Mathematics as whiteness: Deconstructing Interest Convergence and Institutional Culture in Community Colleges

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Council for the Study of Community Colleges Conference

March 28-30, 2019
San Diego, California

Session Chair: Soko Starobin

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Instructional Approaches and their Connection to Equity and Access in Math Classrooms

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Framing the work

- The knowledge exchanges that occur in the **classroom** are relational
- The nature of students and faculty interactions shape students' identities as mathematics doers when bounded by a common goal of learning a particular piece of content
- Race matters especially in "the contexts where mathematics learning and the struggle for mathematics literacy" occur
- Mathematics education does not empower everyone equally

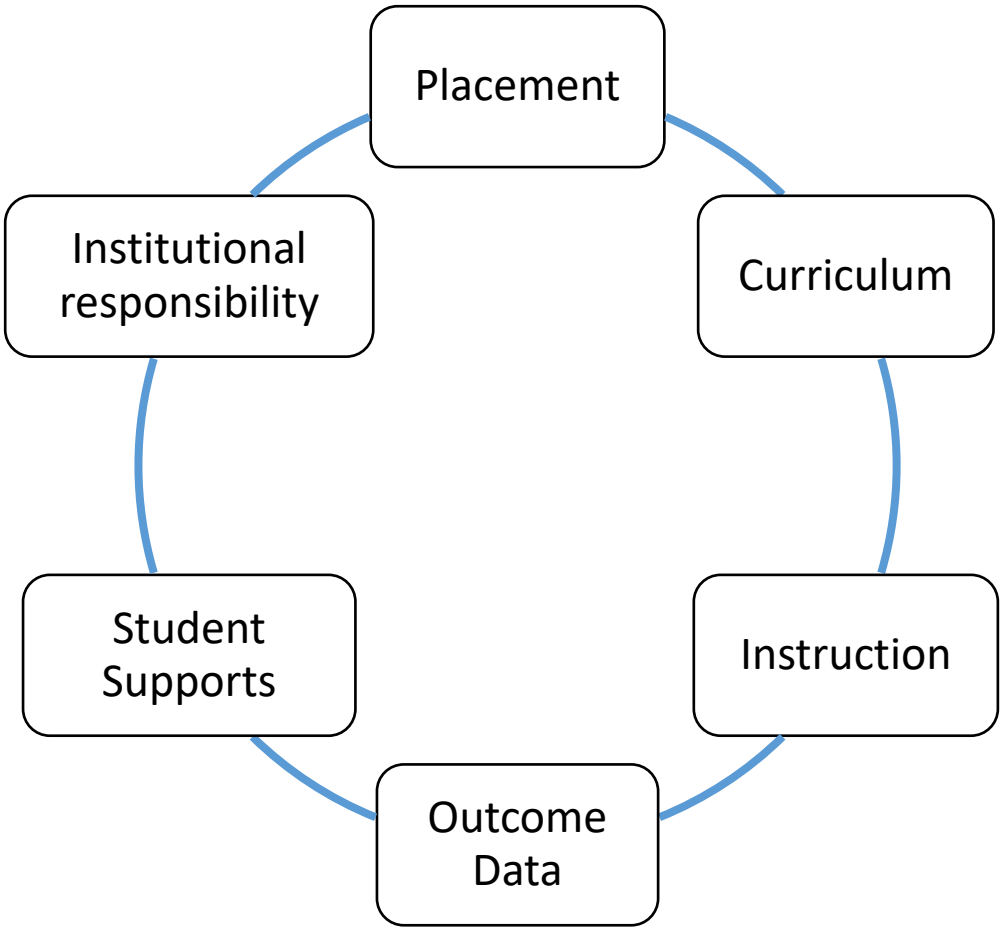
(Battey & Leyva, 2016; Gutiérrez, 2002; Martin, 2006, 2009)

Context

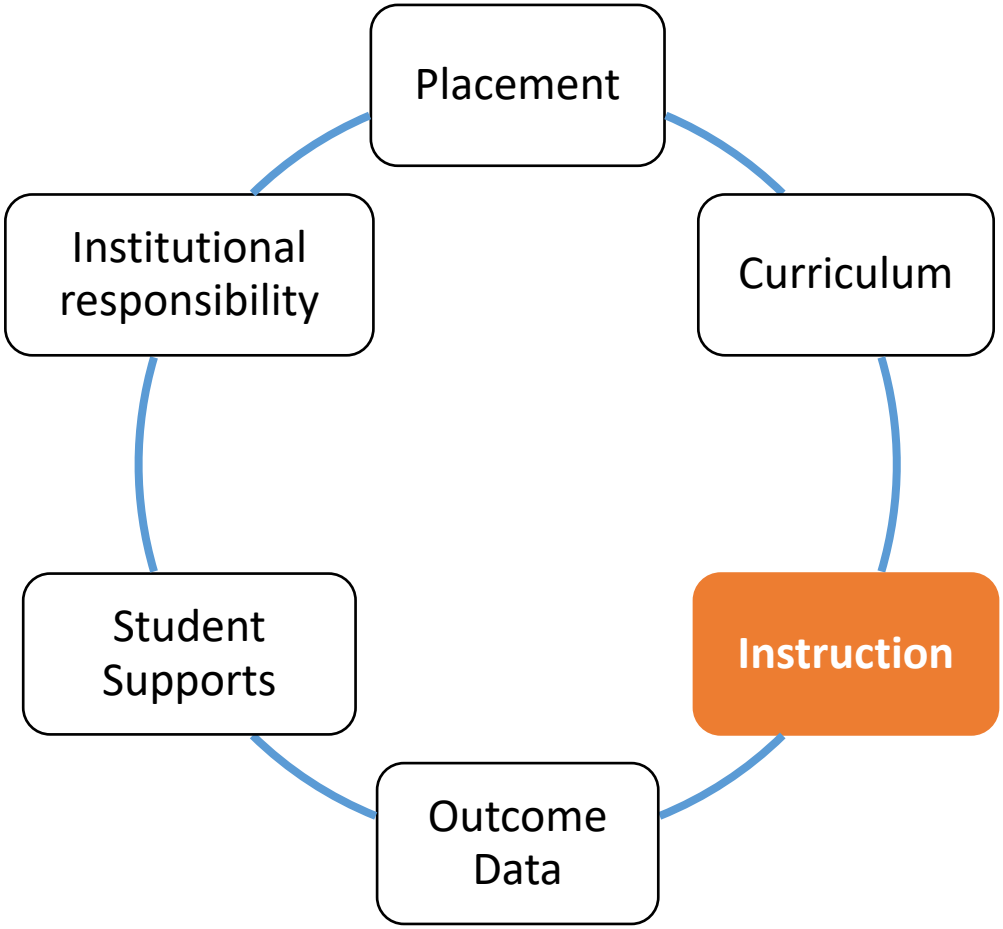
- Case studies for the *Transitioning learners through calculus at community colleges (TLC3):*
  - Programs that show support for students transition from developmental courses to calculus 2
  - At each case we identify the level transparency of information flowing from various stakeholders on six dimensions

(Burn, Mesa, Wood, Zamani-Gallaher, 2016)

TLC3 Dimensions



TLC3 Dimensions

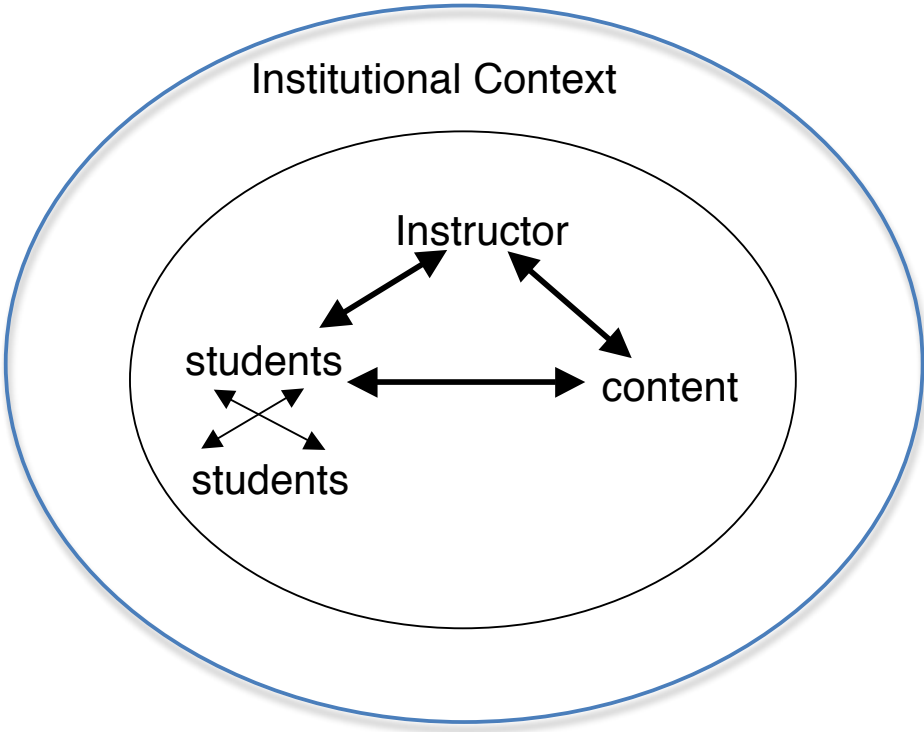


Instruction

The interactions that occur between students, the instructor, and the content inside the classroom. They are bounded by a particular institutional context

- Mathematical
- Relational

(Cohen, Raudenbush, Ball, 2003)



Native Americans in the US

- Disproportionate mis-representation in STEM fields
- Varied access to resources
- Scant data on mathematics faculty profiles
- Large proportion of students are placed in developmental education
- Almost non-existent research literature on Native American college students, instructors, or contexts in mathematics → **Invisibility**

Institutional context

- Tribal college, 100% enrollment students are Native American
  - Several award winning certificate programs
  - Clear connections to local university for transfer
- Focused on supporting their students
  - Modularization of courses
  - Tailored & flexible placement
  - Coaches and tutors fully available, including in dorms
  - Contracts for completing work
  - Summer bridge programs

Institutional context cont.

