

Culturally Responsive Teaching in Collegiate Mathematics

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Condominium Problem



In a particular condominium community, $\frac{2}{3}$ of all the men are married to $\frac{3}{5}$ of all the women.

What fraction of the entire community are married?

Adapted from: Lester, F. (2002). Classroom challenge: Condo problem. In B. Litwiler & G. Bright (Eds.), *Making sense of fractions, ratios, and proportions: 64th yearbook* (pp. 191-192). Reston, VA: NCTM.

What do YOU think?



In a particular condominium community, $\frac{2}{3}$ of all the men are married to $\frac{3}{5}$ of all the women.

What fraction of the entire community are married?

In the chat box (but don't press Enter yet!),

If you are the student, what is your reaction to this problem?

Story with Our Students (Initially)

Questions:

“Are only ‘men and women’ married?”

“No same sex marriages here?”

Comments:

“Oh give me a break....*somebody's* gay.”

“Nabb, why is math so fake?”

“This problem is so 60s.”

“This wouldn't be the case in reality.”

On defining **equity**

1. Access
2. Achievement
3. Identity
4. Power

Gutiérrez, R. (2009). Framing equity: Helping students “play the game” and “change the game.” *Teaching for Excellence and Equity in Mathematics*, 1(1), 5-7.

What should teachers do?

Continue using the problem with visible discomfort, or seek an alternative?

Our initial solution was to add a phrase:
“Assume each man is only married to one woman, and vice versa.”

On defining ***Culturally Responsive Teaching***

Culturally responsive teaching can be defined as using the cultural knowledge, prior experience, and performance styles of ethnically diverse students to make learning encounters more relevant to and effective for them . . . creating caring learning communities where culturally different individual and heritages are valued . . . challenging racial and cultural stereotypes, prejudices, racism, and other forms and intolerance, injustice, and oppression. (Gay 2018, p. 36, emphasis added)

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Mathematics (and the Perception of Neutrality)

Mathematics intertwines with social issues.

The result is a mathematics that is...

