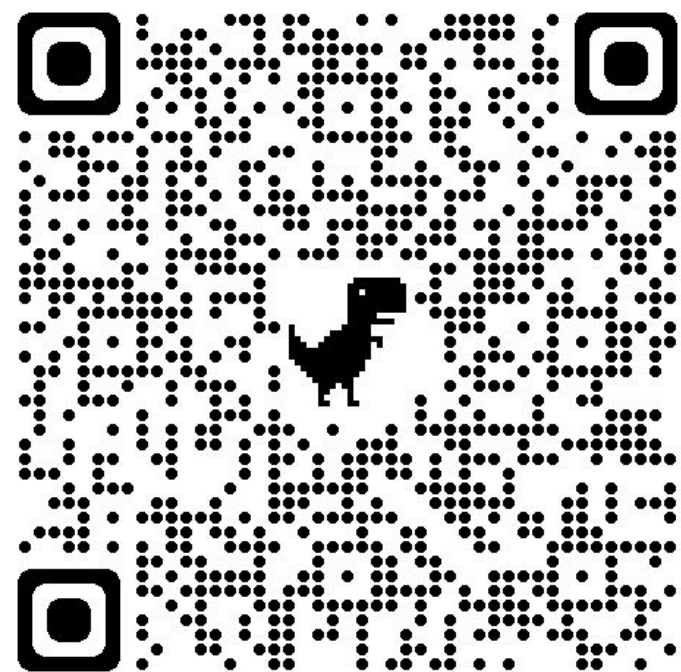




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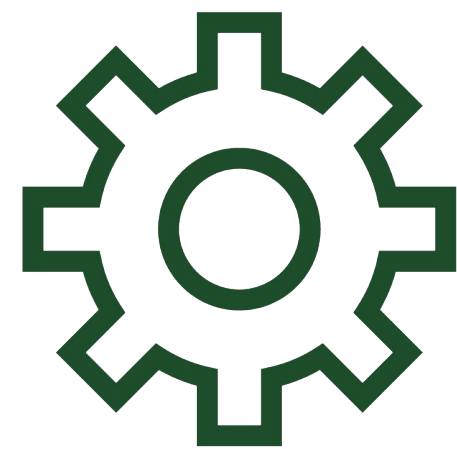
# Supporting Equity Through Coordination in Calculus: Balancing Fairness with Justice

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Jess Ellis Hagman  
Colorado State University

# Plan for Talk & Discussion

Brief background of  
components of  
Calculus programs



Framing of equity,  
systems, and asset  
orientation



Interactive discussion  
about new  
coordination system at  
CPP



# A little about ME and my Calc Journey

Went to Cal Poly SLO for BS and MS in math (switched from bus to math after taking bus calc)