- Complex system of data monitoring
- Explicit messages valuing Native American heritage
- Waved fees for some students; book costs are part of the tuition
- In-dorm counseling
- …

Very strong sense of commitment (passion and devotion) to serving Native American students across all levels of the institution

The Classroom

Mathematical practices

1. Mathematical Work
   - Questions asked and by who
   - Problems solved
     → level of mathematical challenge of the classroom work
2. Student engagement
   - Organization
   - Who is in charge of the mathematics
3. Relevance and Metacognition

Relational strategies

1. Welcome-ness
2. Empowerment
3. Culturally relevant teaching
4. Performance monitoring
5. Classroom Environment

(Mesa & Thrill, 2018; Wood et al., 2015)

Guiding questions

- To what extent are Native American students being invited to engage in mathematical challenging work?
- To what extent are Native American students being considered full members of the mathematics classroom?
- How transparent are the instructors regarding the need to engage Native American students in challenging mathematics and becoming a full participant of mathematical work?

Mathematical practices

- Lessons mainly led by the instructors
- Instructors asked many questions to engage their students
  - Of 823 questions in 7 lessons, 63% required a one answer; 28% required a yes/no answer.
- Instructors provided students with example problems
- Problems were mostly on learning procedures
- In most lessons: Students worked individually
- In two lessons: Students worked in small groups all the time

Relational Practices

- Regular use of empowerment, welcomeness, validation, and performance monitoring
- But not uniformly. Some instructors
  - Used students names
  - Reminded students of availability of coaching and tutoring
  - Checked students' performance in the classroom
  - Invited **all** students to participate
- No mention of Native American contexts
- Open ended tasks were not culturally relevant
- No explicit messages about Native American's competency and belonging into mathematics

Mismatch?

Strong institutional commitment to serve Native American Students

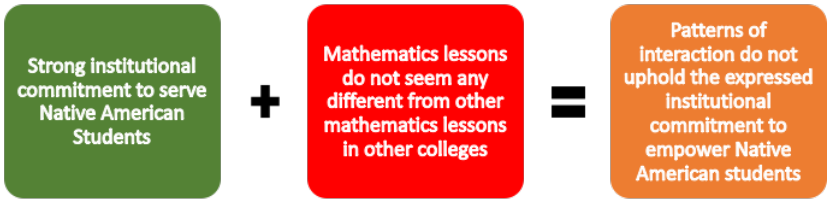
+

Mathematics lessons do not seem any different from other mathematics lessons in other colleges

=

Patterns of interaction do not uphold the expressed institutional commitment to empower Native American students

Why the mismatch?



- Mathematics is a white space

  Predominant rules of interaction in math classes counter interaction patterns advocated for Native American students
  - discussion instead of being told
  - group work instead of individual work
  - connections to context rather than abstract work
  - collaboration instead of competition
- Mathematics instructors do not share Native American heritage

(Demmert, 2001; National Indian Education Association 2016)

Next steps

- Hold conversations about the role of relationship building in mathematics classroom across the mathematics faculty
- Make explicit connections to Native American heritage, language, and traditions, and to their lived contexts
- Strengthen collaborations with adjunct faculty
- Requires:
  - Funding (expertise & time) for creating and sustaining such spaces
  - Understanding the role we play, as researchers, administrators, and practitioners, to transform these spaces

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Entering and Participating in the Mathematics Classroom Space: Examination of Classroom Maps and Faculty Efforts to Support Southeast Asian Students

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Mathematics as a white institutional space

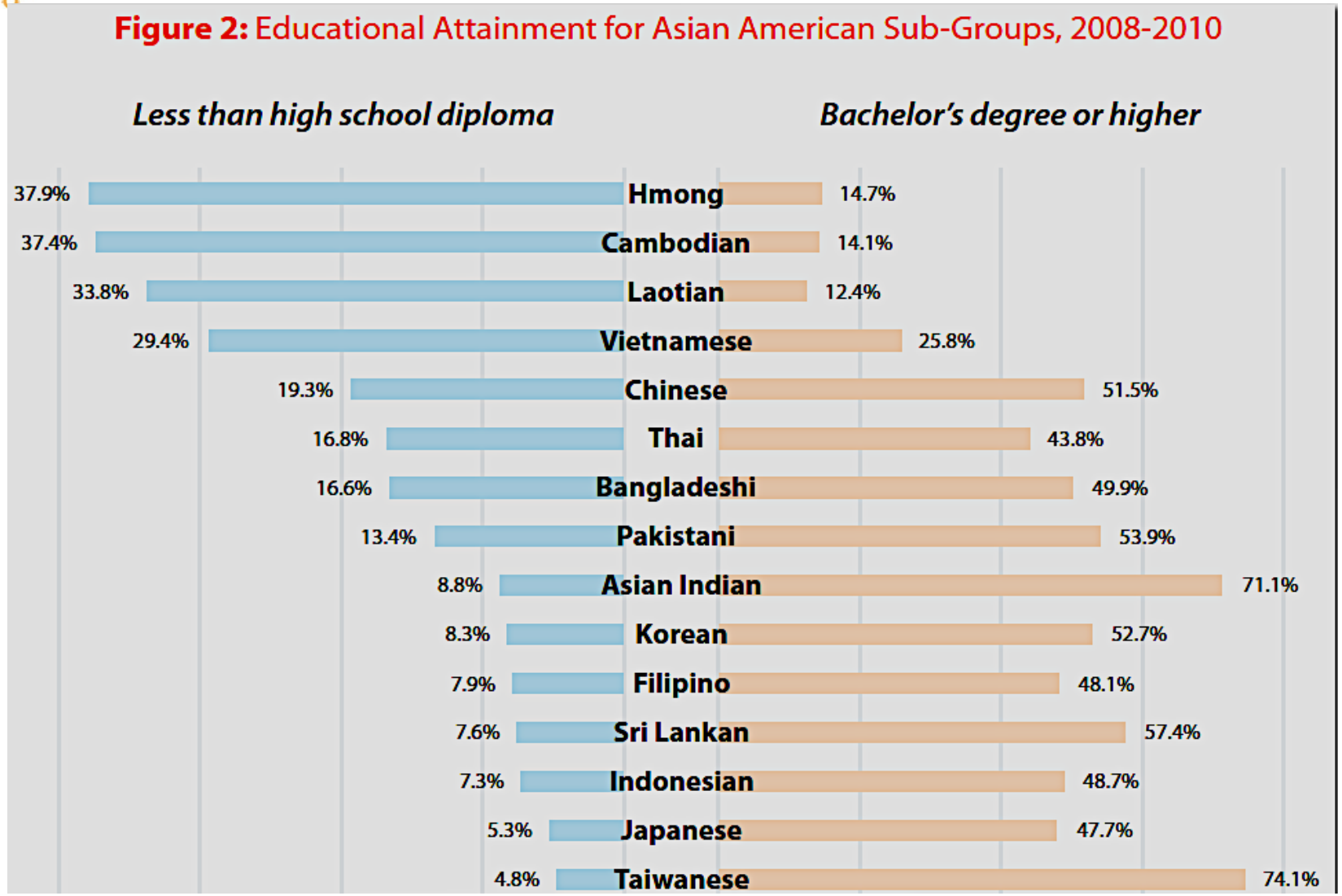
- Whites framed the organizational logic of the discipline
- Historical construction of the curriculum by white elites
- Numerical dominance of white people and exclusion of people of color in the field (see recent case of Dr. Edray Herber Goins)
- Mathematical knowledge and its production is assumed to be neutral, impartial, and equally accessible by all

(Martin, 2009)

Model Minority Myth

- Ascribed intelligence/natural ability in math
- Research is more nuanced, but practitioners may have this bias
- Can negatively impact student help-seeking behavior
- Insidious in using Asian Americans as evidence of the "American dream" and in not calling out underperformance of white students

Figure 2: Educational Attainment for Asian American Sub-Groups, 2008-2010



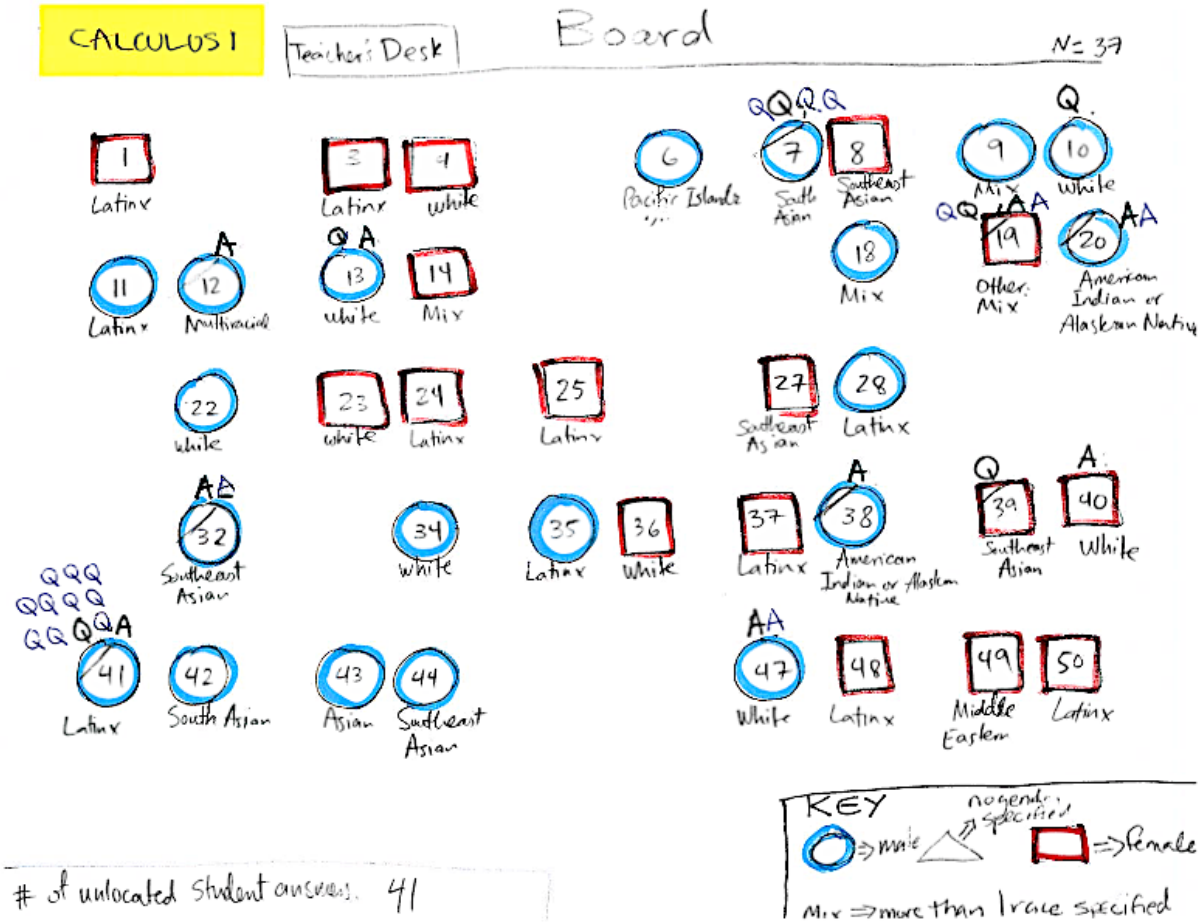
TLC3 AANAPISI Case

Asian American, Native American, Pacific Islander Serving Institution (10% by enrollment)

