OBSCURING RACIAL INEQUITIES THROUGH GENDER-FOCUSED DISCOURSE: AN ANALYSIS OF STUDENT PARTICIPATION IN A CALCULUS CLASS

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Inequities in STEM participation for people of color and women are documented extensively, often highlighting issues of representation and/or achievement. This study adds to the literature by looking at participation inequities in a high school calculus class. Equity is conceptualized as a fair distribution of opportunities for students to engage in rich mathematical experiences. Analysis of participants' dialog revealed talk about student participation focused primarily on gender patterns, even when pertaining to only one race-gender group of students (i.e., White males). Analysis of whole-class participation showed White dominance superseded male dominance; White males had the most robust opportunities to participate followed by White females, females of color, and males of color. Findings suggest participants' gender-focused discourse obscured racial inequities in classroom participation.

Keywords: Gender; Equity, Inclusion, and Diversity; Classroom Discourse

Decades of research document inequities related to sexism and racism in STEM (science, technology, engineering, and mathematics) participation (e.g., Martin, 2009; Wang & Degol, 2017). Often participation studies focus on issues of representation (e.g., Cheryan, et. al., 2017) or achievement (e.g., Oates, 2009). In contrast, this study looked at participation inequities as they played out through interactions in a 12th-grade calculus class over one distance learning semester. The focus of this study was on how classroom participants (teacher, student teacher, and students) made sense of students' participation with respect to race and/or gender and how whole-class participation patterns corresponded to race and/or gender.

Equity is defined as the fair distribution of opportunities for students to engage in rich mathematical experiences, supporting deep disciplinary understandings and positive mathematical identities (Esmonde, 2009; Schoenfeld, 2014). Students' identities are conceptualized as complex and multi-dimensional. In the words of Crenshaw (1991), "Because women of color experience racism in ways not always the same as those experienced by men of color and sexism in ways not always parallel to experiences of white women, antiracism and feminism are limited, even on their own terms" (p. 1252). Racism and sexism extend into classroom spaces where students' opportunities to participate and learn mathematics are shaped in racialized and gendered ways (Esmonde & Langer-Osuna, 2013; Gholson & Martin, 2019; Sengupta-Irving & Vossoughi, 2019).

This study aims to provide a nuanced understanding of students' varied experiences in a high school calculus class "by making visible what has been obscure and bringing to the center what has been marginalized" (Bullock, 2018, p.123). Research questions are: 1) How did participants articulate participation issues related to race and/or gender? 2) How were whole-class contributions distributed across students in the class?

Theoretical and Conceptual Framing

Teaching and learning are considered sociopolitical endeavors through which power is distributed, either perpetuating persistent inequities or challenging existing hierarchies and injustices (Gutiérrez, 2013; Philip et. al., 2017; Valero, 2018). Based on sociocultural theories,

learning is defined as changes in students' participation in collective classroom practices (Lave & Wenger, 1991; Vygotsky, 1978) and is a function of students' opportunities to participate (Gresalfi, et. al., 2009). Inequities are created and perpetuated through the construction of disparate and stratified opportunities for students to engage in meaningful learning experiences (Esmonde & Langer-Osuna, 2013; Shah & Crespo, 2018). Over time, patterns of participation play out through interactions between teachers, students, and mathematical tasks (Clarke, 2004), and these interactions are racialized and gendered forms of experience (Leyva, et. al., 2021; Martin, 2006).

Methods

Data Collection

Participants. Participants included one math teacher (White female), one student teacher (Mexican male), one researcher (White female) and 12th-grade students in the teacher's 1st period (Pd.1) AB Calculus class and 2nd period (Pd.2) AB Calculus class. The public high school used distance learning during the 2020-21 school year. Due to the pandemic, students took only three courses at a time, resulting in fewer lessons per course than is typical. Race and gender identities are self-stated for participant interviewees. Racial identities included Black, Chinese, Filipino, Iranian-American, Mexican, Mixed, White, and others. Gender identities included female and male. I have selected identity groups intentionally and I acknowledge they are imperfect. Non-White identifying students are grouped as "Students of color" based on how students talked about themselves related to their peers. (Guadalupe said, "it's different with PoC girls and the White girls in class…") I have chosen to capitalize "White" to draw attention to the power this classification holds, intending to highlight the non-neutrality of this label (Ewing, 2020).

Participant Discourse Data. Table 1 displays descriptions for the four data types included in the race-gender discourse analysis: lessons, lesson debriefs, one-on-one participant interviews, and informal conversations. Table 2 shows the race and gender of participant interviewees.

Table 1: Data Used for Discourse Analysis

Source Type	With Whom?	Quantity	Total Hours
Lessons	Pd.1 class	45 observations (semester 2)	45
	Pd.2 class	47 observations (semester 2)	47
Lesson Debrief Sessions	teacher & student	30 Pd.1 debrief sessions	2.0
	teacher	45 Pd.2 debrief sessions	7.7
Participant Interviews	teacher	1 teacher, 4 interviews	3.6
	student teacher	1 student teacher, 3 interviews	1.9
	Pd.1 students	9 students, 16 interviews	9.4
	Pd.2 students	8 students, 11 interviews	6.0
Informal Conversations	teacher & student	8 recorded Zoom conversations	1.8
	teacher	12 email chains	n/a

Table 2: Interviewee Identities

	People of Color	White
Female	Students-5	Teacher-1
		Students-4
Male	Student Teacher-1	Students-3
	Students-5	

All lessons, lesson debriefs, and participant interviews were video-recorded through Zoom and took place during the spring semester (Jan - June 2021). Most video-recorded informal conversations and email exchanges took place during this timeframe as well; however, several informal exchanges between the researcher and teacher occurred during the fall semester.

Student Contribution Data. This paper uses observations of whole-class discussions that occurred during 30 "regular" semester 2 Calculus lessons (Pd. 1); optional "help" lessons were excluded from the analysis (Table 3). In addition, Pd. 2 calculus lessons were excluded from this analysis due to space, though both classes are included in the race-gender discourse analysis.

Table 3: Description of Data Used for Contribution Analysis

	Pd. 1 Calculus
# of School Days (Semester 2)	48
# EQUIP Whole-Class Observations	40*
# of "Regular" Lesson Obs	**30**
# of Optional "Help" Lesson Obs	10

* 5 days - groupwork only; 2 days - testing, 1 day - researcher absence

Whole-class discussion data was collected using EQUIP (Equity QUantified In Participation) (Reinholz & Shah, 2018), an observation tool used by researchers to track user-defined discourse dimensions at the student contribution level. The discourse dimensions in EQUIP relevant to this paper are *Contribution solicitation method* (i.e., cold-called, encouraged, volunteered) and *Contribution type* (i.e., responded to a teacher question, asked a question, shared solution, responded to student question, declined to answer, offered a comment, identified mistake, read out loud, shared screen). Every time a student contributed during a whole-class discussion, the contribution was logged using EQUIP and selections were made for each discourse dimension.

Data Analysis

Participant Discourse Analysis. All explicit references to gender and/or race made by participant interviewees (from Pd. 1 & Pd. 2) during the spring semester 2021 were identified from video; several conversations between the teacher and researcher at the end of the fall semester 2020 were also included. All references were sorted into one of four topics (Table 4).

Table 4: Reference Topics with Examples

Topic	References to…	Example
Participation	how categories of students participated during class	White boys dominated class conversations
Representation	the relative number of participants in activities, locations, professions	lack of female students in advanced math courses
Beyond this Class	patterns extending to students' community or society generally	lower expectations for females of color doing math
Self-Reflection	participants' first-hand experiences	pressure to do well and prove assumptions wrong

Once sorted by general topic, references were grouped into specific observations, accounting for different wording but the same meaning. For example, the comments "I noticed the classroom is very male-dominate" and "the boys were talking too much" were both coded as the same participation issue (i.e., boys dominated class conversations). These observations were then sorted according to identity category (e.g., gender, race-gender, race-class) depending on how participants framed their observations. For example, if a participant referred to students' gender and race identities, the observation was assigned *race-gender* as the identity category. References were also coded depending on which participant made the observation.

Whole-Class Contributions. Student contributions were exported from EQUIP to excel and merged with student gender and race data (self-stated when available, otherwise teacher ascribed). Data were aggregated by lesson, student, and class. Quantities were first tabulated by gender (i.e., male, female) and then by race-gender groups (i.e., female students of color, White female students, male students of color, White male students). Only student contributions from Pd.1 (not Pd.2) were included in this paper due to space limitations.

Findings

Findings are organized according to the two research questions. The first section reports how classroom participants (the teacher, student teacher, researcher, focal students) articulated

participation issues related to gender and/or race. The second section reports how whole-class contributions were distributed across gender-race groups.

Participation Issues as Articulated by Classroom Participants

To understand how participants conceived participation "issues," we take a closer look at the references related to classroom participation that were positioned by participants as less-than-ideal. Table 5 shows specific classroom participation issues by identity category, including which participant(s) made the references.

Table 5: Race and/or Gender Participation Issues by Participant

	Observations of... Classroom Participation Issues	# of References Total	By Whom?
GENDER (30)	Boys dominated class conversations	12	T-6, ST-2, S-4
	Girls did not speak up	7	T-6, S-1
	Boys did not collaborate as well as girls in small-groups	7	T-4, S-3
	Student comment-"Wednesday help sessions are for girls"	3	ST-2, S-1
	Boys were sought out as math experts more than girls	1	T-1
RACE-GENDER (6)	White boys dominated class conversations	6	T-3, ST-2, R-1
RACE (1)	Students had different opportunities to participate (White vs. students of color)	1	R-1
RACE - CLASS (2)	Affluent White kids spoke about expensive ski vacations during class	2	T-2

KEY	
T	Calculus teacher
ST	Student teacher
S	Student(s) in the class
R	Researcher

Almost all observations of participation issues referenced gender in some way, either gender-alone or the intersection of gender and race (36 out of 39, 92%). The most common participation issue articulated was that boys dominated class conversations, identified by the teacher, student teacher, researcher, and four students. There were 18 references to this issue; 12 referred to boys in general and 6 referred to White boys. This issue was talked about as a gender issue (boy dominance) twice as often as a race-gender issue (White boy dominance), even though the students to whom participants were referring were all White males. The four students who mentioned this issue were students of color (3 female, 1 male) and all described the issue without mentioning race. However, it is possible students *thought* about the issue as race-related but chose to *speak* about it as gender-related. On the other hand, the adults all spoke about imbalanced participation as a race-gender issue at least once. The teacher spoke about this issue sometimes as a gender issue and sometimes as a race-gender issue, as did the student teacher. The researcher made one reference to the issue, referring to it as "White boy" dominance.

Another often-mentioned participation issue was that girls in the class did not speak up enough. The teacher mentioned this issue 6 different times, expressing frustration with the situation. During a lesson debrief, the teacher shared, "I'm really annoyed with [name 1] and [name 2] cuz they are the starlets in this class. They get everything right. They would have been in BC Calculus, but they decided not to bother. And they're not contributing to the class." The issue was also brought up once by a White female student who shared, "For the really hard problems, there are 3 girls who get it and they're the only girls in the class- or not the only girls, the only *students* in the entire class who get it, but they don't really want to speak up and explain it or talk about it, which I've found really interesting." The three students to whom the teacher and student are referring are all female students of color; however, the issue was identified as a gender issue, not a race-gender issue. The teacher and student's confusion regarding why students were not speaking up could have been connected to presumed similarities in gender identity, but they were not accounting for differences in racial identities. The White female teacher and White female student may not have known what it was like to be a female *of color* in a *White* male-dominated math class. In support of this theory, here is one example of how race shaped experiences for one female student of color in this class:

> Within calculus and the girls, I feel like we should be supporting each other more than some of us do… it's different with PoC girls and the White girls in the class… It's a little bit more hostile, [White girl] is very hostile toward me. And so, I'll be like, 'Oh, okay.' I don't want to overstep. And with [PoC girl] it's not like that… I understand the PoC girls more and so they're a bit more supportive… a lot of times [White girls] are a little bit more reserved about their work, which is fine. You don't have to help us or share your work with us, but we don't necessarily act that way towards them… it's not the same. It's just different.

There was only one reference to a participation issue related to race-only; that reference was made by the researcher. After completing a preliminary class observation at the end of the fall semester, the researcher shared with the teacher her observation that only one student of color had opportunities during the class period to participate in competent mathematical ways (e.g., answer how/why questions). The only other race-related participation issue raised was by the teacher in reference to two affluent White students talking about their ski vacations.

Student Contributions during Whole-Class Discussions

Contributions were quantified by totaling the number of contributions made by Pd. 1 students during regular lesson whole-class discussions over the entire semester. There were 28 students enrolled in this course who made a total of 767 contributions during the 30 observed lessons.

Given participants' gender-focused discourse shown in the previous section, contributions were initially examined by gender. Table 6 shows total contributions, mean contributions, and contribution solicitations broken down by gender (female / male). Values in the table are color-coded depending on how the percent of contributions compares to the percent of female and male students in the class. If the percent of contributions made by a group is more than 3% higher than the percent of population represented by that group, then table values are green. If the contribution percent is within 3% of the population percent, then values are yellow. If the contribution percent is more than 3% lower than the population percent, then values are red. The same color-coding scheme is used in all tables in this section.

Table 6: Student Contributions by Gender

	Total # of Students	Total Contributions (Semester 2)	Mean Cont. per Student	Contribution Solicitations		
				Cold-Called	Encouraged	Volunteered
ALL Students	28	767	27.4	218	44	505
Female	8	181	22.6	74	21	86
	29%	24%		34%	48%	17%
Male	20	586	29.3	144	23	419
	71%	76%		66%	52%	83%

KEY	Difference from Population %
Green	3% or more higher
Yellow	+/- 3%
Red	3% or more lower

Female students made 24% of all whole-class discussion contributions averaging 22.6 contributions per student, which is 5% lower than what would be expected given perfect alignment between contributions and population representation. The difference is notable but not extreme. Looking at solicitation method highlights bigger differences in participation patterns between female and male students. Specifically, 83% of voluntary contributions were made by male students, and the teacher encouraged roughly the same number of contributions from female and male students. In addition, the teacher cold-called on male students twice as often as female students. Considering females represented 29% of students, the number of voluntary contributions was considerably lower than expected for females, whereas the numbers of cold-called and encouraged contributions were higher. Table 7 shows contributions made, again

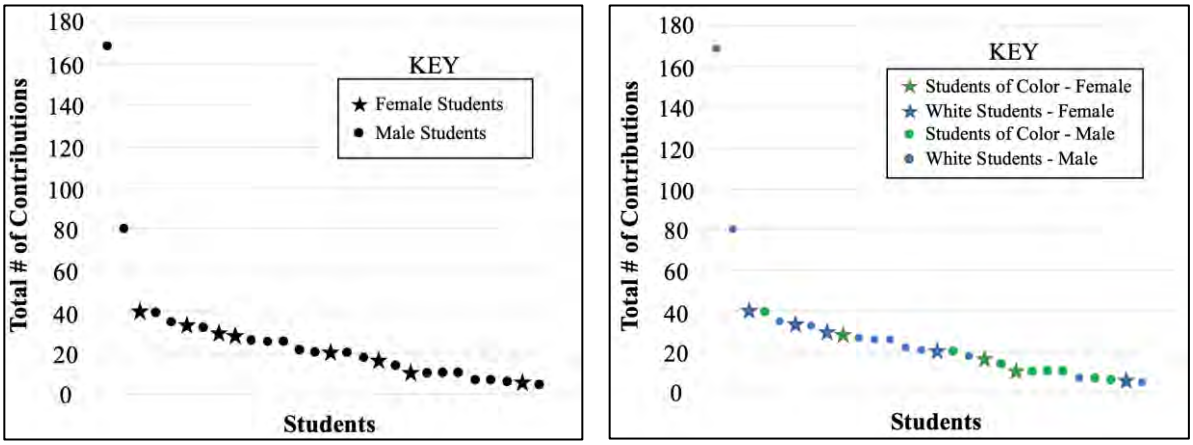
broken down by gender, by participation type (e.g., # of responses to a teacher question, # of questions asked, # of times a student declined to answer a question).

Table 7: Student Contributions by Participation Type and Gender

	Total # of Students	Responded to Teacher Q	Asked a Q	Shared Solution	Responded to Student Q	Declined to Answer	Offered a Comment	Identified Mistake	Read Out Loud	Shared Screen
ALL Students	**28**	**482**	**132**	**45**	**30**	**29**	**25**	**12**	**8**	**4**
Female	**8**	106	14	18	10	13	6	6	4	4
	29%	22%	11%	40%	33%	45%	24%	50%	50%	100%
Male	**20**	376	118	27	20	16	19	6	4	0
	71%	78%	89%	60%	67%	55%	76%	50%	50%	0%

Data indicate females (compared to males) were somewhat less likely to offer unsolicited comments or respond to teacher questions and much less likely to ask questions. They were also somewhat more likely to respond to student questions and much more likely to share problem solutions, decline to answer questions, identify mistakes, read out loud, and share their screen. There was a mix of seemingly productive and unproductive forms of participation by female students. Taken together, data suggest female students were less likely than male students to participate in academically risky ways. One explanation is that females shared problem solutions and identified peers' mistakes when they felt confident with content; in contrast, they declined to answer teacher questions and neglected to ask their own questions when they were more unsure.

To get a better sense of how contributions were distributed among individual students, total contributions per student were sorted from high to low and then plotted (Figures 1a & 1b).



Figures 1a & 1b: Contributions per Student by Gender (1a) & Race-Gender (1b)

Figure 1a shows two outlier male students (dots), one with 169 contributions and one with 80. Female students (stars) seem to be spread evenly across the class, with females taking 4 out of the top 9 contributor positions. Based on Figure 1a, one might conclude inequitable participation in this class could be attributed to the dominant males; presumably, if these two students stepped back allowing others to contribute, then all would be ok. However, adding race to the analysis tells a notably different story. Figure 1b reveals 12 out of the top 14 class contributors were White (86%), including the two dominant males. Although females seemed to be distributed evenly across the spectrum of class contributors, students of color (green symbols) were not. This finding prompted analyses of contributions by race-gender groups (Tables 8 & 9).

Table 8: Student Contributions by Participation Type and Race-Gender

	Students of Color						White Students					
	Total # of Students	Total Contributions (Semester 2)	Mean Cont. per Student	Contribution Solicitations			Total # of Students	Total Contributions (Semester 2)	Mean Cont. per Student	Contribution Solicitations		
				Cold-Called	Encouraged	Volunteered				Cold-Called	Encouraged	Volunteered
Female	3	54	18	21	8	27	5	127	25.4	53	15	59
	11%	7%		10%	14%	5%	18%	17%		24%	34%	12%
Male	8	117	14.6	53	5	59	12	469	39.1	91	18	360
	29%	15%		24%	11%	12%	43%	61%		42%	41%	71%

Table 9: Student Contributions by Participation Type and Race-Gender

	Total # of Students	Responded to Teacher Q	Asked a Q	Shared Solution	Responded to Student Q	Declined to Answer	Offered a Comment	Identified Mistake	Read Out Loud	Shared Screen
ALL Students	28	482	132	45	30	29	25	12	8	4
Students of Color										
Female	3	25	7	7	3	4	1	2	2	3
	11%	5%	5%	16%	10%	14%	4%	17%	25%	75%
Male	8	74	24	7	3	8	0	1	0	0
	29%	15%	18%	16%	10%	28%	0%	8%	0%	0%
White Students										
Female	5	81	7	11	7	9	5	4	2	1
	18%	17%	5%	24%	23%	31%	20%	33%	25%	25%
Male	12	302	94	20	17	8	19	5	4	0
	43%	63%	71%	44%	57%	28%	76%	42%	50%	0%

Findings from this analysis reveal that participation inequities in this class extended beyond gender groups. Male students did not dominate class contributions; *White* male students dominated. In fact, male students of color experienced the fewest opportunities to participate across all contribution categories compared to the other gender-race groups. Male students of color made 117 contributions, only half of what would be expected given their representation in the class (15% of contributions vs. 29% of population). They were the least likely group to share problem solutions, respond to student questions, or offer unsolicited comments. None of these three types of participation were required by the teacher; the teacher asked for volunteers to share homework solutions for extra credit and if no one volunteered, the teacher did it. The teacher also answered students' questions if no student volunteered to answer them, and unsolicited comments were shared without any explicit invitation and therefore not required. The only participation type for which male students of color were within the expected range was declining to answer questions. They declined to answer their fair share of questions, but this is the one contribution category for which higher is not better.

Female students of color experienced the second fewest opportunities to participate. The three group members accounted for 54 contributions (7% of total contributions vs. 11% of population) averaging 18 contributions per student, slightly higher than male students of color (14.6 per student), but lower than White females (25.4 per student) and White males (39.1 per student). Female students of color were cold-called and encouraged to contribute as expected, while White female students were cold-called and encouraged *more often* than expected. In addition, White female students responded to teacher questions and offered unsolicited comments as expected, while female students of color contributed in these ways *less often* than expected. White female students were not that different from their White male peers with most contribution frequencies falling within the expected range or above. Consistent with the initial analysis, the exceptions seem to be related to risk-averse participation and seem to be true

regardless of race; specifically, females (in general) were less likely to ask questions, more likely to decline to answer, and less likely to offer voluntary contributions. With 469 total contributions (61% of total contributions vs. 43% of population) White male students dominated whole-class participation. The two outlier White male students certainly impacted the contribution numbers, but they were not the only White males contributing; nine out of the top 14 class contributors were White males. The only two participation types with lower-than-expected rates for White males were declining to answer questions and sharing screens. Four times during the semester the teacher asked, "Can someone please share the task prompt on their screen?" and all four times females responded to this request; three of those four times were female students of color.

Discussion

Participants spent much more time talking about classroom participation issues related to gender than race. Even issues that pertained only to White male students or female students of color were repeatedly framed with respect to gender alone. Differences in whole-class participation by gender did indeed exist but the analysis of gender-race groups revealed a more nuanced, and consequentially different, participation story. Findings revealed *White* dominance superseded *male* dominance; White male students had the most opportunities to participate, followed by White female students, female students of color, and finally male students of color.

Taken together, findings suggest participants' gender-focused discourse obscured racial inequities in classroom participation. Gender-focused discourse drew attention to discrepancies in male / female participation, but differences in the participation of White students and students of color were not noticed, or at least not talked about. The only participation issue mentioned related to race (and not gender) was an issue I raised before the start of the spring semester. After doing a trial run with EQUIP, I shared with the teacher that only one student of color had been given opportunities during that class period to contribute in "mathematically competent" ways. The teacher acknowledged the importance of this observation at the time. Yet, neither one of us (both White women) referenced this (or any other) race-related participation issue again. It was not that I noticed issues and chose not to mention them; I did not see racial inequities in spring semester participation until I conducted the gender-race analysis of student contributions.

Questions remain as to how our identities as White women may have clouded our ability to talk about and notice racial inequities. However, the student teacher, a man of color, did not mention race-related participation issues either. It is very possible that students of color noticed racial inequities but chose not to talk about them. Despite the seemingly strong relationships I built with students that year, the fact remained that I was a White woman researcher asking students of color to share with me their personal observations. Students shared a lot, but I cannot assume they shared everything they noticed or experienced.

While attending to gender inequity is extremely important, attending to gender alone is not enough. Discourse focused exclusively on gender obscures the intersectional experiences of numerous other marginalized groups of students, including male students of color, transgender and queer students, and students labelled with "disabilities." In addition, attending only to gender reifies gender as a binary, which further marginalizes students who identify as neither male nor female. Moving forward, an intersectional approach to mathematics education research is of utmost importance. Topics worth exploring further include: how racial and gender-based inequities interact with inequities related to virtual classroom spaces, how gender and race shape participants' noticing, how classroom participation varies for groups of students across different contexts, and how the experiences of individual students within the same identity groups compare to one another.

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