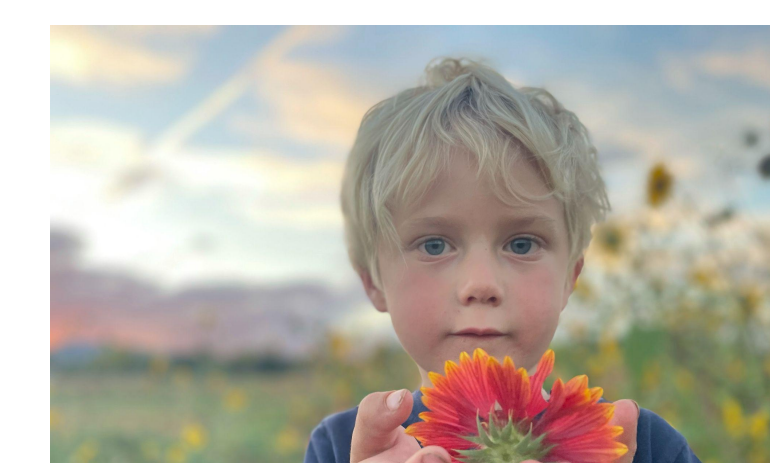
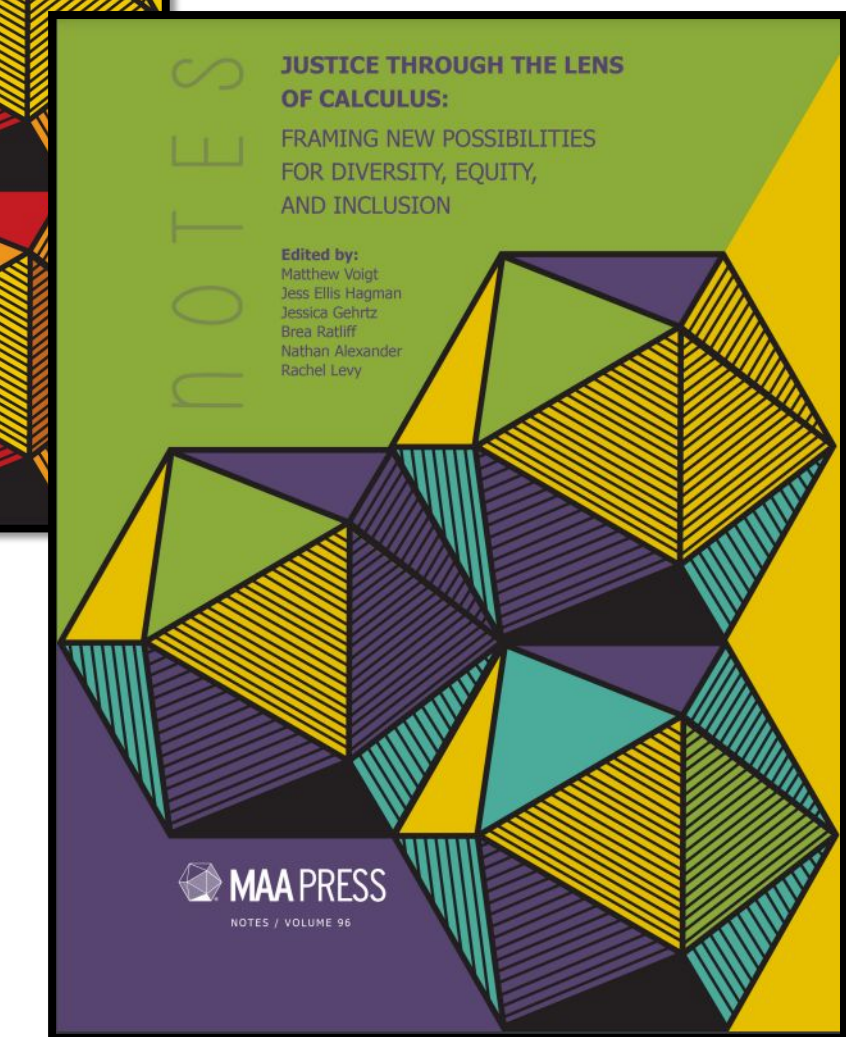
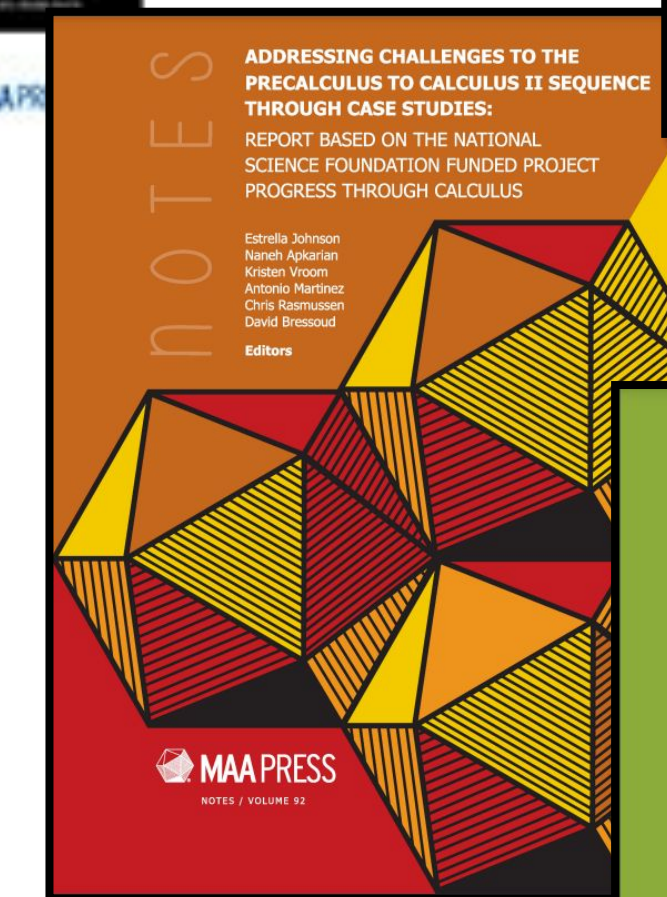
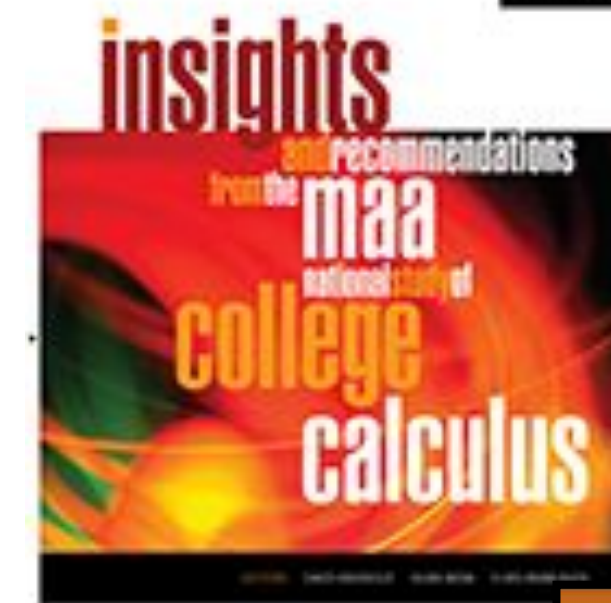
PhD in Mathematics and Science Education at San Diego State University / UC San Diego to “fix calc”

Research “characteristics of successful calculus programs” in some form for about a decade

Recognized the lack of equity within our approach - called for centering equity within discussions of success

2020: Got tenure, had first kiddo, pandemic - shifted focus to support departments to make these changes