- **Selection** – High Southeast Asian population, AANAPISI eligible, math outcomes, program features
- **Institutional identity** – proud, welcoming, beautiful
- **Mathematics program** – proud, small and growing, changing
- **Data collected –** site visit classroom observations, 8 faculty/admin/staff interviews, 3 student focus groups (<10), site visit notes, institutional documents

The Classroom Space

(n = 299 surveys, 88% response rate)



Battey & Leyva (2016)

- How does whiteness operate in mathematics?
- Who is privileged and who is oppressed?

Framework for Understanding whiteness in Mathematics Education

Institutional – ideological discourse, curriculum, organizational logic

Labor – cognitive, emotional, behavioral effort

Identity – mathematics as a racialized form of experience, shaping and conforming to the norms

Institutional Data: Who is Oppressed?

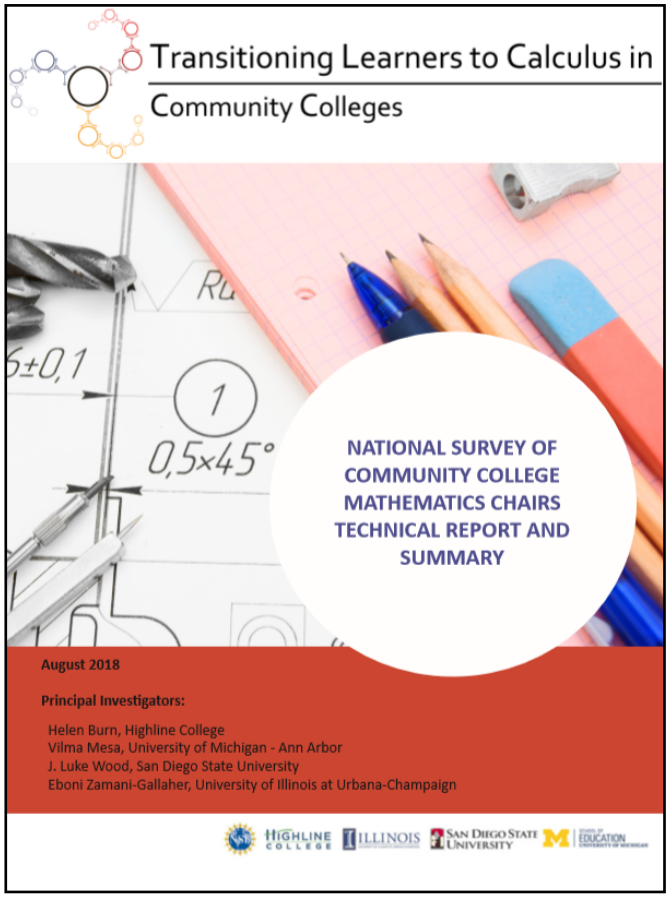
- Inability to disaggregate data to identify Southeast Asian and Hmong students (11% AAPI by California CC Chancellor's Office)

- Classroom surveys
  - Southeast Asian representation by level:
  - Calculus - 9%
  - Trig - 9%
  - Precalc – 0% 103 – 3% 201 - 0%

- Math courses were more male but not more white (~30%) as the level increased

- 17 surveys (6%) from Southeast Asian students: More gender parity than the overall class, similar in tending to be young, science and technology majors, 20% took developmental-level courses

TLC3 National Survey of Community College Mathematics Chairs (*n* = 455, 44% response rate)



45% had readily available access to data

49% had access but not readily available

17% disaggregated by race/ethnicity

The Classroom Space – Data Collected

- Seating chart and student surveys (who asks and answers questions)
- Mathematical Practices (e.g., problems worked, who does the work, student engagement)
- Relational practices (e.g., welcomeness and validation, performance monitoring, culturally relevant teaching)

The Classroom Space

Modern classroom facilities but very crowded:
(>40, national average is <25)

In a 30-minute segment, there were

33 instructor questions
4 student questions
5 problems worked

23% of class time spent with students working problems

Median of 7 references to the relevance of the mathematics

In a 5-minute segment

Probability of:

- Lecture with limited student response: .88
- Lecture with extended student response: .30
- Student working individually: .24
- Student working in pairs: .19

Examples of Culturally Relevant Teaching in 5 of 8 classes (pop culture examples, providing different approaches to problems)

Relational strategies not specific to student subgroups

Who Asks and Answers Questions?

- **Calculus (2 classes)**: 13 students answered; 15 asked questions

1 Southeast Asian student answered and asked (8%, 6%)

5 white students answered and asked (38%, 33%)

51 cases of unlocated student questions or answers

- **Trigonometry (2 classes)**: 2 students asked, 8 students asked

8 Southeast Asian students, none asked or answered Qs.

1 white student asked and 5 white students answered

Faculty interviews: How does your practice support Southeast Asian American students?

- Aware of Southeast Asian student subgroup
- Generally believed to do well although tends to be quiet

- Rising tide lifts all ships/color-blind approaches to supporting students: good teaching, office hours, tutoring center, study groups, space to work on campus

- Two instructors who lived in the community for a long time had more in-depth understanding of their Southeast Asian students (language and financial challenges, family responsibilities, cultural norms)

Connecting to whiteness: Who is privileged in the classroom space?

Students who can conform to and learn in this classroom space:

- "Interactive lecture" (Burn & Mesa, 2017)
- Willing to ask and answer questions in a high-paced environment
- Seek help outside of class: office hours, tutoring center, study groups, access to space to work on campus

Implications for Southeast Asian and Hmong Students

- Relationship building is fundamental to helping students become full participants in and outside of class
- Understand financial and other resource needs
- Research is needed on Southeast Asian student learning experiences and success strategies
- Implications for co-requisite courses – live learning and finding ways to identify prerequisite needs

A Taxonomy of Practices in Math: Insights from the Instructional Development Inventory

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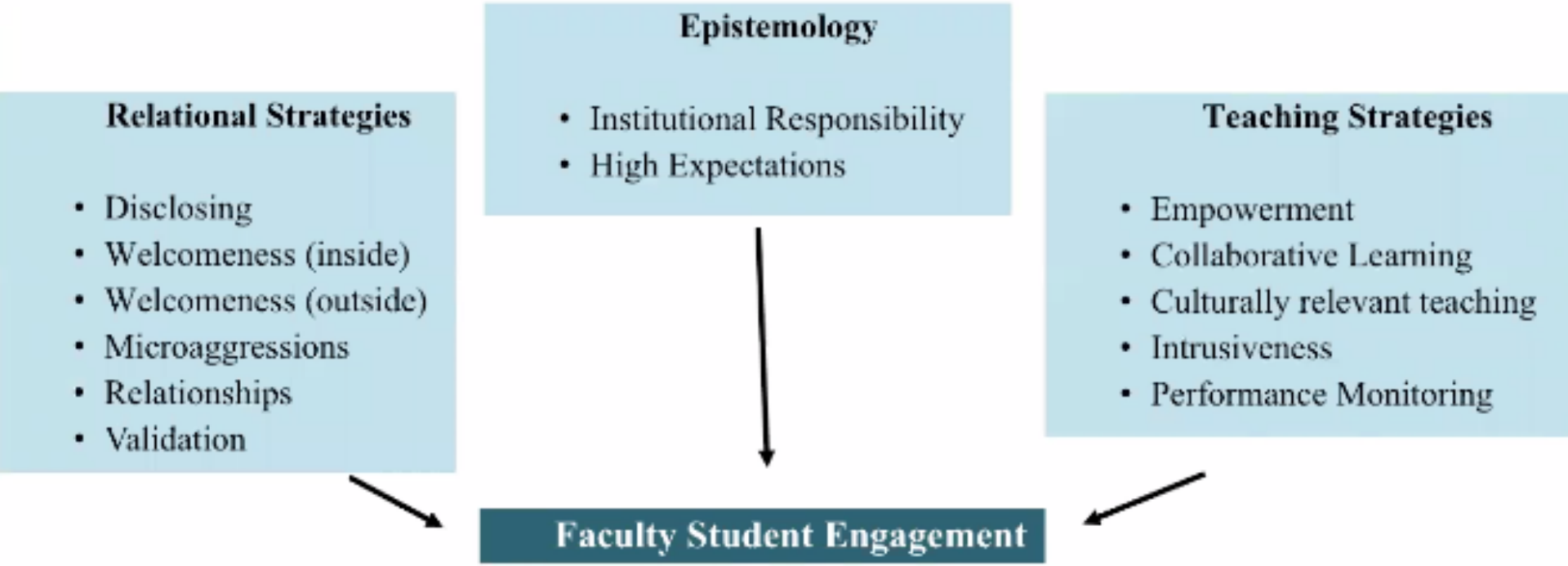
Development of CCIDI