racialized

political

geographical

cultural

gendered

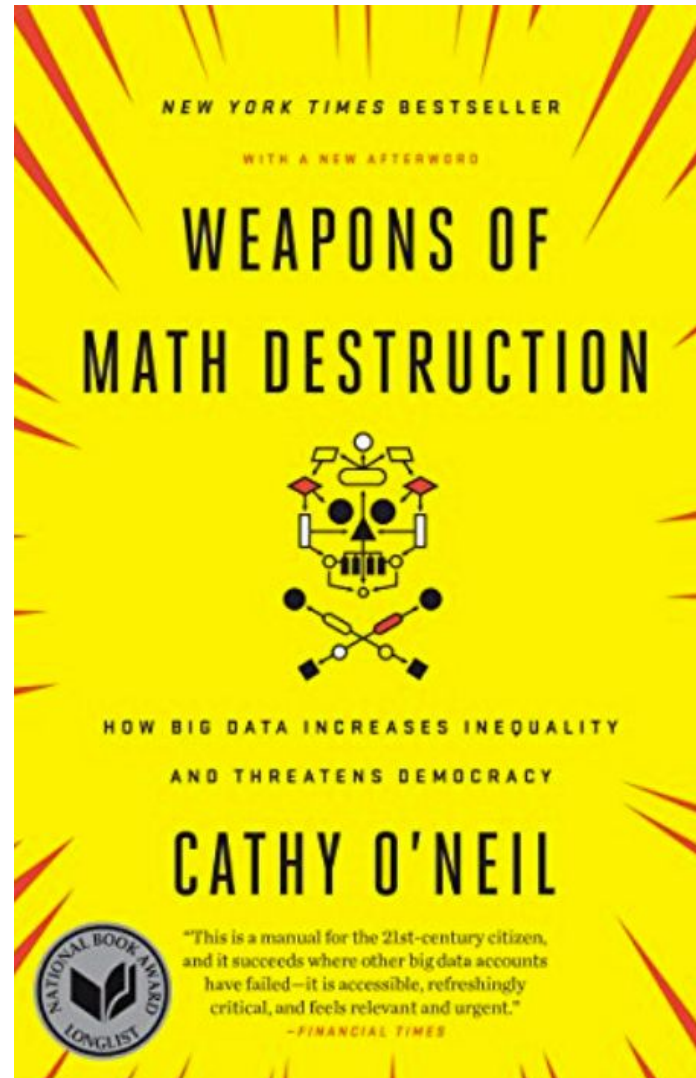
linguistic

socioeconomic

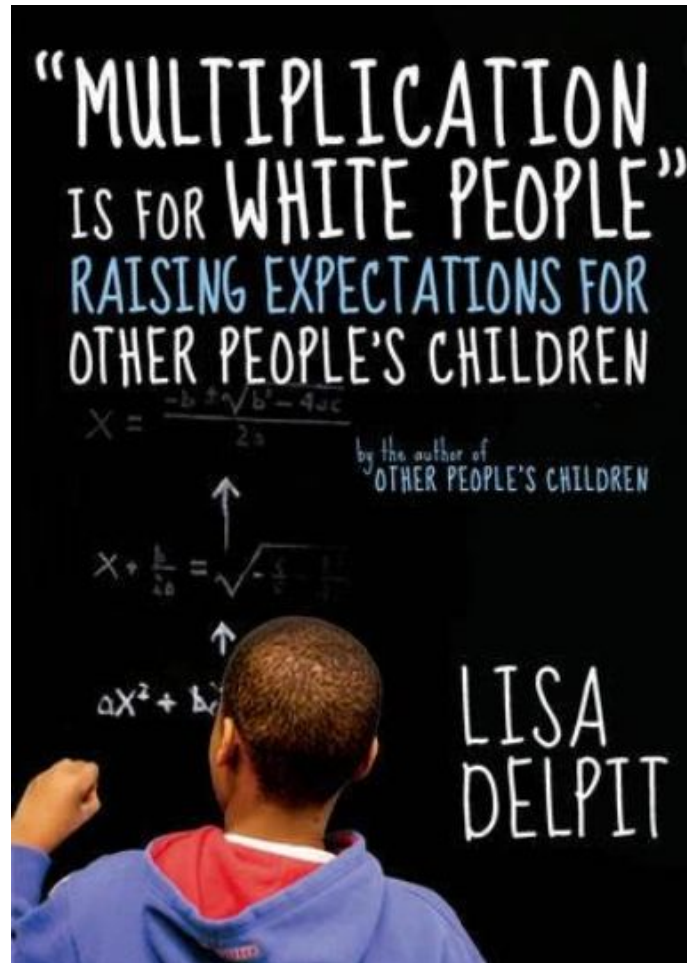
generational

or some combination thereof.

Political



Racialized



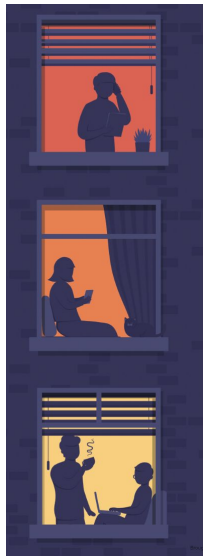
Cultural/Racialized



Source: Family Guy - C'mon! Do the Math! <https://youtu.be/8ko-PFtLtkk>

Let's Do Some Math!

- 2 minutes to unpack the problem individually
- Jot down some possible solution strategies (not the final answer)



In a particular condominium community, $\frac{2}{3}$ of all the men are married to $\frac{3}{5}$ of all the women.

What fraction of the entire community are married?

In the chat box (but don't press Enter yet!),
What strategy you could use to solve the problem?

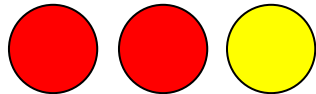
Mathematics of the Condo Problem

- Invokes reasoning about both ratios and fractions
- Possible strategies from our students:
 - common denominators: $10/15 + 9/15 = 19/30$
 - combining ratios: $10/15 \oplus 9/15 = 19/30$
 - multiplication, division, or addition of fractions
 - trial and error
 - algebraic equations
 - common numerators: $6/9 \oplus 6/10 = 12/19$

Example of Common Numerators

Building up with counters

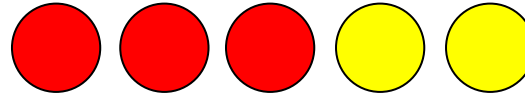
Married Unmarried



Men

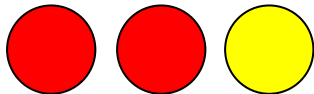
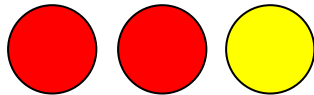
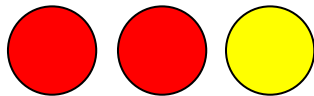
Married

Unmarried

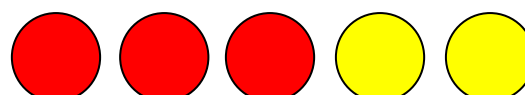
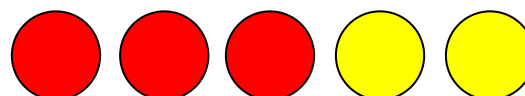


Women

Then the students can “clone” (Lamon, 2005, p. 185), meaning the students can repeat a unit ratio without having to know the overall size of the community.