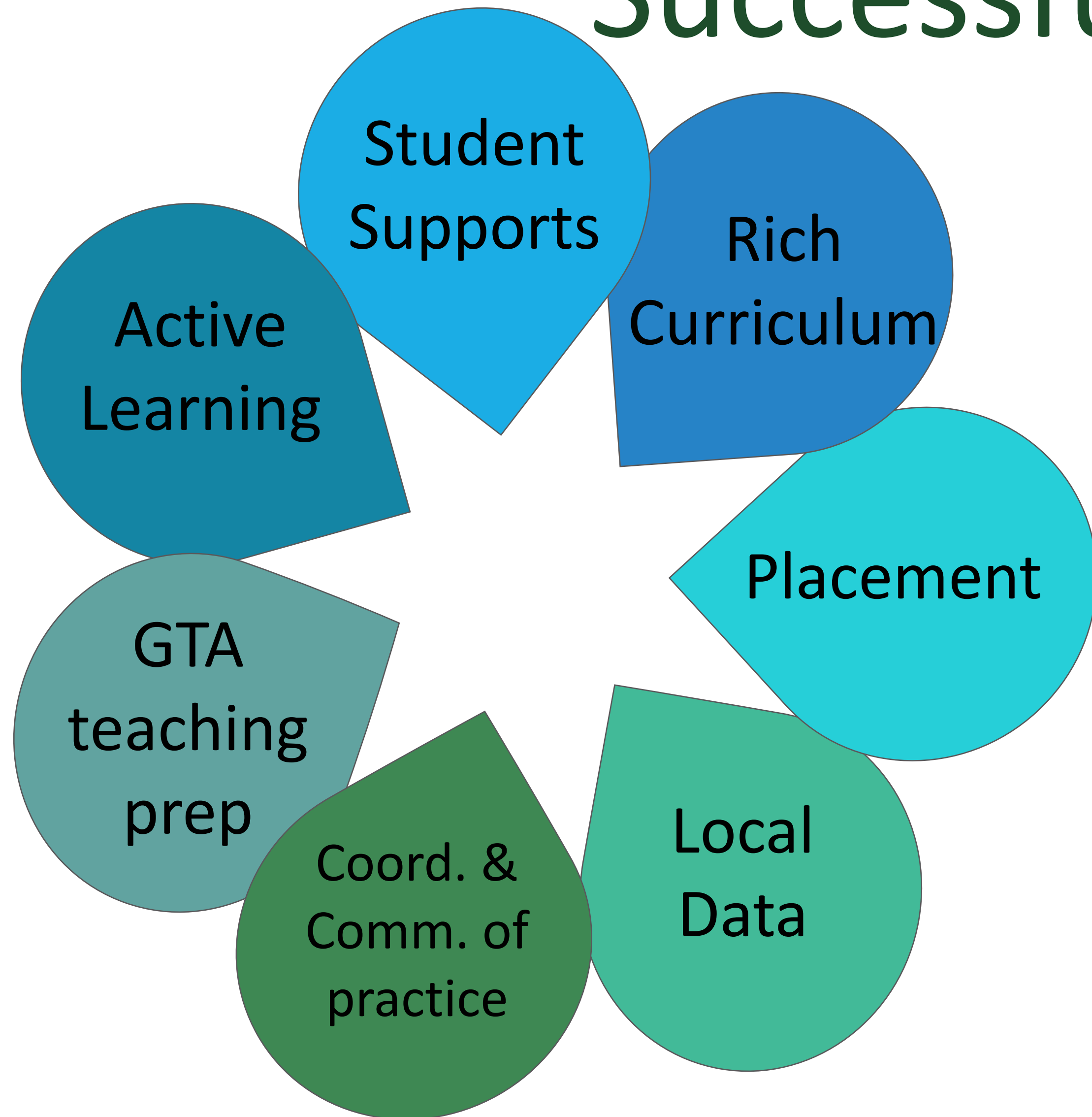
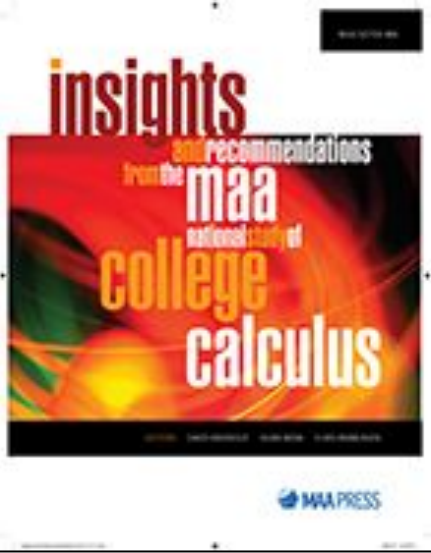
ACT UP Math grant - working with three department to center equity and student data



Achieving Critical Transformations in Undergraduate Programs in Mathematics

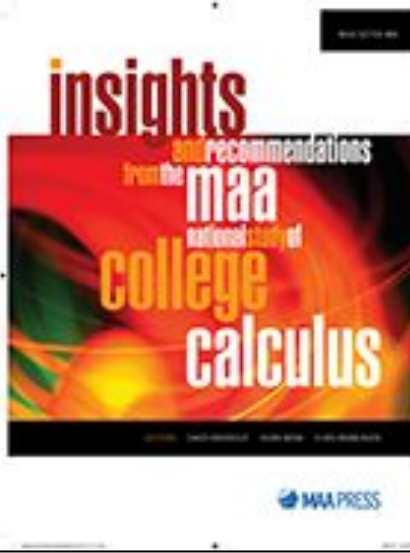
# MATH

# 2010's: Seven Characteristics of Successful Programs



- Case studies at 5 PhD granting institutions
- Involving interviews with ALL involved with Calculus I, class observations, and student group interviews
- These 7 features emerged as important
- Correlated with success; cannot prove causations

# Percentage of Bachelor's Degrees earned in 2009 (Percentage of Bachelor's Degrees earned in STEM fields in 2009 in parenthesis)

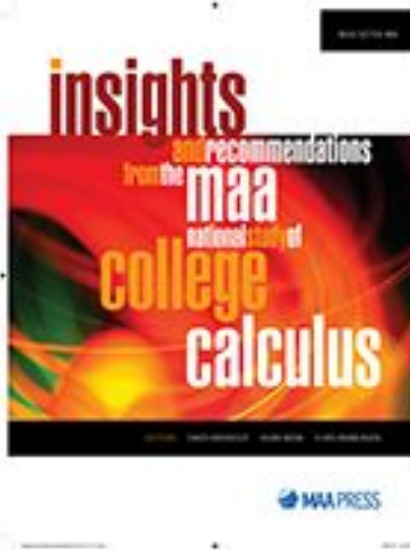


	PTI	LPU1	LPU2	PTU	LPrU
<b>Total (STEM)</b>					
<b>Woman</b>					
<b>White</b>					
<b>Hispanic/Latinx</b>					
<b>AA &amp; Black</b>					
<b>Asian</b>					
<b>American Indian/Alaska Native</b>					