- "to inform professional development programming for instructional faculty"
- Twelve teaching and learning areas that have an intensified effect on success for students of color (Perceptions) (Relationships) (Practices)
- CC-IDI psychometric properties tested on 1,775 faculty members from 125 randomly selected community colleges.
- Threshold scores developed to compare against institutions in the top quarter producing community colleges.
- Full sample – 497, reduced sample 436
- Survey of math faculty (two rounds)

Development of CCIDI



Primary Composite Variables

- Cluster Variables
  - Culturally Relevant Teaching
  - Humanizing Practices
  - Racial Microaggressions

- Outcome Variables
  - Relationship Building
  - Validating Practices
  - Welcoming Engagement (Outside)
  - Intrusive Practices

Data Analysis

- Missing replacement (expectation maximization)
- Exploratory data analysis
- Reliability analyses
  - Culturally Relevant Teaching - 3 items, .867
  - Racial Microaggressions – 4 items, .969
  - Humanizing Practices – 3 items, .896
- K-means cluster analysis
- Profile Analysis
- Analysis of Variance with Posthocs (Bonferroni & Dunnett's C)

Sample

AGE	Percent
18-31	4.6%
32 to 38	13.8%
39 to 45	17.5%
46 to 52	22.1%
53 to 59	18.9%
60 to 66	12.2%
67 and older	10.8%

Class Size	Percent
Less than 20	24.4%
21 to 30	46.4%
31 to 40	23.0%
41 or more	6.2%

GENDER	Percent
Woman	55.2%
Man	44.3%

Time Status	Percent
Full-Time (T)	41.6%
Full-Time (TT)	10.6%
Full-Time (NTT)	15.9%
Part-Time (HO)	18.2%
Part-Time (Mult)	13.7%

Other	Mean
# Classes	4.1 (2.35)
Years Teaching	19.7 (8.25)

Modality	Percent
Online	3.9%
Hybrid	13.1%
Face to Face	77.1%
Other	6.0%

Level	Percent
Dev Math	28.0%
G.E.	20.9%
Major Required	25.2%
Multiple	24.5%
Dual Enroll	1.4%

K-means cluster

- Convergence was achieved with five clusters
- Minimum distance between initial clusters was 3.557
- All variables significantly contributed to cluster formation
- Created new variable using cluster membership

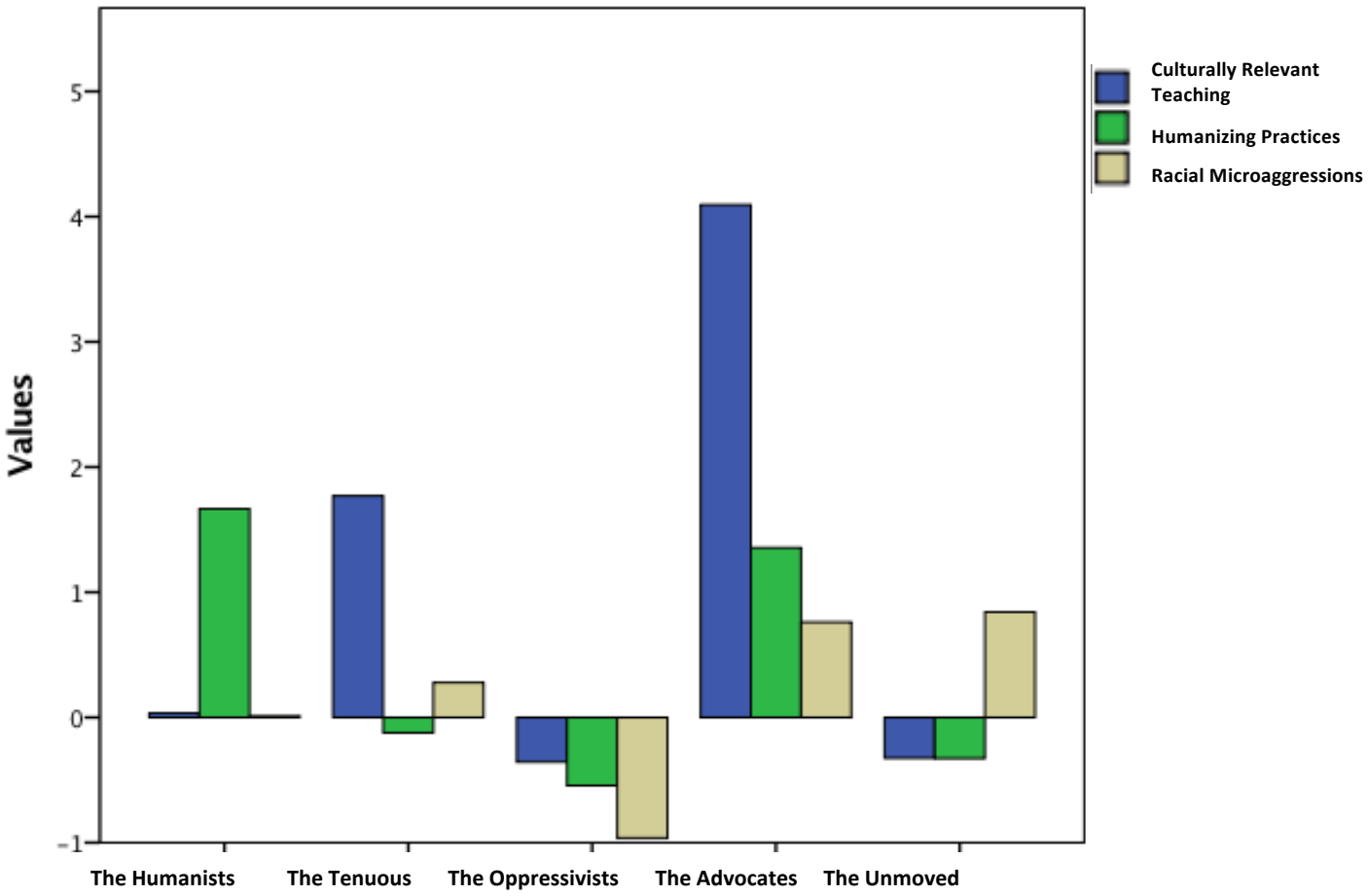
Cluster	*n*	Percent
Cluster 1	68	15.59%
Cluster 2	29	6.65%
Cluster 3	174	39.9%
Cluster 4	14	3.2%
Cluster 5	151	34.6%

