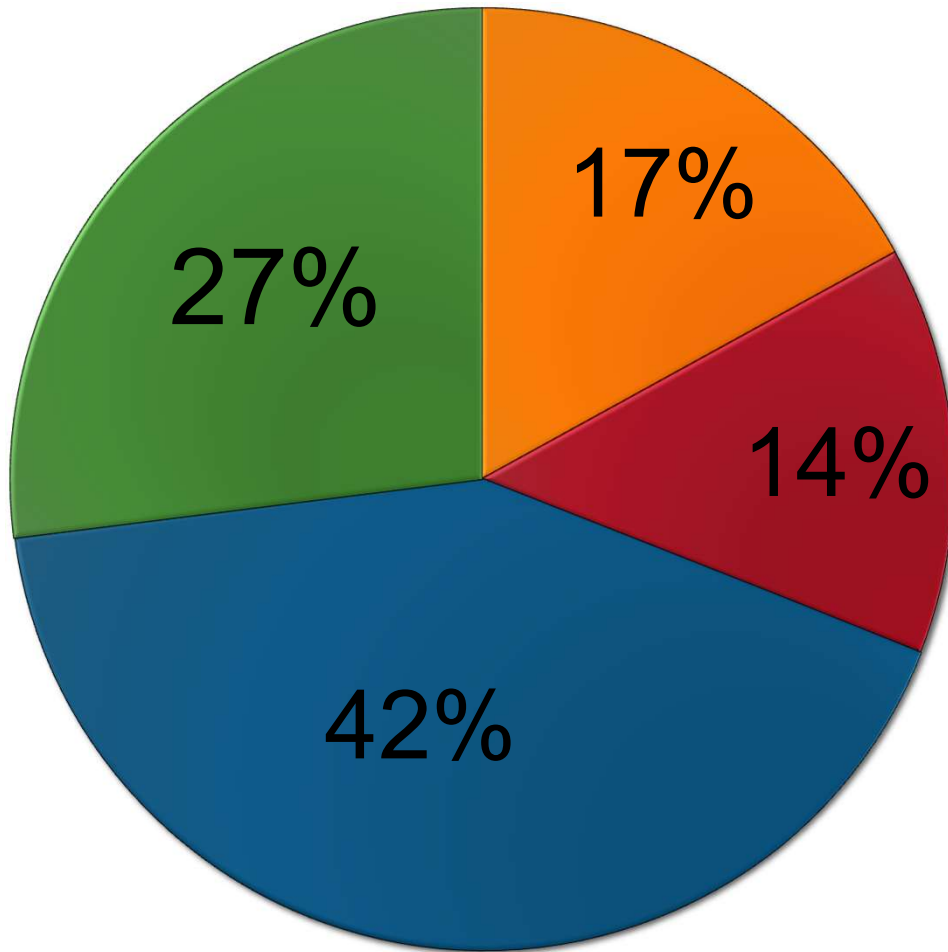
STEM Interest Declines from Middle School among All Students but...

- Female students' interest in STEM declines more than male students
- African American and Latino/a students report lower levels of interest in STEM than others

(Some) Reasons

- Lack of relevance, meaning
 - Less opportunity for personal and parental involvement
 - Implicit Bias and Stereotype Threat
- Less confidence in abilities; lower achievement

12th Grade Students in the U.S.



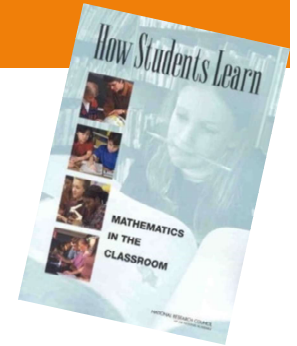
■ Math Proficient +
STEM positive

■ Not Math
Proficient +
STEM positive

■ Not Math
Proficient +
STEM negative

■ Math Proficient +
STEM negative

Principles of Expert Learning (“How Students Learn”)



1. Learning is enhanced when new and existing knowledge is **structured around the major concepts**.
2. New knowledge and understanding **builds on existing knowledge and experience**.
3. What is learned is **shaped by the context in which knowledge and skills are acquired**.
4. **Social interactions enhance learning**.
5. **Learners' motivation to learn and beliefs about their abilities influence how much is learned and how much effort is put into the learning process**.

Research Also Tell Us...