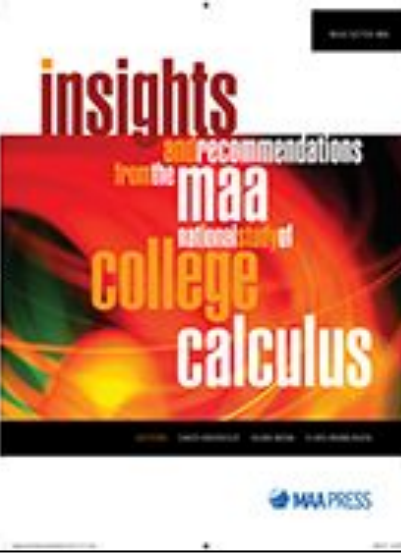
Since publishing these findings, and helping departments use them to improve their programs, I've reanalyzed the data, bringing to bare the **demographics of the students at the 5 schools we visited**

# Percentage of Bachelor's Degrees earned in 2009 (Percentage of Bachelor's Degrees earned in STEM fields in 2009 in parenthesis)

	PTI	LPU1	LPU2	PTU	LPrU
Total (STEM)	620 (542)	6473 (1822)	5323 (2004)	1073 (816)	6864 (1350)
Woman	26.1 (23.7)	51.2 (29.9)	52.5 (43)	21.7 (15.2)	50.9 (23.7)
White	79 (80.1)	67.4 (62.7)	31 (26)	87.2 (88.4)	87.3 (87.2)
Hispanic/Latinx	3.4 (3)	4.6 (2.5)	10.9 (8.1)	1.6 (1.5)	3.2 (2.1)
AA & Black	1.8 (1.7)	5.7 (3.8)	1.6 (1)	1.5 (1.2)	0.5 (0.4)
Asian	6.9 (6.8)	12.3 (17)	43.2 (52.2)	1.1 (1.2)	3.3 (3.8)
American Indian/Alaska Native	0.5 (0.4)	0.9 (0.5)	0.5 (0.5)	0.7 (0.5)	0.8 (1)



# Percentage of Bachelor's Degrees earned in 2009 (Percentage of Bachelor's Degrees earned in STEM fields in 2009 in parenthesis)



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<b>White</b>	79				
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<b>AA &amp; Black</b>	1.8				
<b>Asian</b>	6.9 (6.8)	12.3 (17)	43.2 (52.2)	1.1 (1.2)	3.3 (3.8)
<b>American Indian/Alaska Native</b>	0.5 (0.4)	0.9 (0.5)	0.5 (0.5)	0.7 (0.5)	0.8 (1)

We actually identified characteristics of calculus programs that successfully serve a majority white or Asian and male population

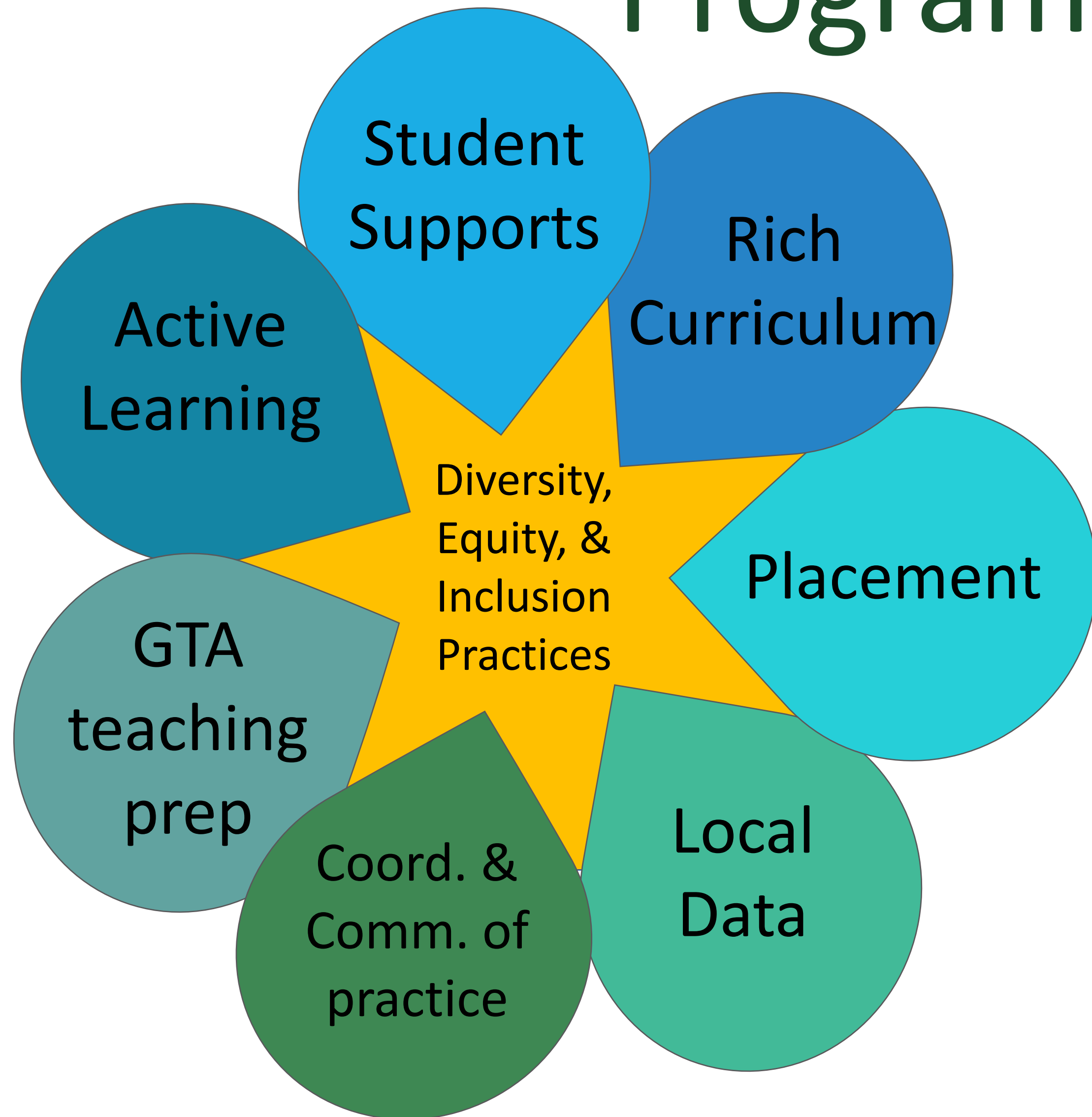
# Successful calculus from a different perspective