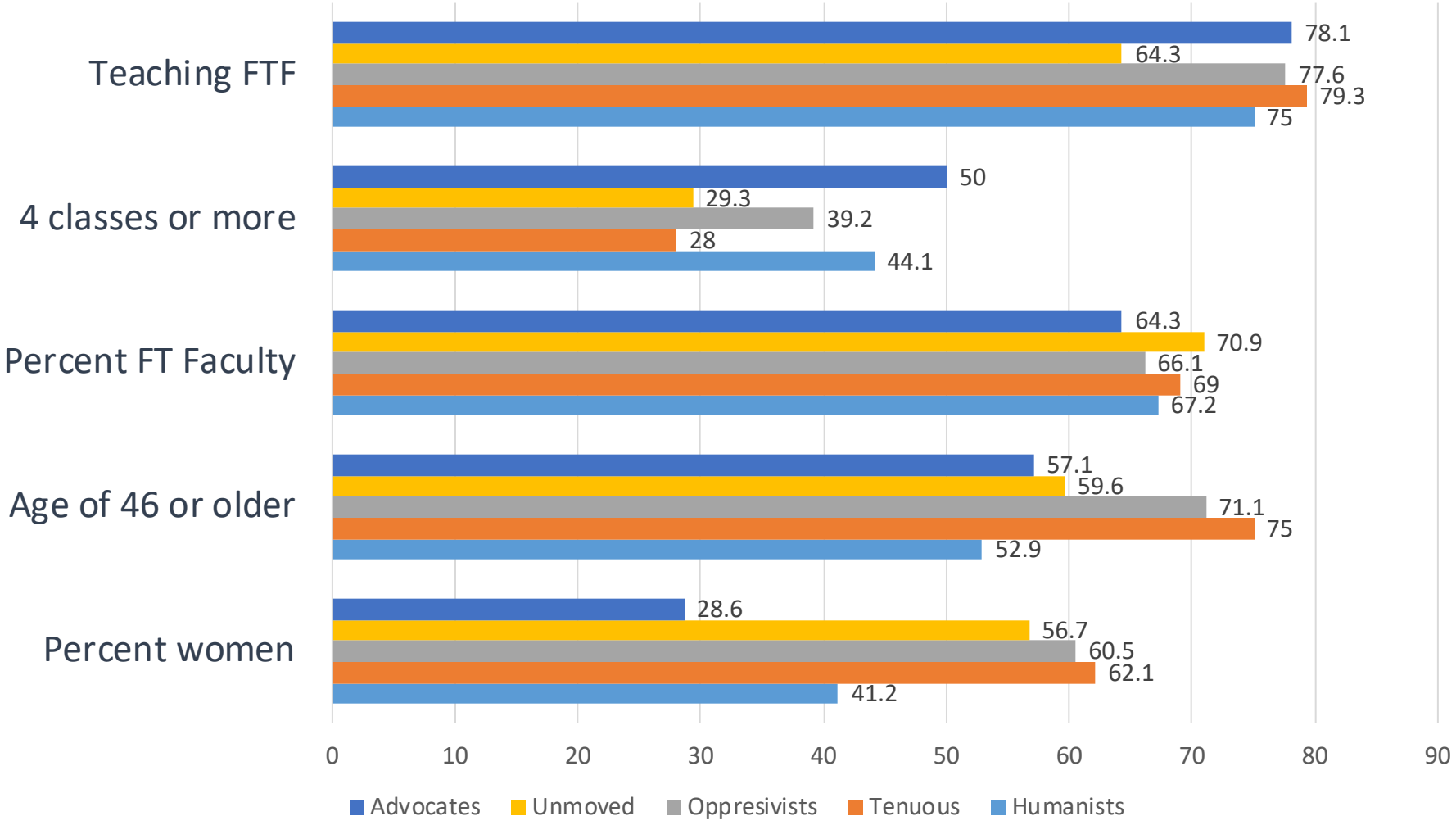
ANOVA

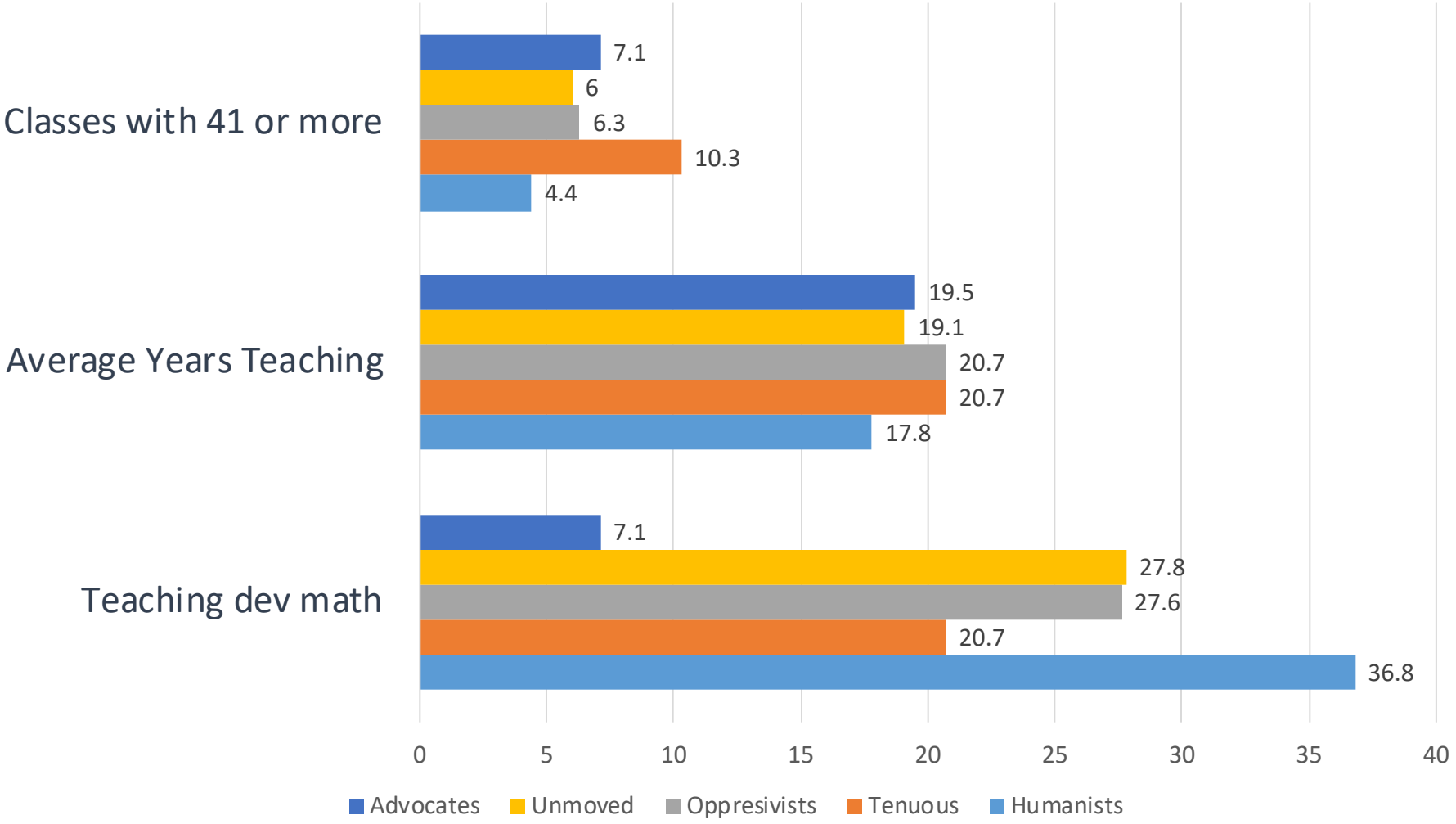
	Cluster		Error			
	Mean Square	df	Mean Square	df	F	Sig.
Zscore(CRT_FINAL)	90.874	4	.166	431	547.755	.000
Zscore(HUM_FINAL)	70.519	4	.374	431	188.474	.000
Zscore(MICRO_FINAL)	69.521	4	.377	431	184.484	.000

K-means cluster

Cluster	*n*	Percent
Cluster 1	68	16%
Cluster 2	29	7%
Cluster 3	174	40%
Cluster 4	14	3%
Cluster 5	151	35%




Teaching FTF
78.1
64.3
77.6
79.3
75
4 classes or more
50
29.3
39.2
28
44.1
Percent FT Faculty
64.3
70.9
66.1
69
67.2
Age of 46 or older
57.1
59.6
71.1
75
52.9
Percent women
28.6
56.7
60.5
62.1
41.2
0
10
20
30
40
50
60
70
80
90
Advocates
Unmoved
Oppresivists
Tenuous
Humanists


Classes with 41 or more
7.1
6
6.3
10.3
4.4
Average Years Teaching
19.5
19.1
20.7
20.7
17.8
Teaching dev math
7.1
27.8
27.6
20.7
36.8
0
5
10
15
20
25
30
35
40
Advocates
Unmoved
Oppresivists
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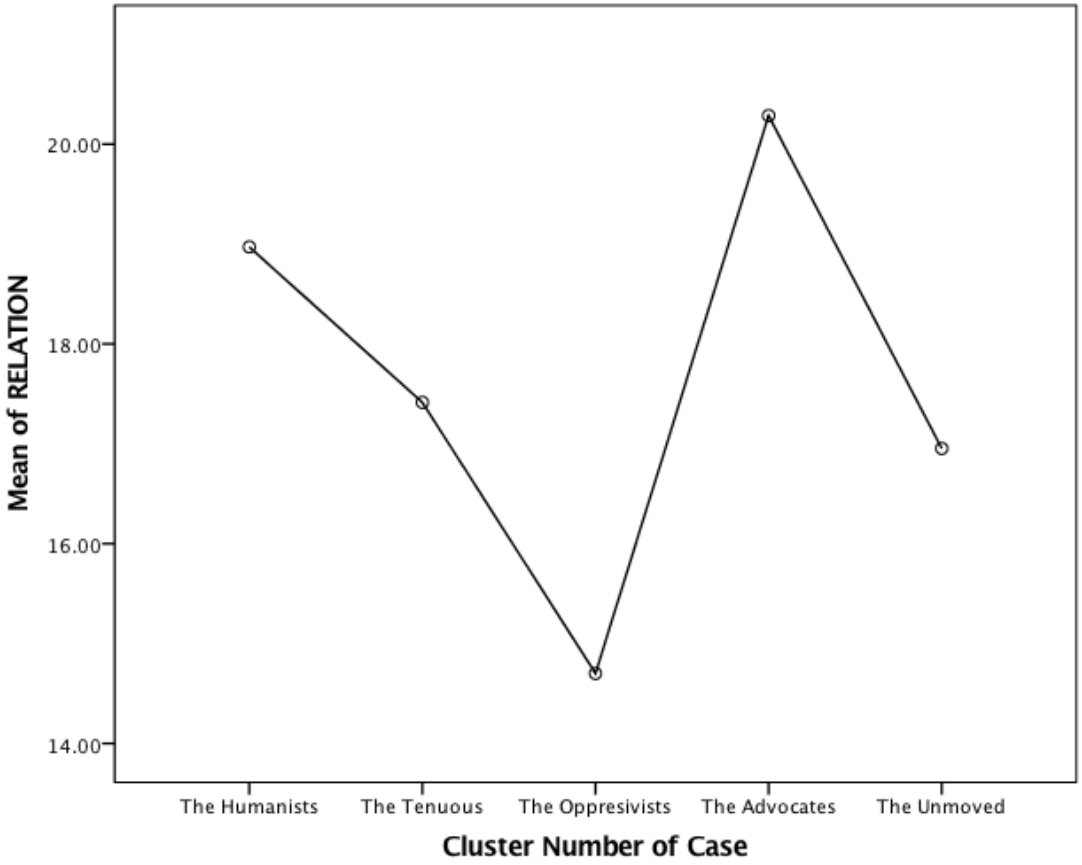
Humanists

Findings: Relationship Building

- Satisfied assumption of homogeneity of variance (Levene's 1.672, p=n.s.)

- ANOVA results F =22.921, p<.001, n^2= .175 (Large)



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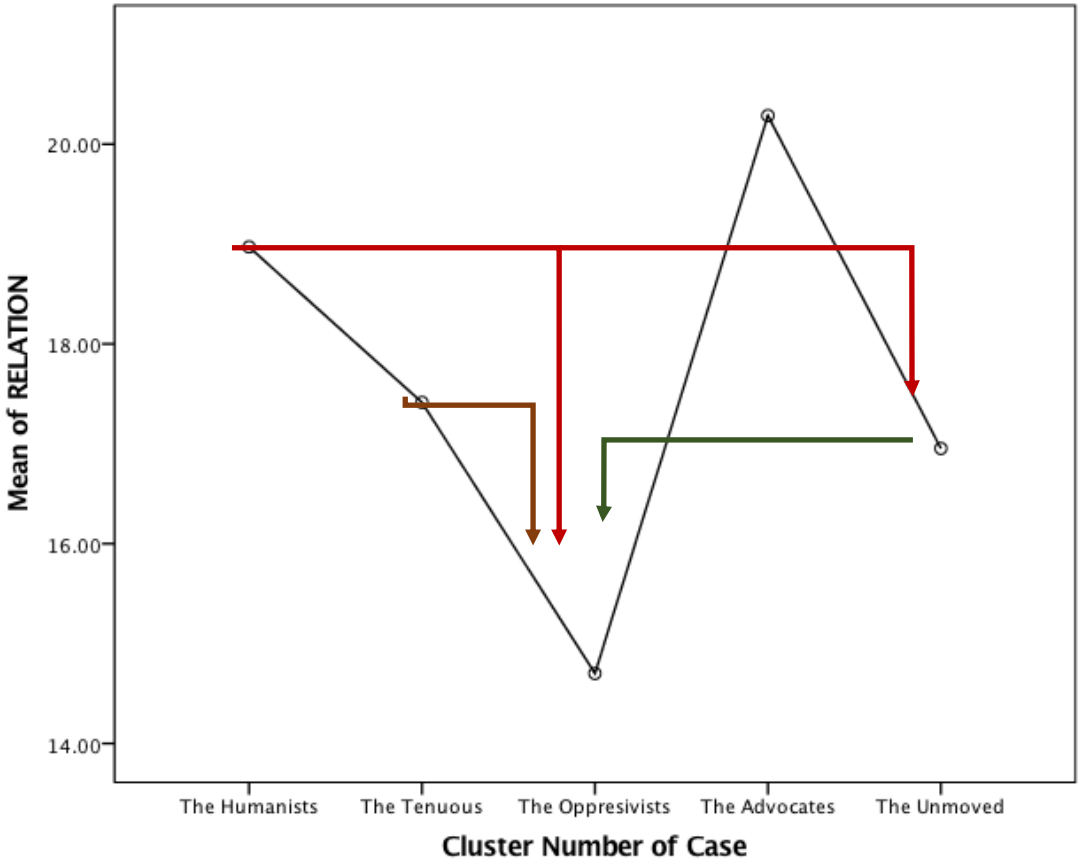