- mathematics ability is primarily a function of **opportunity, experience, and effort**—not innate intelligence.
- effective mathematics teaching **cultivates mathematics abilities.**
- equitable access and support includes attention to **students' reasoning and identities**— *one size does not fit all.*

Aims of Culturally Responsive Mathematics Teaching

- **Promote deep, meaningful mathematics learning**
- **Value students' sense of identity**
- **Build on students' cultural assets**
- **Expand students' sense of possibility**
- **Empower students to analyze issues and generate solutions**

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Transforming Academic and Cultural Identidad through Biliteracy (TACIB)



CALIFORNIA STATE UNIVERSITY
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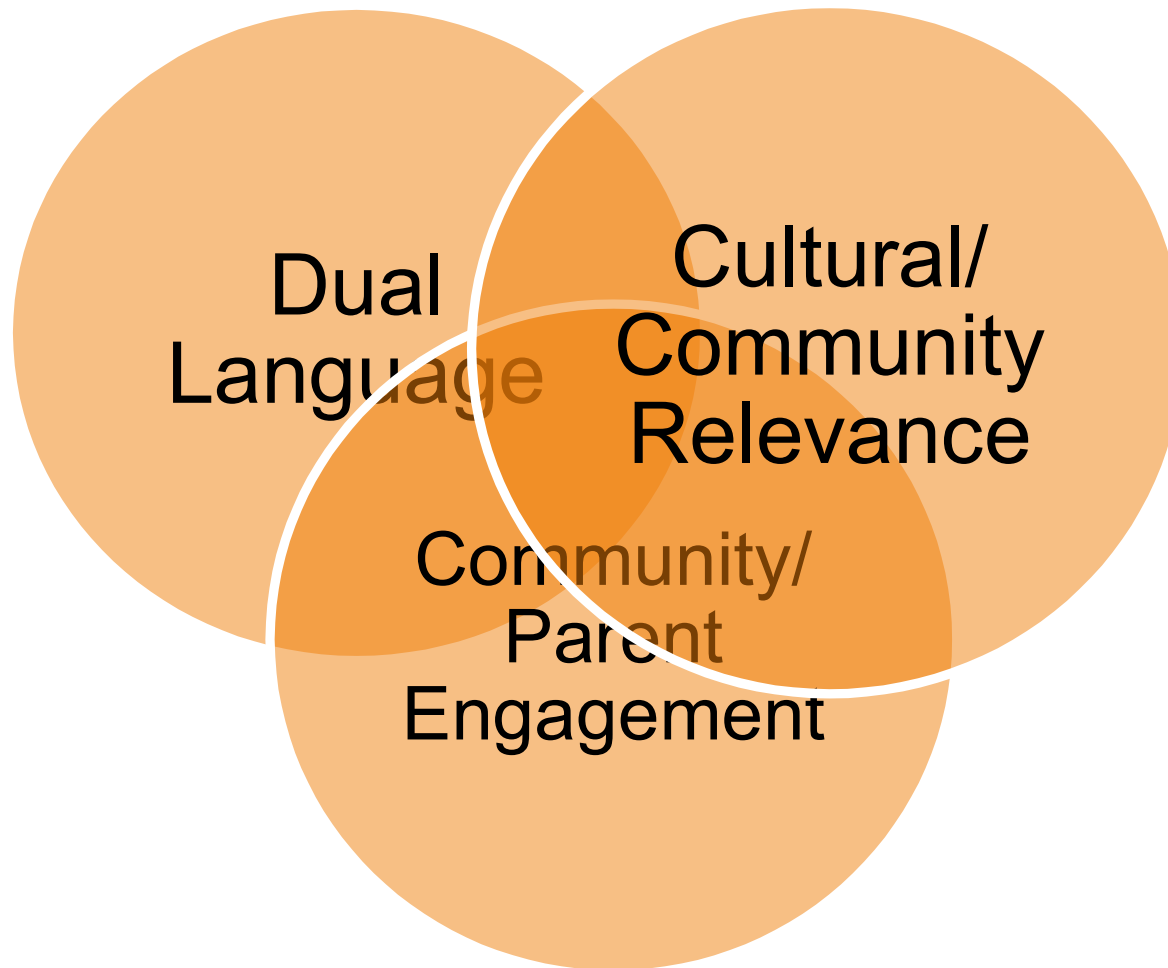


Collaboration to create culturally relevant lessons,
biliteracy, and family & community engagement in STEM.