“Mathematics as a gatekeeper course” +  
“mathematics intelligence is innate/fixed” + lack of  
diversity in STEM = “Some demographics of students  
are just naturally better at math than others”

- These discourses are (1) wrong and (2) detrimental to students’:
  - Sense of belonging in STEM (Good, Rattan, & Dweck, 2007),
  - Academic performance (Steele & Aronson, 1995),
  - And takes significant mental energy to manage and overcome (McGee & Martin, 2011)

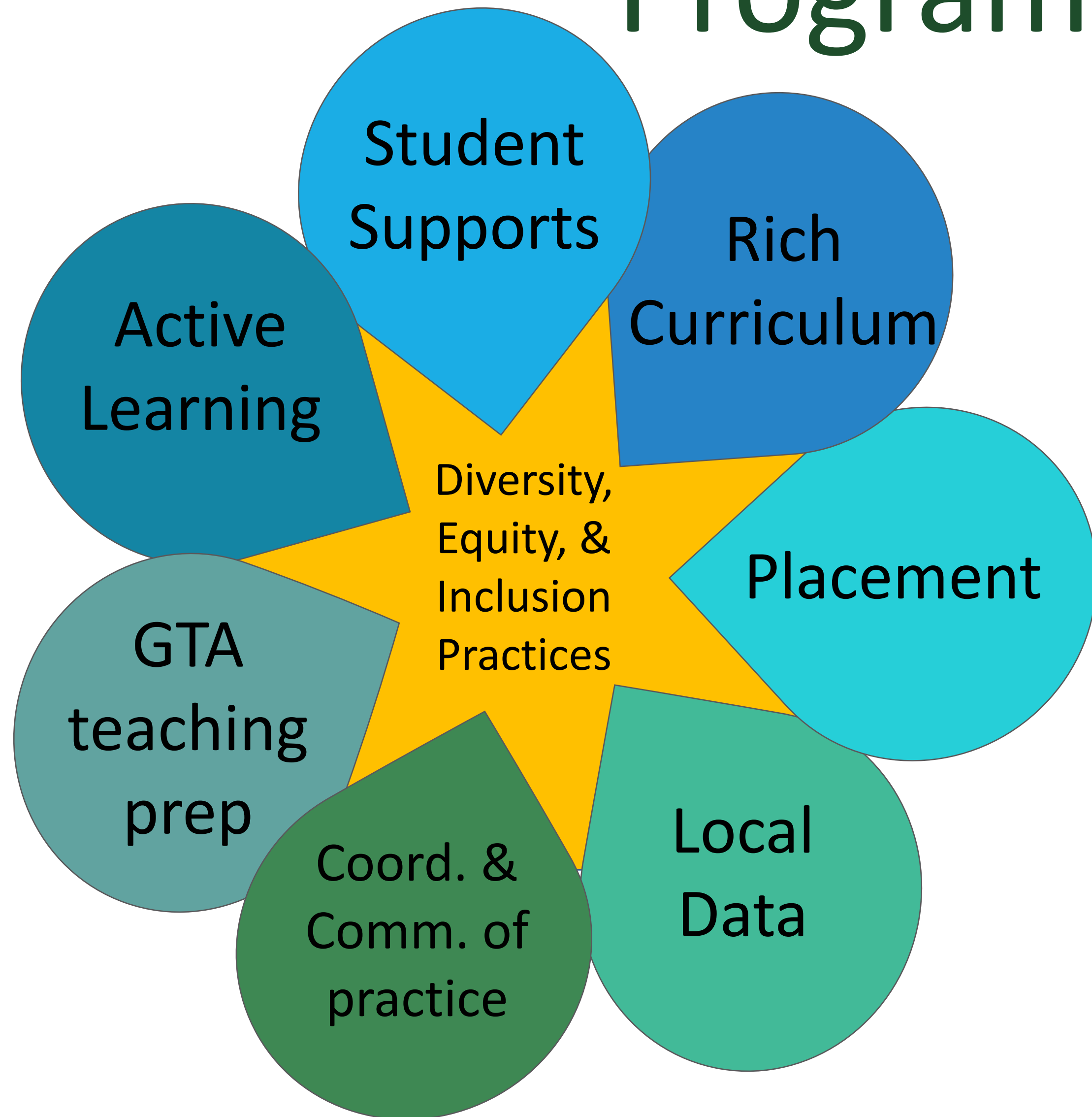


# 2018: Seven Characteristics of Successful Programs: *Revisited*




- Alone the 7 characteristics cannot create a successful program; need the 8<sup>th</sup> characteristic
- Emerged as integral due to its absence rather than presence in the data
- Three interrelated components: Diversity, Equity, and Inclusion practices