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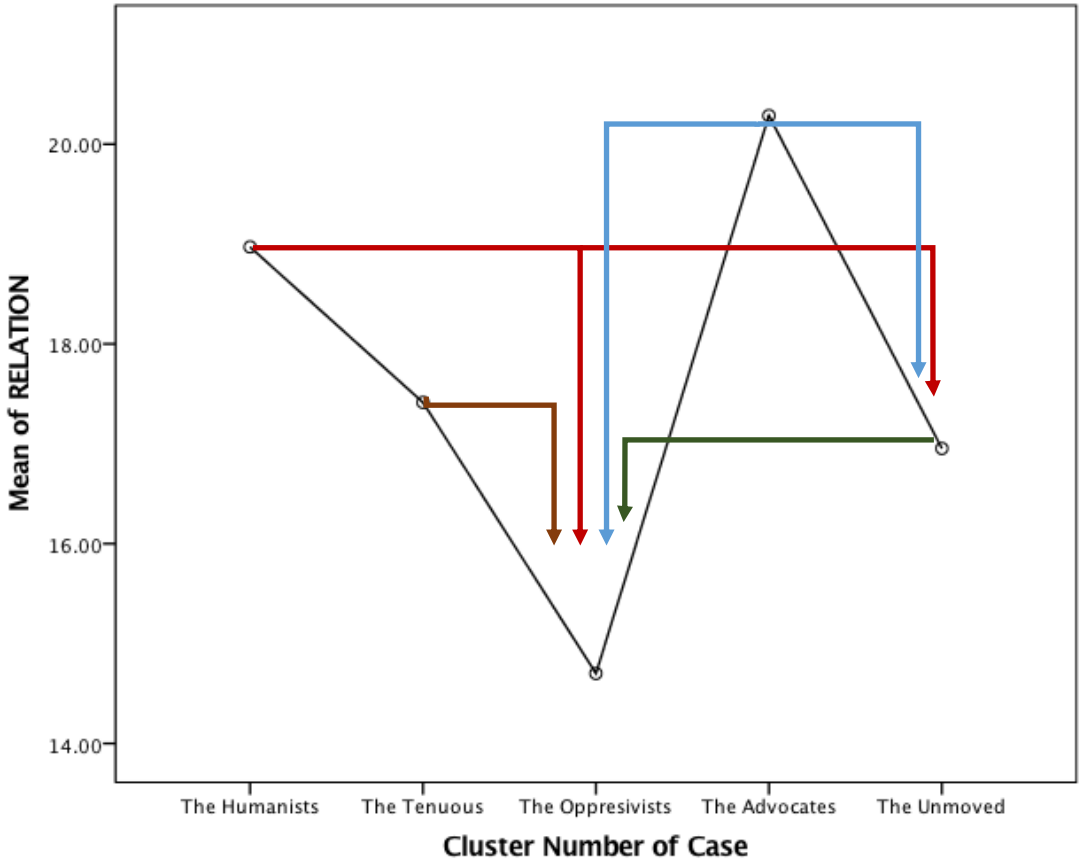
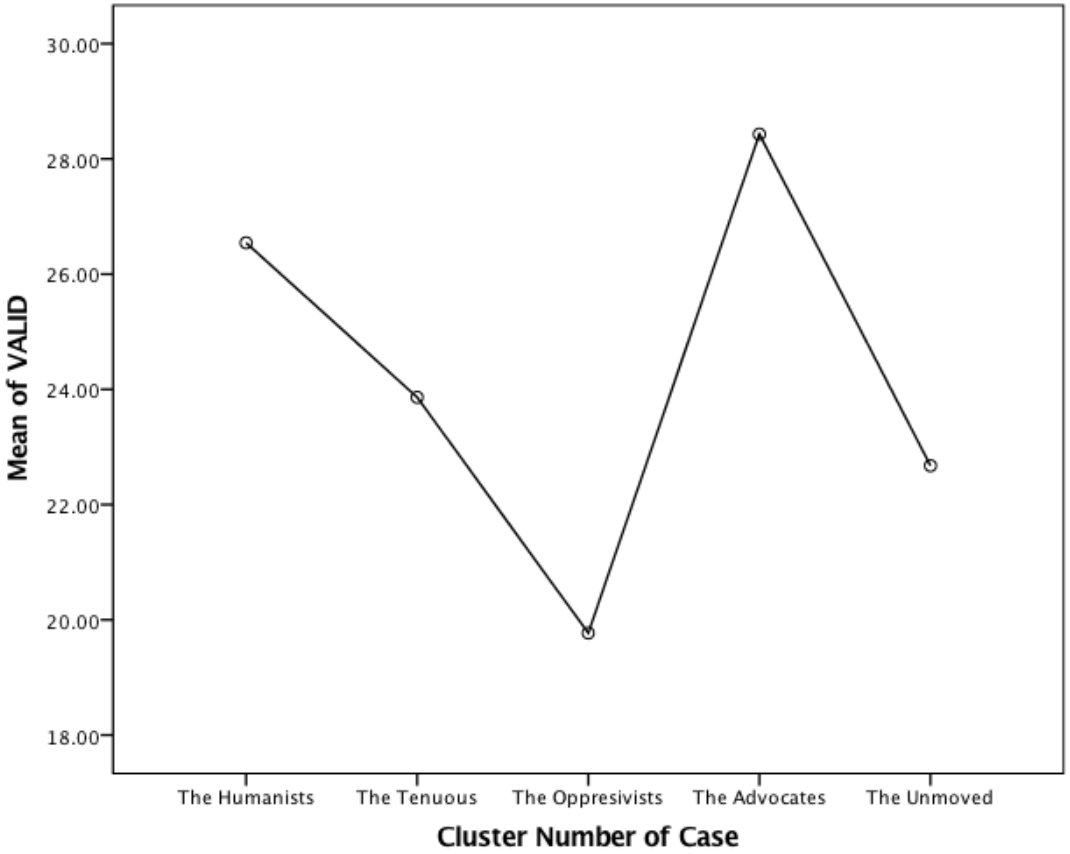


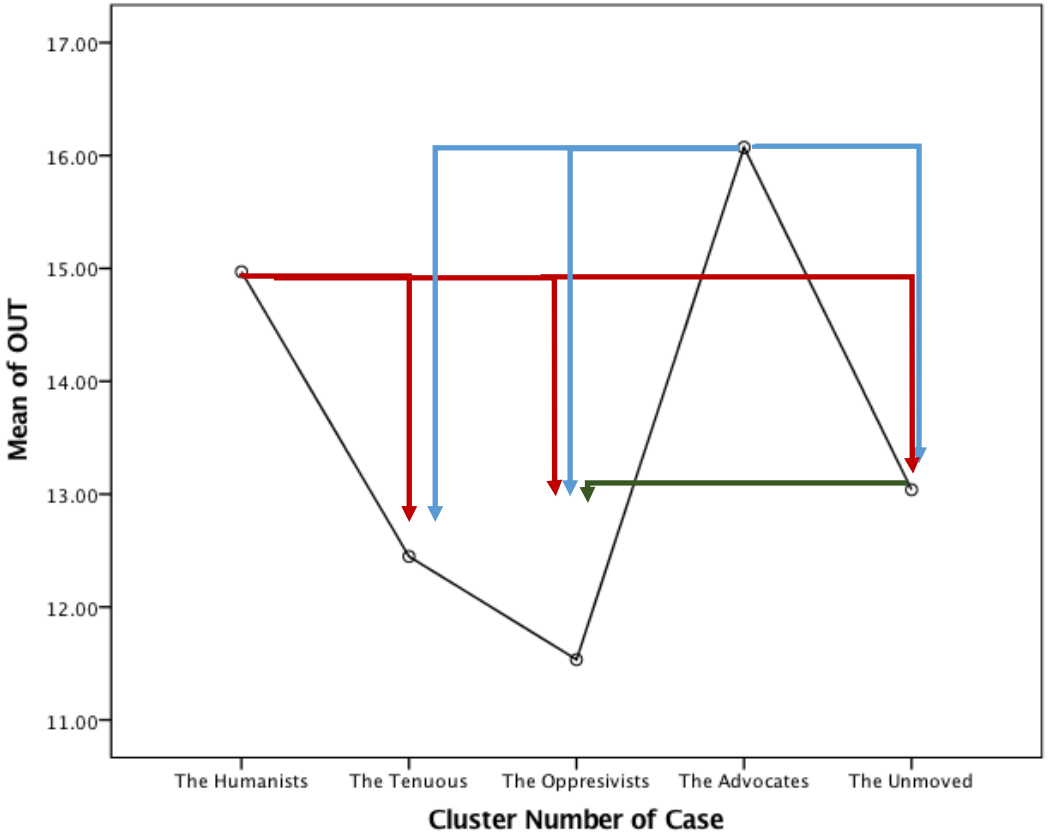
Findings: Validating Practices

- Violated assumption of homogeneity of variance (Levene's 13.706, p<.001)
- Welch ANOVA results F =27.388, p<.001, n^2= .60 (Large)