Men



Women

Rewritten Problems (by Students)

Here's a new condo problem: Guinea pigs are social creatures and are meant to live with a buddy. Not all owners know this so not every guinea pig ends up with a buddy. In a certain pet store, $\frac{2}{3}$ of the brown guinea pigs have a buddy and $\frac{3}{5}$ of the white guinea pigs have a buddy. What fraction of the guinea pigs have a buddy? (Each guinea pig can only have one buddy.)

In my closet, $\frac{2}{3}$ of all my jeans still fit me and $\frac{3}{5}$ of all my shirts fit me. What fraction of all the clothes in my closet fit me?

At an animal shelter, $\frac{2}{3}$ of all the dogs have brown spots. $\frac{3}{5}$ of all the cats have brown spots. What fraction of all the dogs and cats have brown spots?

For the condo problem you could change it from humans to penguins in a colony. Since penguins are animals that mate for life you could say that $\frac{3}{5}$ of the female penguins have mates and $\frac{2}{3}$ of the male penguins have mates.

Story with Our Students (After)

Is the problem appropriate? Timely?

“There are far more same sex marriages occurring now so this problem needs updating.”

“I think it is neat that you can see the past in a problem like this. This used to be pretty normal, but now it seems like you are behind the times if you use this problem.”

“I had no idea this [rewriting problems to be more inclusive] was a thing. I guess like everything else, these problems eventually expire.”

Story with Our Students (After)

Pedagogy/Teacher Decision-Making

“This made me think a lot about teaching. I think we teach more than just math. We have to teach about life and how to be welcoming to one another.”

“Kids are like sponges. They will probably ask a lot of questions about this problem. Imagine if one kid has two moms. They actually might be confused why this problem ignores that. The teacher has to be ready to have a conversation about this.”

Is the Condo Problem Unique?

Statistics/Data Interpretation. "This lesson uses texting to teach statistics. In the lesson, students will calculate mean, median, and standard deviation. They will construct and interpret dot plots based on data they collected. Students will also use similarities and differences in shape, center, and spread to determine who is better at texting, boys or girls."

Source: <https://www.cpalms.org/Public/PreviewResourceLesson/Preview/130630>

Discrete Math/Finite Math/Proof. Suppose at a dance party, every boy dances with at least one girl and no girl dances with all the boys. Prove that there must exist boys, b and b' , and girls, g and g' , in the party such that b dances with g and b' with g' , but neither b dances with g' nor b' with g .

Source: Joshi, K. D. 1989. Foundations of Discrete Mathematics. New Delhi: New Age International.

Is the Condo Problem Unique?

Addition and Subtraction. Nine boys and eight girls were in the class. How many children were in the class in all?

Source: <http://tasks.illustrativemathematics.org/content-standards/1/OA/A/1/tasks/161>

Discrete Math/Finite Math. In how many different orders can 3 married couples be seated in a row of 6 chairs under the following conditions?

- (a) Anyone may sit in any chair.
- (b) Men must occupy the first and last chairs.
- (c) Men must occupy the first three chairs and women the last three.
- (d) Everyone must be seated beside his or her spouse.

Source: Dossey, J. A., Otto, A. D., Spence, L. E., & Vanden Eynden, C. (2006). Discrete Mathematics. Boston, MA: Pearson.

Is the Condo Problem Unique?

Recursive Thinking. A Sultan arranged his wives in order of increasing seniority and presented each with a gold ring. Next, every third wife, starting with the second, was given a ring. Of these wives with two rings, every third one starting with the second received a third ring, and so on in this manner. His most senior and most cherished wife was the only one to receive ten rings. How many wives did the sultan have? Try to generalize your solution.

Source: Masingila, J. O., & Lester, F. K. (1998). Mathematics for elementary teachers via problem solving. Upper Saddle River, NJ: Prentice Hall.

Ratios and Rates. “...make a comparison of two quantities that are measured in the same units by comparing the ratio of the number of boys to the number of girls in this class to the ratio for different classes (and the whole grade).” (p. 13).

Eureka math: A story of ratios. (2016). Grade 7 Math, Module 1, Topic A, Lesson 1. An experience in relationships as measuring rate. San Francisco: Jossey-Bass.

Take Aways

1. Awareness that math intersects social issues
2. Culturally responsive teaching is everyone's responsibility
3. Action step: What's best for YOUR students and the classes you teach?

"A classroom cannot foster the development of autonomy in the intellectual realm while suppressing it in the social and moral realms."

Constance Kamii

For more details...



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Questions?

THE END

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Breakout Room to Do Some Math!

- 5 minutes to unpack the problem
 - Groups of 2 members
 - Use the time to record possible solution strategies
 - Breakout room slide deck
 - Breakout Room 1 works on the *We are Group #1* slide
 - Breakout Room 2 works on the *We are Group #2* slide
 - etc.
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