# 2018: Seven Characteristics of Successful Programs: Revisited



- If a math department is looking to improve its calculus program, and attends to the original 7 characteristics but not the 8<sup>th</sup>, it may improve the program for the students already succeeding, but not for the students who it is not already working for
- 8<sup>th</sup> feature works in concert with 7 original features



Coord. &  
Comm. of  
practice

- Creating uniform assessments, curriculum, pacing, expectations of students is fair for students
- Support a community of practice among instructors to create a shared ownership (coordinated independence; Rasmussen et al., 2019) over the course, and allow instructors to put effort into supporting students instead of logistics of course
- A coordinator can serve as a resource manager, in which case the resources shared is the most important - *nudging* towards more student centered, meaningful, or culturally connecting tasks
- OR can come from a humanistic-growth orientation, emphasizing their role in supporting the personal and professional growth of the instructors teaching within the courses (Martinez\* et al., 2022)
- \*Note that Antonio Martinez is now an Assistant Professor at CSU Long Beach and would be a great person to talk to



Diverse,  
Equitable, &  
Inclusive  
Practices

Coord. &  
Comm. of  
practice

- We know the systems outside our classes impact our students and these systems are fair
- So working on coordination without attending to equity can further perpetuate existing inequities
- **How this can engage with equity?**
  - Creating a coordinated system that centers the needs of marginalized students
  - Knowing the needs and experiences of marginalized students
    - student advisory committee (paid)
    - collecting qualitative student data

# Critical Framing of Equity

Coordination systems often focus on making the access to course resources uniform to help make the achievement more uniform; how can a coordination system focus on the role of identity and power?



# Dimensions of equity



How are students' afforded different access to resources needed to support their learning?



How do students' identities interact with their experiences in the class?



How can students be seen as experts on their own experiences?



How are students' achieving in comparison to one another?



Gutiérrez, R. (2009). Framing equity: Helping students “play the game” and “change the game.” *Teaching for Excellence and Equity in Mathematics*, 1(1), 4–8.



# Critical Framing of Equity

The critical dimensions of equity require not just supporting students within the existing systems, but changing the systems to better support students.

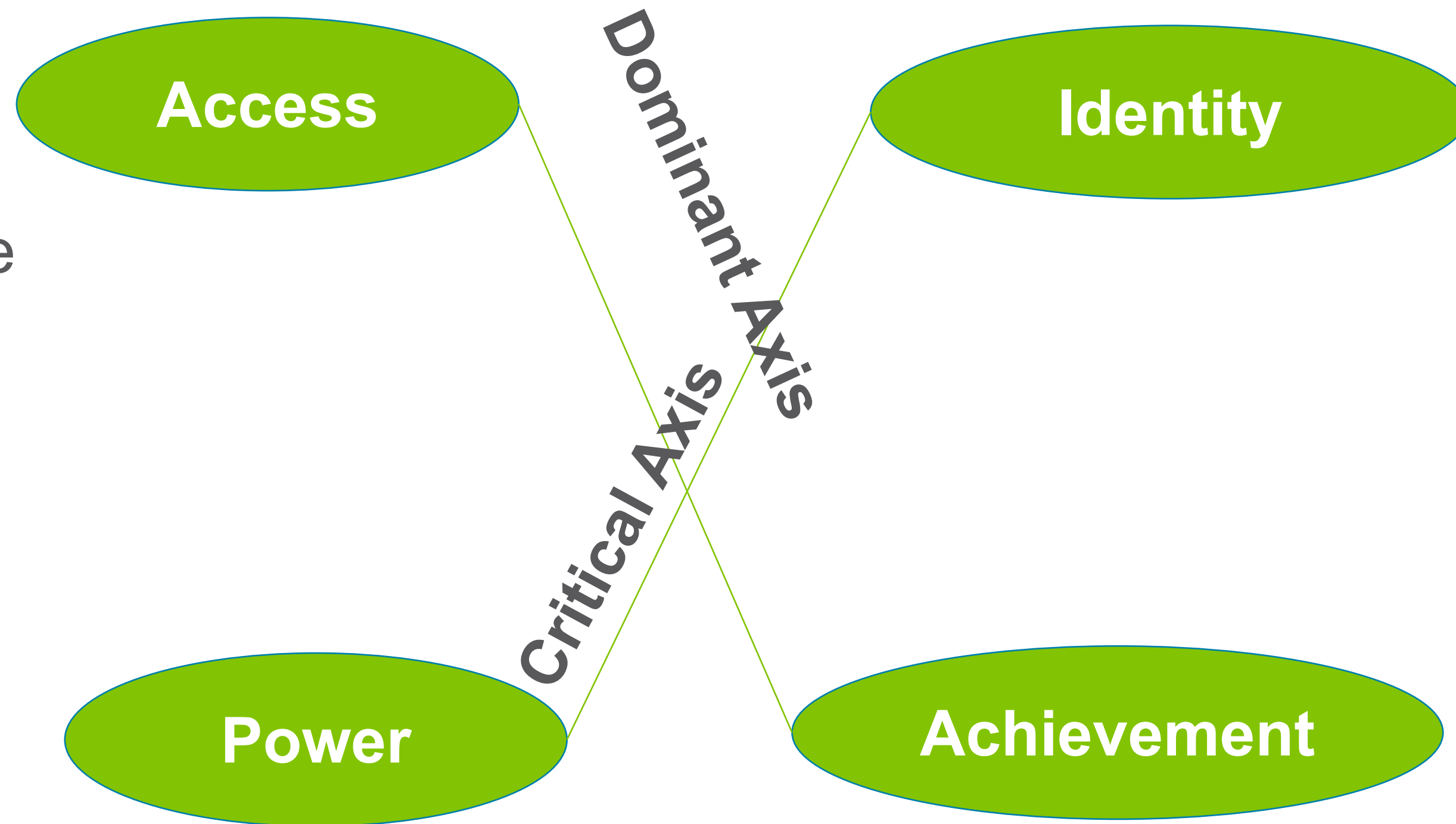
How can a coordination system be changed to center the needs and experiences of students from marginalized identities?



# Dimensions of equity



**Dominant:** Working within the existing system to improve experiences for students with marginalized identities



**Critical:** Working to change the systems to center experiences of students with marginalized identities

Gutiérrez, R. (2009). Framing equity: Helping students “play the game” and “change the game.” *Teaching for Excellence and Equity in Mathematics*, 1(1), 4–8.



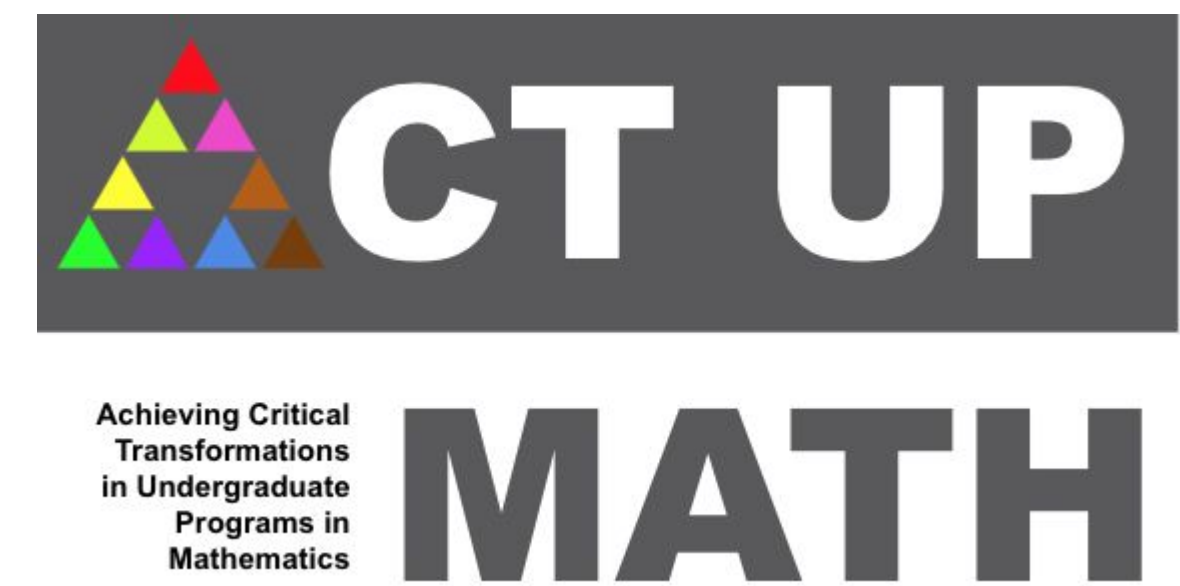
# What do we mean by Critical?

Critique and challenge the existing **systems** that create inequities

Make improvements that extend beyond the confines of these systems

Systems include...

content we teach,  
the way we teach it,  
the programs that support these teachings,  
the departments that house these programs,  
the advising processes placing students into these courses,  
and much more.



# What does a critical approach to equity mean? Some rough draft thinking...

- A. “A critical approach means to center issues of discrimination and seek to alleviate them. The goal is to build an inclusive space where all people feel safe.”
- B. “A critical approach means addressing systemic barriers and tearing them down! It’s about seeing how patterns and processes in place may serve to inhibit certain groups of people”
- C. “A critical approach means to question assumptions and normative practices. Our history is built on inequitable treatment of people and thus we must seek to fix how the system is working”
- D. “A critical approach recognizes the ways in which identity can be a precursor to power. For example the ways that cisgender men and white folks have privileges afford to them.”
- E. “A critical approach seeks to build critical citizens so that they may change the game. The goal for education is to produce students who take a critical lens to the world around them”
- F. “A critical approach means critiquing power and those that exploit power. For instance, examining the ways in which standardized testing companies profit from the use of inequitable testing and have financial gains.”
- G. “A critical approach means attending to diversity, equity, and inclusion.”
- H. “A critical approaches means a timely, important, or radical change”

# Anti-deficit and Asset Orientations

**Deficit orientations** focus on deficiencies of students – their lack of preparation, lack of engagement, lack of understanding...