Findings: Welcomeness Outside

- Satisfied assumption of homogeneity of variance (Levene's 1.932, p=n.s.)
- ANOVA results F =16.652, p<.001, n^2= .13 (Medium)



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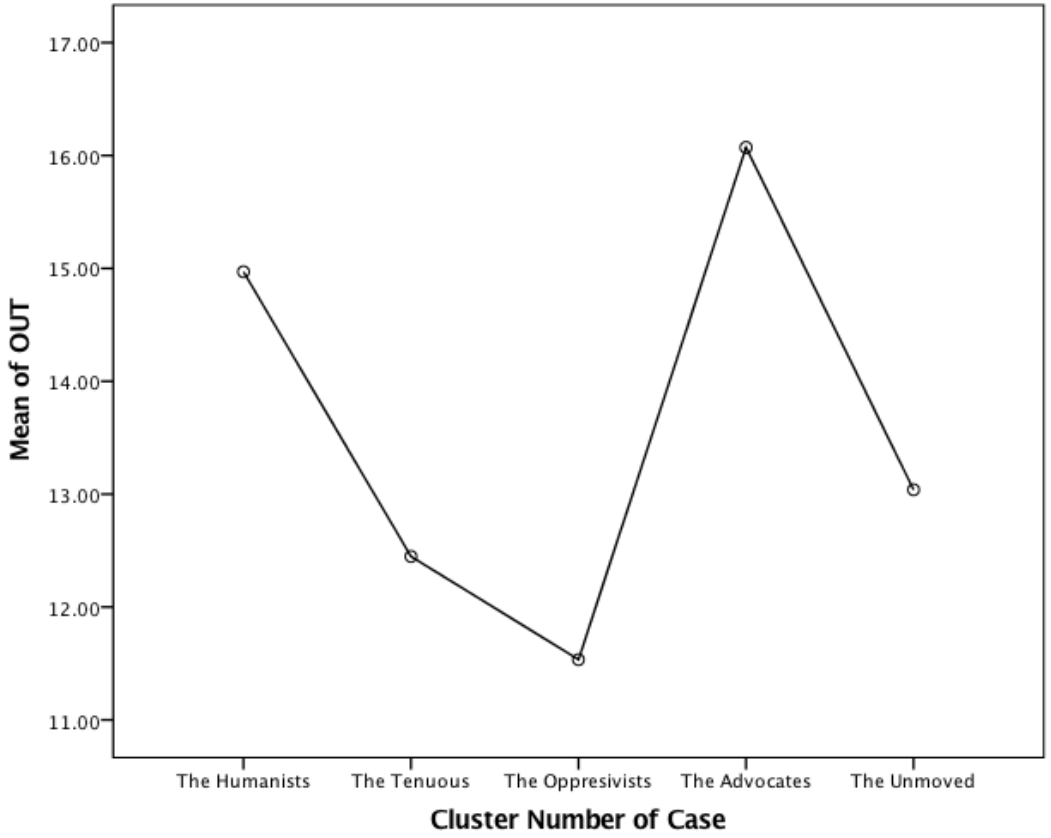

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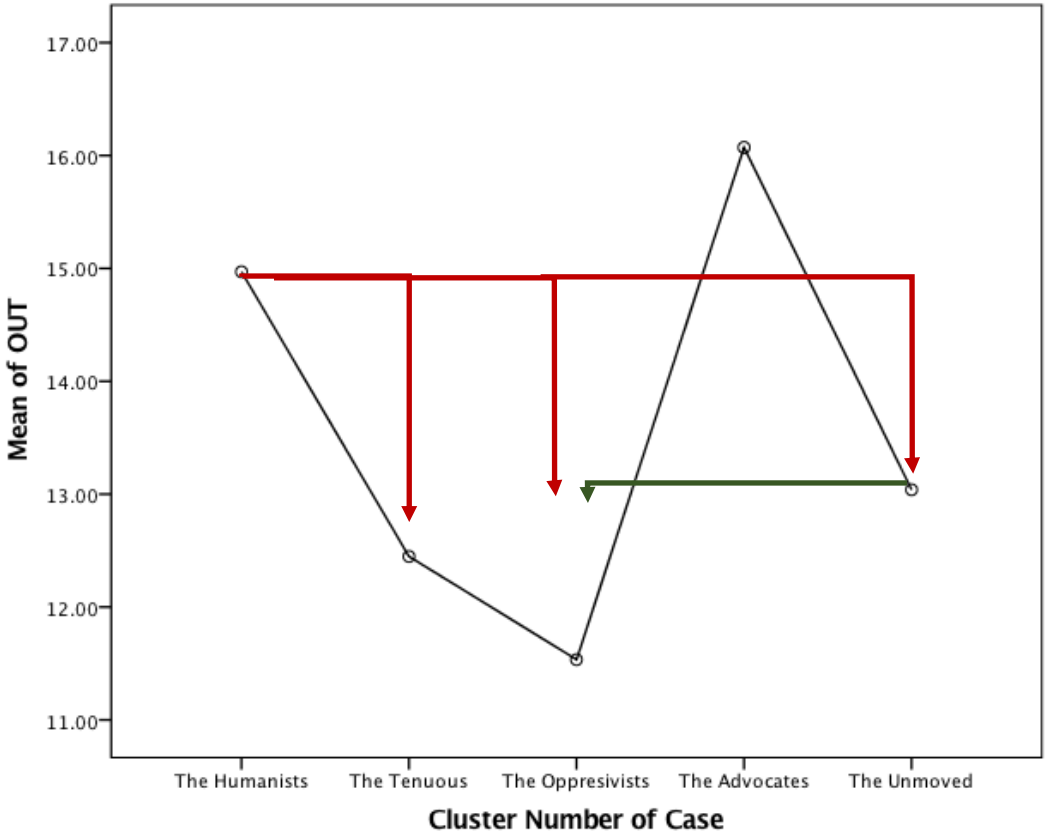

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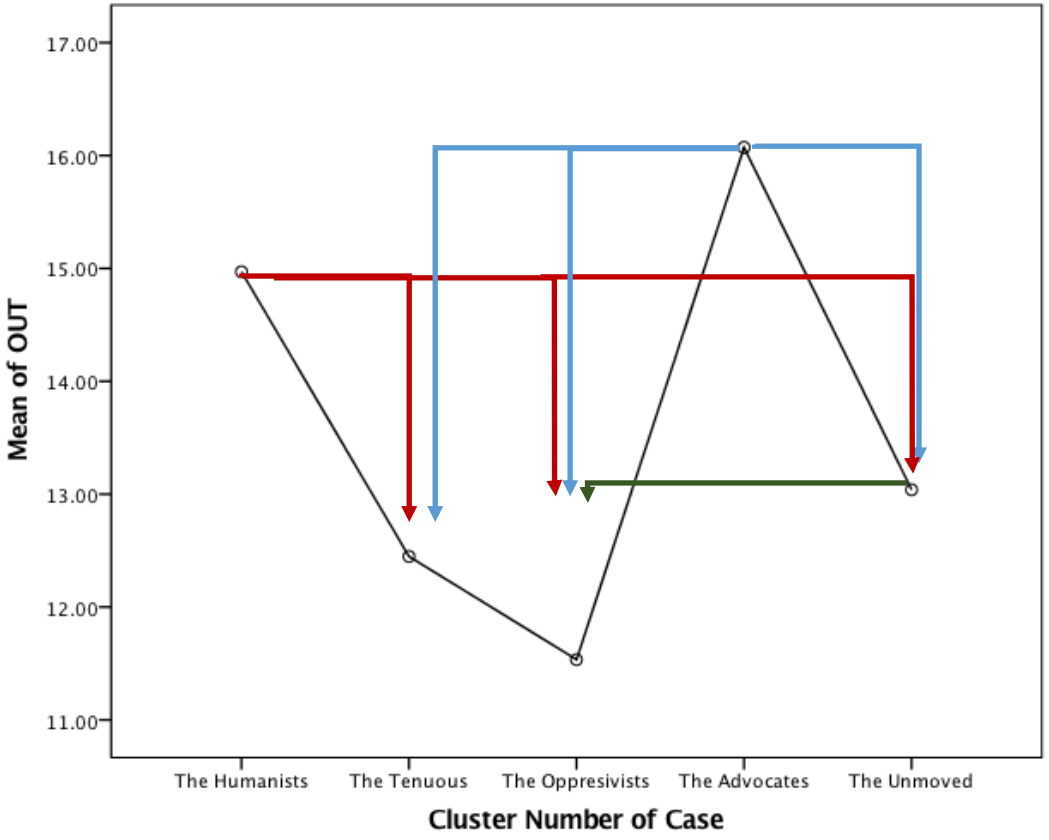
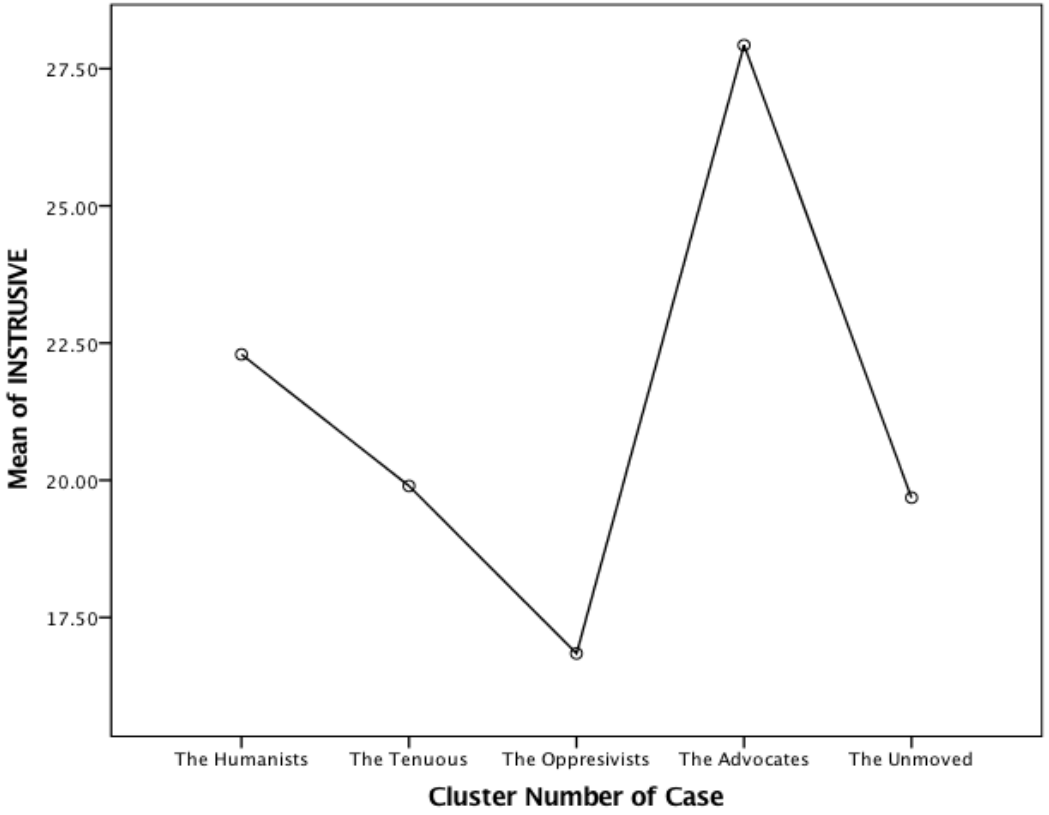