<http://tacib.weebly.com/>

National Science Foundation award #1321339

TACIB Project Model



School District Partners
19,000 students K-6
30,000 students 7-12



79%



54%



11%



8%

TACIB Teacher Fellows

- **3 school sites, one elementary and two junior high**
- **12 teachers, all Latina/o and bilingual (Spanish/English)**
- **7 release days/year + week-long summer institute**

CRMT Lesson Analysis Tool

(Aguirre & Zavala, 2013 and [TEACH MATH](#))

- 1) Cognitive demand
 - 2) Depth of knowledge and student understanding
 - 3) Classroom discourse
 - 4) Power and participation
 - 5) Academic language support for ELLs
 - 6) Cultural/community-based funds of knowledge
 - 7) Use of critical knowledge/social justice
- WHAT?
- HOW?
WHO?
- WHY?

Funds of Knowledge/ Culture or Community Support

- **How does my lesson help students connect the content with relevant/authentic situations?**

1	3	5
No evidence of cultural/community connection; “culturally neutral” context	At least one sustained example of connecting math to students’ interests/culture /community	Intentional connections to interests/culture/ community throughout the lesson; Understanding of math and of culture/community are deepened, extended

Learning about Students' Funds of Knowledge

Funds of Knowledge includes...

- linguistic and ethnic patterns of interaction
- aspects of familial and community knowledge and lived experiences
- “the behaviors, beliefs, and artifacts of the communities of the particular students in a particular classroom” (Ensign, 2003, p. 415)

Must know your students' context and communities

- Cultural/Community Resource Map
- See <https://padlet.com/ellismathed/crmt>

Example: Lotería and Integer Addition

<https://www.youtube.com/watch?v=J3YW9HBtT8g>

You pay 10 pesos to play the lotería. You win 32 pesos, and the next round you decided to play again and pay 30 pesos. You lose the second round and pay 20 pesos on the third round where you win 12 pesos.

- **How many pesos do you have after the three rounds?**
- **How can you express each round using mathematical notation?**

Example: Currency Exchange and Proportional Reasoning



1 US Dollar =
7.5 Guatemalan Quetzal



You go the market with your grandmother to buy enchiladas Guatemaltecas. The sign says 2 Quetzales for 3 enchiladas.

- 1. What will it cost for 8 enchiladas?**
- 2. What is the cost in U.S. dollars for 1 enchilada?**

Ms. Saldivar's Reflection

I thought that making math relevant to students involved simple changes to math problems, like using Hispanic names.

*Now I am constantly thinking about how I can create a lesson that is culturally relevant for my students and trying to infuse the social justice components into most lessons. **My focus is not just on procedures but in depth understanding of math using relevant problems...having students explain their thinking and develop real world solutions.***

- 7th grade teacher

Power and Participation

- **How does my lesson distribute math knowledge authority, value student math contributions, and address status differences among students?**

1	3	5
The authority of math knowledge exclusively resides with the teacher who has the final word about correct answers. Student math contributions are minimal. Status differences are evident.	The authority of math knowledge between teacher and students is sporadically shared. At least one instance where multiple contributions are accepted and valued. At least 1 strategy to minimize status differences.	The authority of math knowledge is widely shared between teacher and students. Mathematical contributions are actively elicited from students and all are valued. Multiple strategies to minimize status among students are evident.

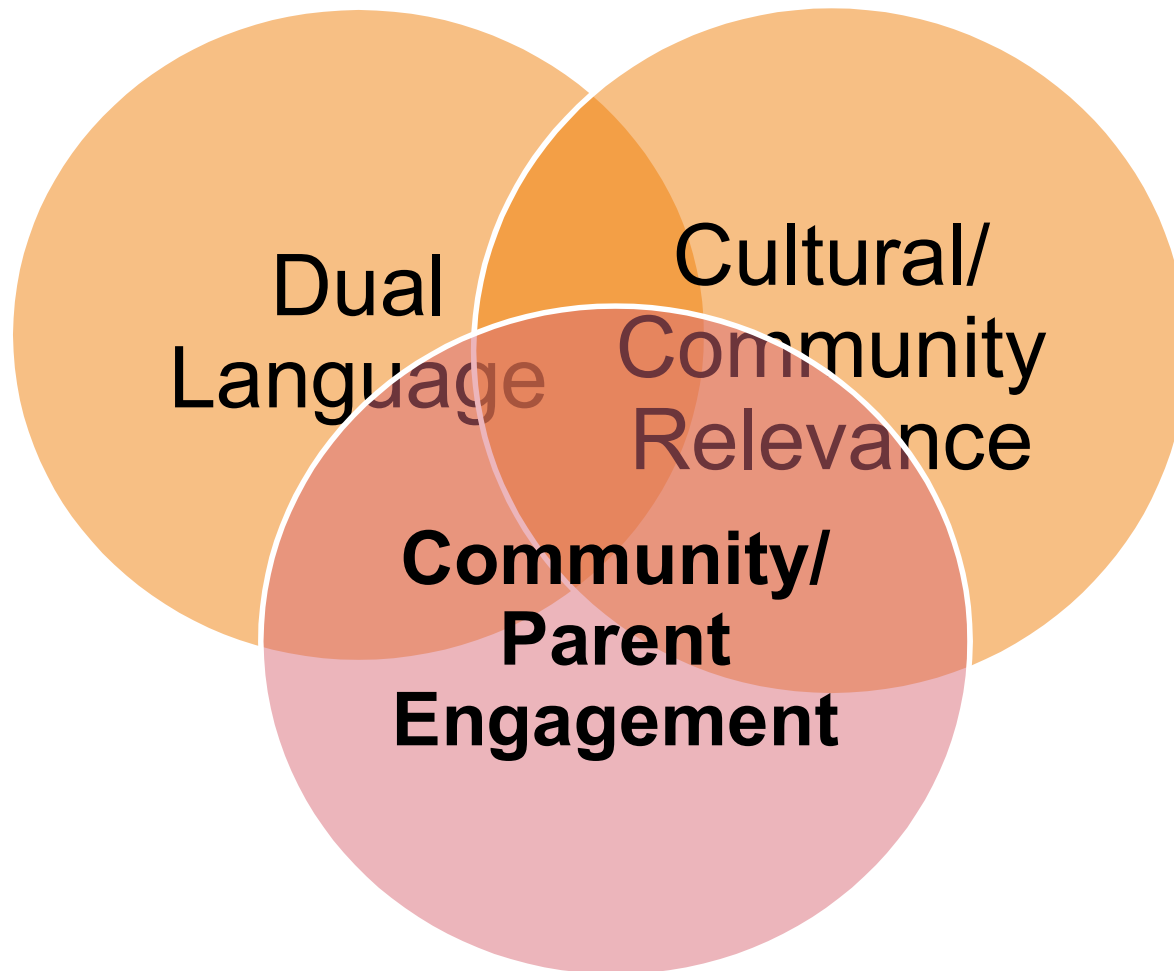
Turn and Talk

Or use <https://padlet.com/ellismathed/crmt>



- **How well did these lessons reflect...**
 - **Funds of Knowledge/Culture or Community?**
 - **Power and Participation?**
- **What ideas about Funds of Knowledge/Culture or Community have you used in your lessons?**
- **What have you done to address Power and Participation?**

TACIB Project Model

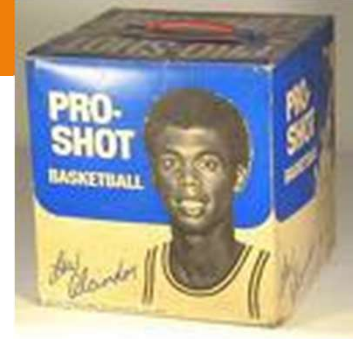




Parents Sharing Mathematics

- <http://tacib.weebly.com>

Packaging Basketballs

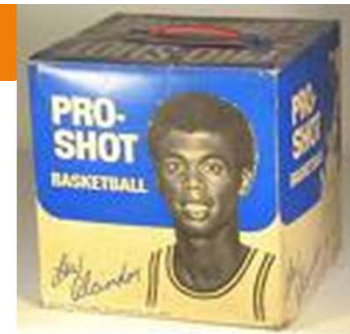


- The Lew Alcindor basketball comes in a cube-shaped box that measures 1 foot along each edge. These smaller boxes are shipped to stores in one large box that contains 24 basketballs.
- **TASK: In how many possible arrangements you can package the 24 boxes?** Use the set of cubes provided and a table like the one below to organize your data.

Length	Width	Height	Volume	Surface Area	Sketch

1. How can you be certain that you've found all possible arrangements?
2. What is best way to arrange these and why?
3. Why doesn't the company send these in sets of 26 basketballs?

Empaquetado de Pelotas



- La pelota de baloncesto del jugador Lew Alcindor viene en una caja cúbica cuyas aristas miden 1 pie de largo. Estas cajas se mandan a las tiendas en una caja más grande que contiene 24 pelotas. **EJERCICIO: ¿Cuántos arreglos se pueden hacer con 24 pelotas? Usa los cubos para producir los arreglos y la tabla a continuación para organizar tus datos.**

Largo	Ancho	Alto	Volumen	Area de Superficie	Bosquejo

- ¿Cómo puedes garantizar que tienes todos los arreglos posibles?
- ¿Cuál es la mejor forma de arreglar las pelotas? ¿Y por qué?
- ¿Por qué crees que la compañía no manda las pelotas en paquetes con 26 pelotas?

The Quinceañera Problem

Isabel wants to invite 130 guests to her quinceañera. How many tables and chairs do you need if each round table seats 8 and each rectangular table seats 6?



Ms. Orozco's Reflection

I feel like an active agent of change in my community. What I teach in my classroom transcends not only the walls of my classroom but also breaks down cultural barriers. Informing parents of how their children can grow up to be mathematicians and scientists who develop the next “big thing” seems so much more attainable now.

- 5th grade teacher

Use of Critical Knowledge/Social Justice

- How does my lesson support students to use what we have learned as a vehicle to understand, critique, and change an important issue in their lives?

1	3	5
No evidence of connection to critical knowledge	There is at least one instance of connecting mathematics to analyze a sociopolitical/cultural context.	Deliberate and continuous use of mathematics as an analytical tool to understand an issue/context, formulate math-based arguments to address the issues and provide substantive pathways to change/transform the issue.

Why Does Empowering Students to Use Math to Critique Matter?

“The mere imparting of information is not education. Above all things, the effort must result in making a [learner] think and do for him[/her]self. ... The only question which concerns us here is whether ‘educated’ persons are actually equipped to face the ordeal before them or unconsciously contribute to their own undoing.”

- Carter Woodson, 1933



What Does It Mean to be Transformative?

- Authentically connect math/science with issue in students' community/culture.
- Provide opportunities to use math/science to understand, analyze, and present findings.
- Empower students as **active change agents**.

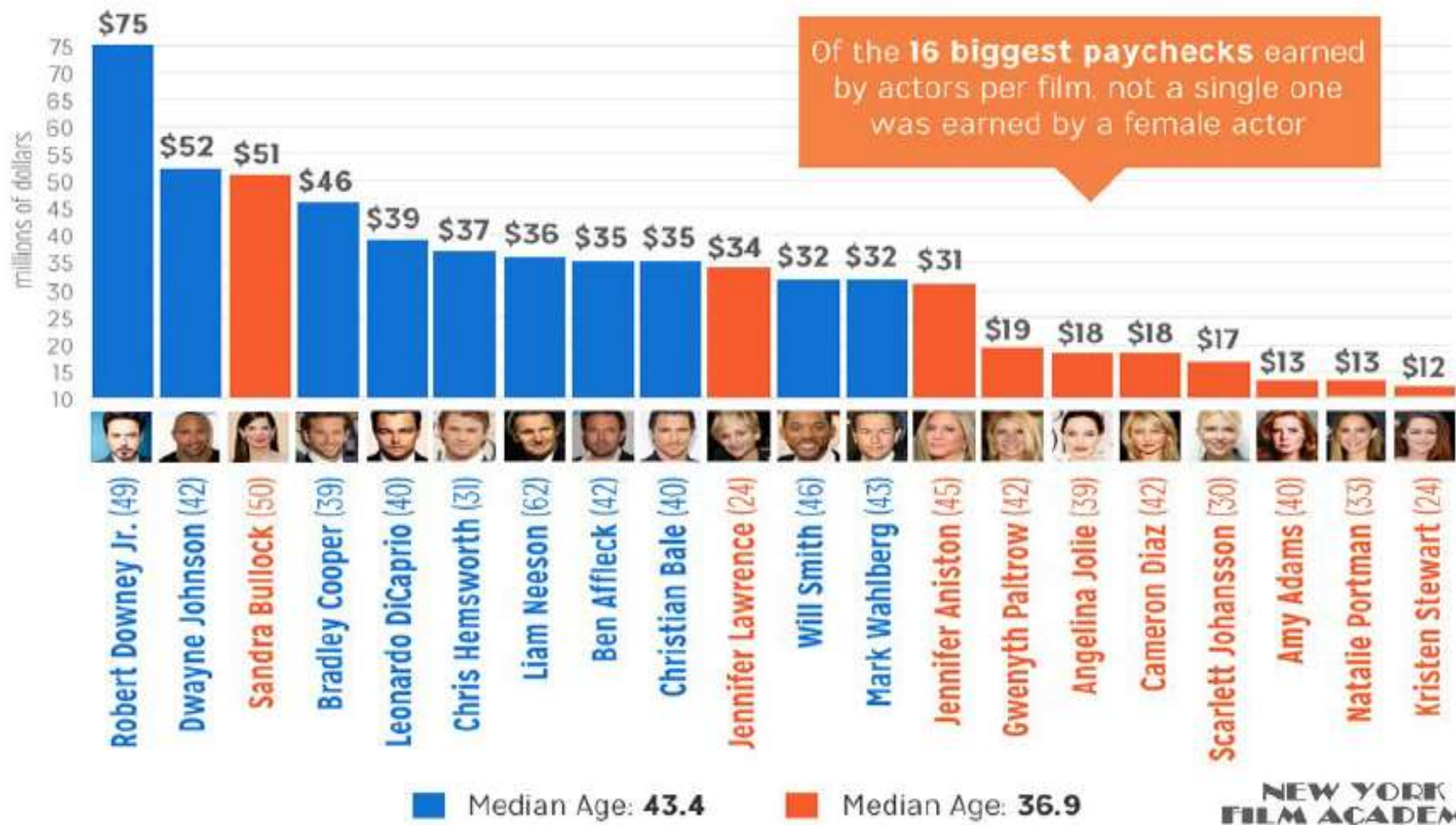
Why Does This Matter?

“The mere imparting of information is not education. Above all things, the effort must result in making a [learner] think and do for him[/her]self. ... The only question which concerns us here is whether ‘educated’ persons are actually equipped to face the ordeal before them or unconsciously contribute to their own undoing.”

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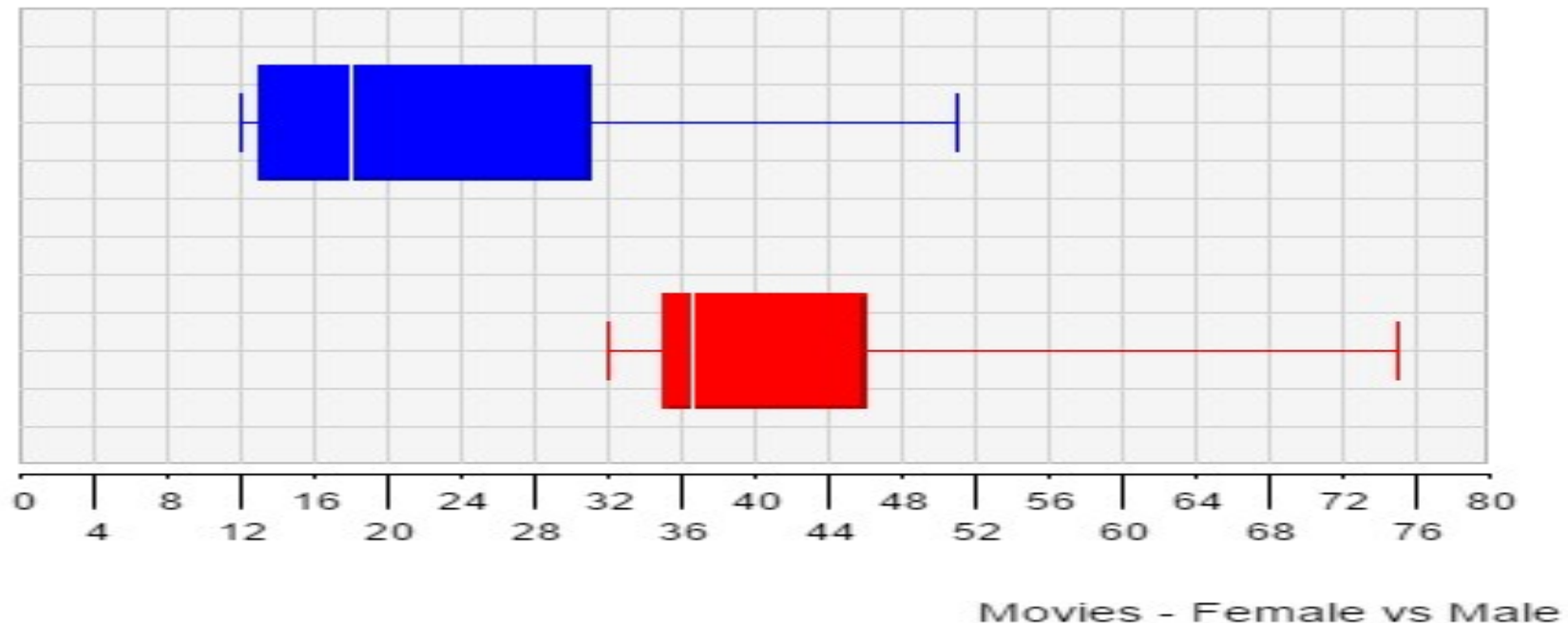
Is This Fair?

IN 2014 ONLY TWO WOMEN, SANDRA BULLOCK AND JENNIFER LAWRENCE, CRACKED THE TOP TEN LIST OF HIGHEST PAID ACTORS, AN INCREASE OVER THE ONE FEMALE ACTRESS IN 2013 TO DO SO. IN ADDITION, AGE STILL APPEARS TO BE A FACTOR IN AN ACTRESS'S MONETARY SUCCESS AS COMPARED TO MEN.



Box Plots and Wage Fairness

1. Create two box plots, one for Top 10 Male Actors and one for Top 10 Female Actors.
2. What do you notice about the plots?
3. Write a mathematical argument to support the claim that the wages are not fair.



Investigation of Cell Tower Placement

1. What areas of Anaheim already have great signal? What streets?

North Ball St, and North East St, already have great signal.

Decide where to place a third tower.

2. What are the coordinates of the third tower? (1.8, 0.8)

3. What is the distance from this tower C, to tower A and B.

$$AC = 5.5$$

$$BC = 3.6$$

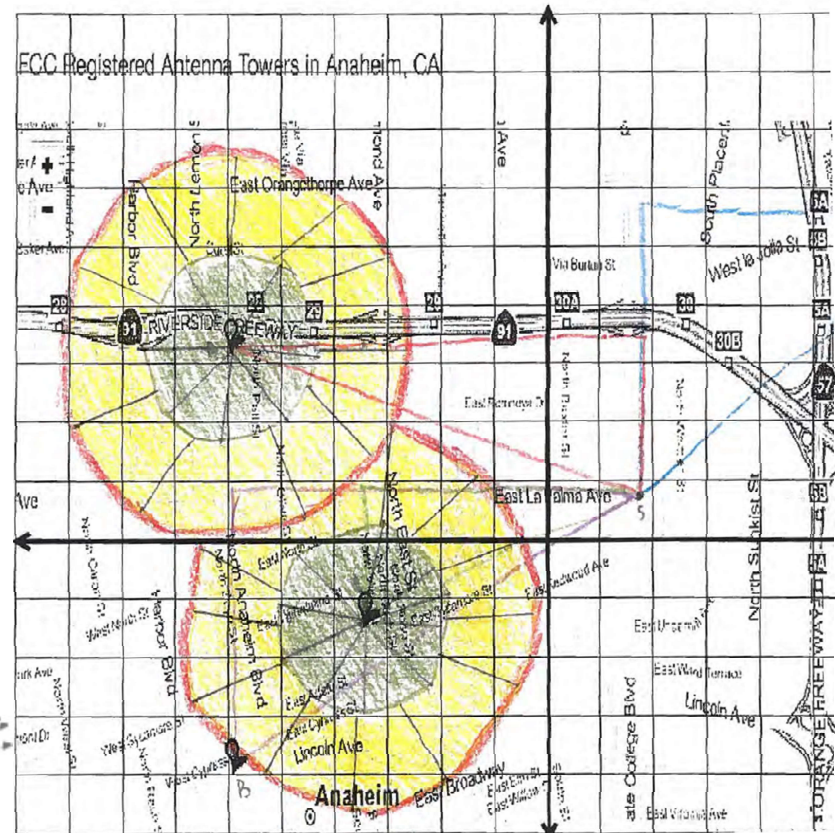
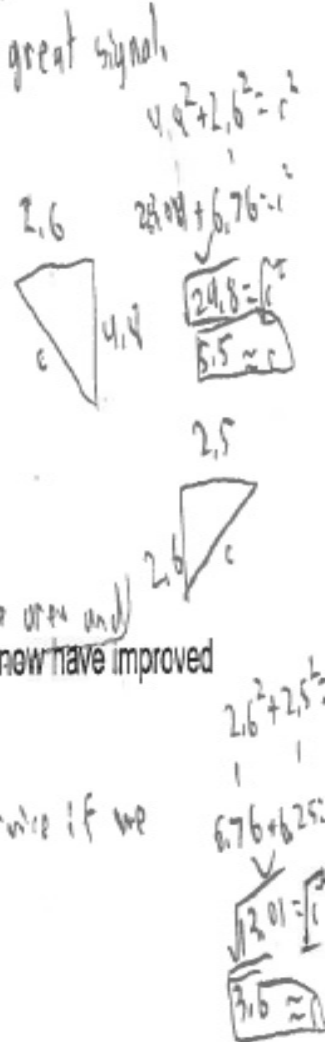
4. What are the reasons you placed this tower in this location?

We decided to place the tower at Sycamore

Because that way, there would be better signal in the area and

5. By placing this tower at this location what other parts of Anaheim now have improved cell service? Sycamore would get money for doing it.

East Lo Palms Avenue would have improved cell service if we decide to place a cell tower at Sycamore.



Student Argument for Cell Tower

Did you know that thousands of people can use a single cell tower everyday? We believe that there should be a cell tower located at Sycamore Junior High School. Some evidence to back our statement up are that Sycamore could get hundreds of thousands of dollars if they place down a cell tower, the closer you are to a cell tower, the better signal there will be, and that there isn't a cell tower currently close enough to give us a good signal. You can counterargue that the radiowaves that the cell tower emits can cause harm to us and possibly cause cancer. The weakness to that argument is that there is no scientific evidence to back up that statement.

Cell phone companies are willing to pay a lot of money to place cell towers. Sycamore can use this money to offer different programs or buy new school materials. According to ocregister.com, "APWireless could take over the leases for 13 cell towers for 15 years. In return, the district received \$3.2 million, he said, which will be used to buy iPads." Ocregister also states that a school in California, Esperanza High School, has cell tower on a light pole between it's football and baseball fields and that they use the money to pay for books, salaries and employee benefits.



Wheelchair Ramp Safety

<https://www.youtube.com/watch?v=RJMdXbDGjYg>

Wheelchair Ramp Design

1. Read about wheelchair ramp requirements in the Americans with Disabilities Act (ADA).
2. Using images from the video, determine why the ramp does not meet ADA specifications.
 - a. Explain what tools and reasoning you used to prove this.
 - b. Give your estimates of the important dimensions to consider.
3. Using any digital tools you want, design a wheelchair ramp for the home in the video.
 - a. Give the dimensions of each component of the ramp. You may ignore the handrail requirement and focus on the ramp itself.
 - b. Explain how your design meets ADA specifications.
 - c. Provide an image of your ramp.

Turn and Talk

Or use <https://padlet.com/ellismathed/crmt>



- How well did these lessons reflect Critical Knowledge/Social Justice
- What ideas about Critical Knowledge/Social Justice have you used in your lessons?
- What questions do you have?

Critical Knowledge/Social Justice

1	3	5
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Outcomes

Teachers CRMT Self-Ratings

- Overall average increased from 2.4 to 3.5 (+46%)
- Power & Participation 2.5 → 4.0 (+60%)
- Funds of Knowledge 2.0 → 3.1 (+55%)
- Social Justice 1.7 → 2.5 (+47%)

Students in Grades 5-6

- Significantly higher mathematics scores than students in non-treatment students

Students in Grades 7-8

- Greater interest in STEM, particularly female students, compared to the control students
- Still analyzing achievement data



Insights from Our Work

CRMT is more than modified lessons.

- Getting to really know students
- Making authentic connections
- Attending to power and participation
- Developing deep understanding
- Engaging families as partners
- Empowering critiques of what is
- Opening doors to what is possible

Teachers Must Be Empowered, too!

Challenges → Opportunities

1. Teachers' prior experiences with mathematics
 2. Teachers' prior experiences with top down professional development
 3. Risk-taking is risky
 4. Curriculum and pedagogical constraints
1. Allow teachers to (re)discover interest in mathematics
 2. Empower teachers as experts of their students and how to meet their needs
 3. Create safe space for risks
 4. Engage in authentic conversations about what it means to "learn" math deeply

Ms. Orozco's Reflection

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- 5th grade teacher

Thank you!!

Questions?



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