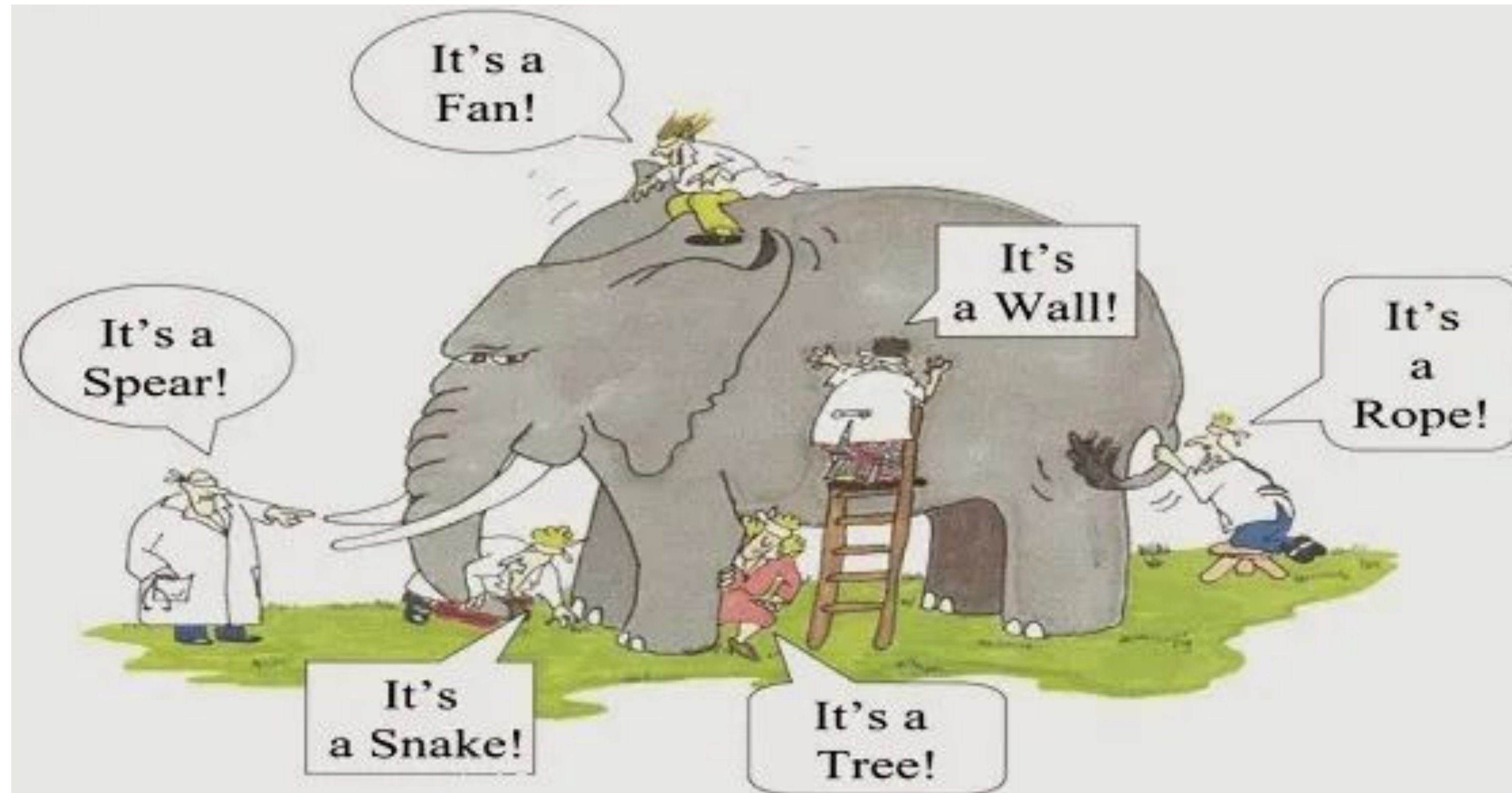
An **anti-deficit orientation** focuses on how the programs are not supporting these students, so rather than a student not being college (or calculus) ready, the college (or calculus) isn't student ready

An **asset orientation** goes beyond this to focus on what strengths all students are bringing in.

**How can a coordination system be anti-deficit and asset oriented? Trust students as experts on their experiences and learn what those experiences are.**



# Understanding the Perspective of Students



Students from marginalized populations have a unique vantage point (expertise) to understand how systems create or perpetuate inequities

# Example: Office Hours & Identity

“[Black and Latin\* students are] scared to go to office hours because they know they will get discriminated [against] and have people see that all people of this color are not as smart as people of this color. I think that’s one reason why people don’t go to office hours.... I haven’t seen people of my color or of different races going to the office hours... It’s only the white people or some Asian people who go to office hours” (pp. 357-358).

Leyva et al (2022) paper

# Example: Normalizing Mistakes & Identity

Isabelle discussed how even with instruction that normalizes mistakes, correcting instructors can be difficult for Latin\* students due to cultural scripts of respecting Authority.

Based of my classes, and math class at [university name]... when they [Latinos] try to argue with people, it's hard for them because the culture is that your parents are right. But white people attempt to argue more with their parents and try to change their parents' opinion... When it comes to correcting in class, maybe Latinos don't want to correct the professor because they don't want the professor to be wrong because the professor is more powerful. They have more authority... White people are used to arguing and changing older people's minds. It's easier for them to correct.  
(p. 354)

[Leyva et al \(2022\) paper](#)

# Discussion

Happy to have open discussion or I have some prompts

- 1) How do you see the coordination system (and other aspects of the intro math courses) supporting equity? What aspects of equity do you mean?
- 2) How do you see them not supporting equity, and how could aspects of the systems be changed to better support equity? (Things to consider – basically all other aspects of “successful calculus programs” – placement, curriculum, teaching approach)
- 3) How can you imagine seeking out students’ experiences in the system and using that information to make changes? What tensions come up when positioning students as experts on their own experiences?





# ACT UP Acknowledgement

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Upcoming dissertation by Tyler Sullivan at Clemson University: An equity centered analysis of course coordination effect on undergraduate Calculus 1 students' mathematics identity





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# Thank you!

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Please reach out with any thoughts or questions that didn't get addressed during the discussion:  
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