Findings: Intrusive Practices

- Violated assumption of homogeneity of variance (Levene's 3.256, p=.012)
- Welch ANOVA results F =38.722, p<.001, n^2= .67 (Large)



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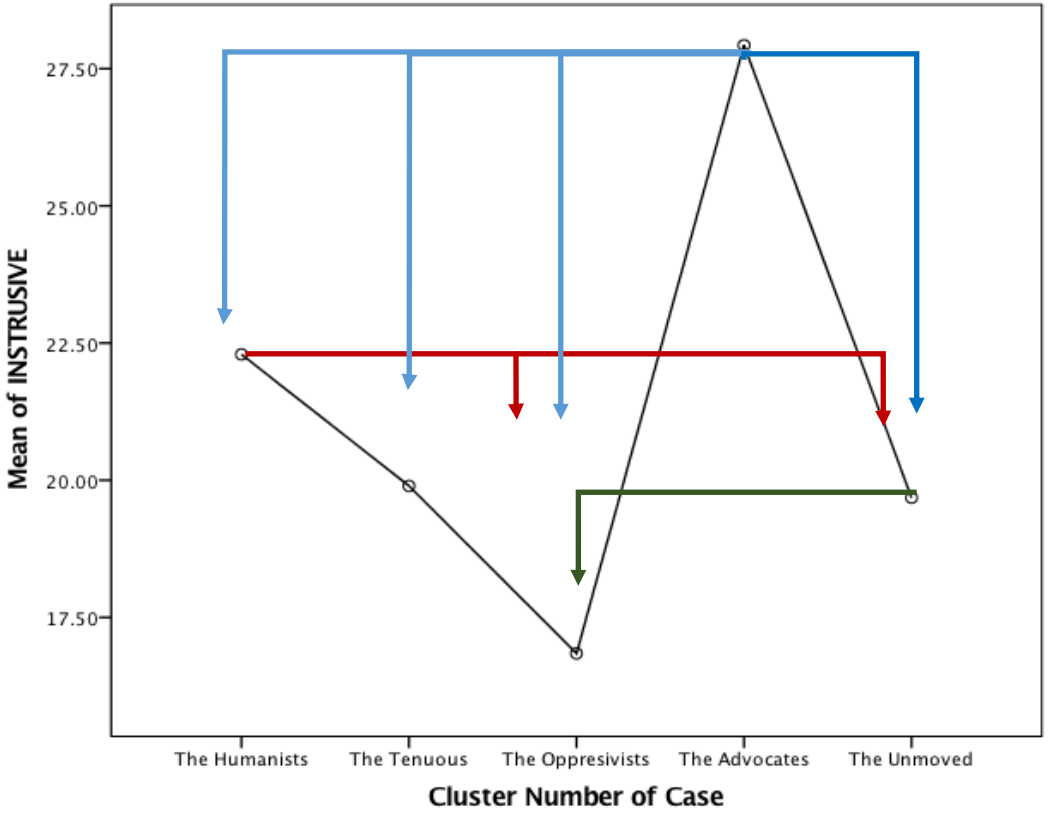

Raceless? Reframing and Reflecting on Community College Mathematics

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Colorblind Ideological Norms in Mathematics

- Blind spots and perceptions of neutrality
  - Assumptions of objectivity that math is culturally unbiased, computation as universal and mathematics for all
- Across the educational pipeline, racially minoritized students are generally underserved in mathematics in contrast to dominant mainstream white students
- Sociohistorical forces and differential treatment of URMs in mathematics-related contexts
- Rhetorical reform when an analysis of equity is limited to access, participation, and completion in mathematics and not the systemic issues, racial realities and tensions

Mathematics Standards, Curriculum, and Reforms

- The status of African American, Latinx, Native American, as well as poor students has not been a primary determinant driving mathematics education reform (Martin, 2003)
- Curricular misalignment in course taking at the secondary level
  - school districts require all student irrespective of their prior preparation to enroll in algebra by 9th grade
- High-stakes testing and placement tests in math have disproportionately impacted URMs in a punitive/negative manner given less access to high-quality teaching (Gutstein, 2003; Tate & Rousseau, 2002)
- Heavy reliance on large numbers of foreign-born workers to fill math and science-based technical jobs and less on the large pool of URMS

Framing Equity

- Math curriculum, teaching, and evaluation are connected to patterns of differential cultural, economic, political and social power -- differential power
- How has math functioned in a manner that recreates and furthers inequalities?
- Equity discussions and equity-related efforts in mathematics education have been largely focused on modifying curricula, classroom environments, and school cultures absent considerations of differential social and structural realities (Gutierrez, 2013; Martin, 2003, 2008)
- Mathematical opportunities are situated in larger realities hence the need for Critical Mathematics challenges looking at equity to perpetuate status quo a (Gutiérrez, 2000)
- Moving discussions of equity in math beyond access and achievement to address issues of identity and power (Gutiérrez, 2002, 2013, 2017; Martin, 2003, 2008)

Context Matters

- There is growing scholarship addressing whiteness in mathematics education (Battey, 2013; Battey & Leyva, 2016; Gutiérrez, 2012, 2017)
- Much of the literature focuses on K-12 education or within four-year college contexts (Mesa, 2017)
- There is a veneer of invisibility of community colleges within this literature and lack of attention to naming community college mathematics as racialized spaces.

Beyond Equity

- Few connections have been made between mathematics learning the ways that math marginalizes relative to centering equity as a topic of inquiry with community college math education
- Need to employ theoretical perspectives that have heuristic value for moving beyond equity oriented rhetoric
- Take into account the collective histories of the groups for whom equity is desired, instead of attributing low achievement to race/ethnicity and acknowledge racism and how schools and the curriculum contribute to differential learning opportunities (Apple, 1992/1999)
- Just having all students take algebra isn't evident of achieving equity in mathematics education

New Directions and Considerations

- When it comes to community colleges and in this case mathematics education, is there a glossing over of the deeply embedded structures that produce inequities in definitions of equity?
- How have math reforms, even in lieu of being equity-minded efforts fall prey to perpetuating some groups being left out?
- Need to challenge definitions of equity to grapple with inequitable conditions URMs face in and outside of school, including the mathematical opportunities in these contexts

Theoretical Considerations

- Mathematics as whiteness
  - History of mathematics is not just to show that certain racial or cultural groups contributed to the knowledge we have today but to also highlight the ways in which settler colonialism or white supremacy are linked to scientific projects (e.g., astronomy being developed to help Europeans identify the location of slaves and to make efficient the export of their labor (Gutiérrez, 2017; Prescod-Weinstein, 2017).
- Critical Race Theory (Dixson & Rousseau 2005; Gillborn, 2015; Ladson-Billings & Tate 1995, Ladson-Billings, 1998; Tate, 1997)
  - Critical Race Pedagogy (Bell, 1992; Jennings & Lynn, 2005; Lynn, 2013).
- Interest Convergence Theory
  - Bell (1992)
  - Secada (1989) called this "enlightened self-interest"
  - "To discuss equity from the perspective of U.S. economic competition is to diminish its moral imperative and urgency" (Gutstein, 2003, p. 38).
- Social Justice Framing Toward Critical Mathematics
  - Mathematics education can also prepare (marginalized and dominant) students to analyze data from the world around them and to develop a critical eye on knowledge and stance toward justice (Gutiérrez, 2002)

Take Aways from the PBI Case Study

- The alignment between how instructors describe their approaches to teaching and how they enacted with them in their classroom did not demonstrate approaches that were explicit culturally responsive
- Beyond attending to teaching approaches, increasing the interactive segments, fostering greater relational practices in mathematics lessons/questions would improve students' opportunities to learn (e.g., more student centered approaches)

Take Aways from the PBI Case Study

- More of students working in groups during class, sought answer questions for which they have to reflect and share outside of class
- Some evidence of problem/inquiry-based learning
- In spite of community colleges being referred to as democracy's doors or the last resort to defend an equitable agenda (Bailey & Morest, 2006)
- Classroom environments and college structures even in well intended departments have racial stratifying impact in the access, enrollment, and success in math reflective of "possessive investment in whiteness," the operationalization of white privilege and curricula that reinforce the status quo (Gutiérrez, 2017; Lipsitz, 1998; Martin, 2009).

Special Thanks

- Acknowledgments

The participants in our colleges and our research assistants: Darielle Blevins, Claire Boeck, Gabrielle Gerhart, Chauntee Thrill

Partial support for this work provided by the National Science Foundation (IUSE awards 1625918, 1625387,1625946,1625891). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation