Groupwork as a Site for Servingness among Undergraduate Latin* Mathematics Students

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Undergraduate mathematics classrooms are racialized spaces for Latin students, even at Hispanic-Serving Institutions (HSIs) with educational missions of cultural affirmation. Instruction plays an important role in reinforcing and disrupting racial oppression in mathematics, which has significant implications for gateway courses (e.g., calculus) that impact STEM persistence. Groupwork is a widely-adopted practice in gateway mathematics courses with intentions to promote equitable access to content and participation; however, research has shown that groupwork can perpetuate inequitable experiences for historically marginalized groups in STEM, including Latin* students attending HSIs. The present study addresses these concerns of racial equity in undergraduate mathematics by exploring Latin* students' groupwork experiences in gateway courses at a HSI. Our findings capture how groupwork facilitated or removed access to a sense of racially-affirming community, which was central in Latin* students' visions of equitable support as mathematics learners at a HSI.*

Keywords: groupwork, Hispanic-Serving Institutions, Latin* students, race, servingness

Purpose of the Study

Latin*[1] students experience undergraduate mathematics as a racialized space due to instances of isolation and underestimation of ability (Leyva, 2016; Oppland-Cordell, 2014). Such realities in gateway courses (e.g., calculus, introduction to proofs) can limit racial equity in educational opportunities, including negative effects on Latin* students' mathematics identities as well as access to course content and STEM majors (Brown, 2018; Convertino et al., 2022). Instructional practices in gateway courses, such as groupwork, that are adopted to build equitable access to content and participation hold potential to disrupt racial oppression for Latin* learners (Laursen et al., 2014; Leyva et al., 2021; Fullilove & Treisman, 1990; Villa et al., 2023). However, research has shown that groupwork can perpetuate inequitable experiences for Latin* students and other minoritized groups (Johnson et al., 2020; MacArthur & Dobie, 2023; Oppland-Cordell, 2014). Researchers have called for work that centers minoritized student populations' groupwork experiences to better understand equitable practices (Ernest et al., 2019; Reinholz, 2018).

Even at U.S. colleges and universities with the federal designation of being Hispanic-Serving Institutions (HSIs), mathematics education remains a racialized environment for Latin* students (Leyva et al., 2022; McGee, 2016). This reality reflects a broader structural concern at HSIs – namely, their lack of institutional visions for serving Latin* students to promote racially-equitable outcomes and culturally-affirming experiences (Garcia, 2020). Research at HSIs that uncovers features of practices and policies for racial equity is a critical need (Vega et al., 2022). To guide such work, Garcia and colleagues (2019) conceptualized *servingness* as a framework that addresses various dimensions of culturally-enhancing opportunities for better serving Latin* students at HSIs, including outcomes, experiences, organizational structures, and external forces.

[1] *The term Latin* is inclusive of gender-nonconforming identities in the Latin American diaspora.*

Research on servingness in STEM has focused on student outcomes related to institutional structures, such as departmental policies (Burn et al., 2019) and support programs (Rodríguez Amaya et al., 2018). However, limited work has examined Latin* students' experiences of STEM instructional practices. Such work is important in gateway mathematics courses that impact STEM retention (Bhattacharya et al., 2020; Byrne et al., 2023; Convertino et al., 2022).

The present study addresses the two areas of needed research in undergraduate mathematics identified above specific to equity issues in groupwork and servingness through instruction. We explored Latin* students' groupwork experiences in gateway mathematics courses at a HSI to uncover features of peer collaboration that constrained and promoted identity-affirming learning opportunities. The study addresses two research questions: (i) How does groupwork in gateway courses reinforce and disrupt mathematics as a racialized experience for Latin* students? ; and (ii) In what ways does groupwork advance and limit opportunities for actualizing Latin* students' conceptions of servingness as mathematics learners at a HSI?

Methods

Our study is from a larger project exploring influences of faculty professional development about culturally-responsive pedagogy in promoting equity for Latin* mathematics students at Sonoma State University – a medium-sized, public university recently designated as a HSI. The university's undergraduate demographics are about 45% white, 35% Latin*, and 20% some other race. The larger project explores instructors' and Latin* students' perspectives on servingness in instruction across gateway courses for STEM majors, including calculus, statistics, introduction to proof, and developmental mathematics sequences. Our team has completed two years of recruitment and data collection since fall 2021. A total of 24 Latin* students were recruited in Year 1 to complete individual interviews via Zoom and journaling about instructional experiences. Fifteen students completed in-person group interviews at Sonoma State during Year 2. Only one student participated in both years. The present report focuses on group interviews.

We invited Latin* students in gateway courses to express interest as participants via email and class visits. We purposefully sampled from students who expressed interest to have multiple voices from different gateway courses as well as to ensure variation in ethnicity and gender. In fall 2022, a total of 31 Latin* students were invited to complete a 2-hour, semi-structured group interview that was audiotaped and transcribed. Fifteen students completed interviews, resulting in six conducted interviews (two for statistics, two for calculus, and two for other courses). The majority of our sample identifies as Mexican or Mexican-American, which is reflective of Sonoma State enrollment. Eleven of the 15 interviewed students are cisgender women. Students with nonbinary gender identities were invited to participate, but were unable to attend the interviews. To the best of our ability, we paired each participant with at least one student of the same gender to mitigate feeling tokenized and make space for variation in race-gender identities. One faculty and two Ph.D. student researchers from outside of Sonoma State conducted the interviews, each with 2-4 participants. To the extent possible, we matched interviewers and participants by race and gender as an effort to build comfort with discussing racism and other forms of oppression. A Latin* researcher was present for all interviews.

Interviews consisted of three parts: (i) students' views on servingness, (ii) responses to three prompts of instructional scenarios corresponding to themes of servingness from Year 1 data analysis (see Leyva et al, 2022 and McNeill et al., 2023), and (iii) responses to an excerpt from Sonoma State's HSI Task Force Report. One scenario featuring instructional practices addressed groupwork:

> My professor asks us to work in groups when solving a mathematics problem, either in class or as homework, followed by presenting our group solution to the class. I often feel concerned about collaborating with classmates in groups because I am unsure if I will have something meaningful to contribute and if my ideas will be welcomed or taken seriously. Groupwork can also be an isolating experience for me as a Latinx student in the mathematics classroom because students may choose to work with classmates of the same racial and gender identities.

For the prompts and report excerpt, we asked about the extent to which Latin* students related as mathematics learners, instructional aspects (dis)affirming of their identities, and ways to improve support. Our analysis focused on the first and third interview parts and the groupwork scenario.

A pair of researchers (one from Sonoma State and one from an outside university, at least one of whom was Latin*) coded each transcript. Sonoma State researchers coded de-identified versions to protect participant confidentiality. We independently and inductively coded to flag instructional and departmental features that students viewed as fostering or limiting servingness, including attention to Latin* students' intersectional identities and cultural backgrounds. A coder from each pair synthesized codes for each transcript to identify themes discussed as a team.

Our team approached the analysis with critical self-reflexivity. We have robust diversity among faculty and students across intersections of race (Asian/Filipinx, Black, Latin*, white) and gender (nonbinary, cisgender woman, cisgender man). Half of our team involved in the present analysis identifies as Latin*, and several members are first-generation college students. As individuals, we brought awareness of how our respective areas of privilege and oppression impact our study of servingness in mathematics at HSIs. We resisted deficit engagement with Latin* students' perspectives and constantly recognized how undergraduate mathematics is situated in broader systems of social power. We bracketed our lived experiences when interviewing and coding to avoid distorting students' perspectives, all while interrogating structures that limit servingness in groupwork and other mathematical contexts at Sonoma State. Our findings avoid essentializing portrayals of Latin* experiences by looking across three cases of groupwork for first-generation females from low-income, Mexican families enrolled in different gateway courses[2].

Findings

Our analysis uncovered how groupwork in gateway mathematics courses can be an opportunity to advance servingness, particularly in terms of Latin* students building a racially-affirming community. Participants shared different reasons for why they valued groupwork, such as accountability to complete assignments, decreased vulnerability of asking questions in class, and meeting new people. Appreciation for groupwork aligned with values of community that were central across participants' views of servingness at Sonoma State. Several students reported feeling served through Sonoma State's student support services (e.g., Educational Opportunity Program office), where they built communities that nurtured their mathematical success. Latin* students, however, also described a lack of race-conscious support in mathematics, including groupwork as an oppressive experience that limited access to content and participation as well as negatively impacted their mathematics identities. Despite an overall lack of servingness in mathematics, participants addressed possibilities through instruction that can disrupt groupwork as an oppressive context and promote a sense of community affirming of their Latin* identities.

[2] The findings do not specify the gateway mathematics course for each participant to protect confidentiality.

We now present findings from analyzing perspectives from three participants (Kayla, Indrid, and Oliva), which offer illustrative cases of how access to community in groupwork can impact servingness. Kayla is a third-year Mexican-American female[3] studying humanities. Indrid is in her first year and Oliva in her second year. Both identify as Mexican females in STEM majors.

The first two sections of the findings address our first research question by detailing racial (in)equity in Lain* students' groupwork experiences. First, we present how social forces, such as stereotypes and structural inequalities, shaped groupwork as a racialized experience. Next, we show how groupwork afforded or disrupted Latin* students' access to a racially-affirming peer community. The final section of the findings addresses how groupwork fell short or advanced each Latin* participant's perception of servingness, answering the second research question.

"If You're Latina… They Don't Take You Seriously If You're in a Group Project"

All three participants addressed how stereotypes of mathematical ability and structural inequities of access contributed to experiences of isolation, with groups often segregated by race and gender. Kayla felt white peers were assumed to be smarter and chosen more often as partners, "When students get to choose our own groups, sometimes for Latinx students, we would feel left out… It's hard to find a group because everybody pairs off with the smart people… because they're white." With strong representation of white students in Kayla's class, she often had white groupmates who seemed to undermine her ability and limit her contributions.

> A lot of Caucasian people, I try to put my inputs, try my best, but when I give the answers, they always look at me like it's wrong. Essentially, they do all the work and I just put my name on it. I still feel I'm not learning anything because then if I ask, 'Oh, how do you do this?' They're like, 'Well, it's simple. Just look at the notes.' I could look at the notes all I want. It's gibberish. Essentially, it's making me feel, again, like I don't know it.

Racialized assumptions of who is mathematically able made groupwork exclusionary for Kayla, restricting her access to learning opportunities and a positive sense of mathematical competence.

Oliva saw herself contributing to racialized segregation during groupwork because she was concerned that collaborating with classmates who did not share her Latinx or Mexican identity could limit her mathematical contributions, "I understand the self-isolation because I still self-isolate… If it were [a] choose-your-own kind of group, I would one hundred percent choose people that look like me, so I can feel related to and I can put forth what I feel like I need to put forth." Her intentional selection of Latinx or Mexican groupmates allowed her to connect with peers who understood her and to protect herself from racialized judgment. Indrid similarly shared how being stereotyped as a Mexican female shaped groupwork as a racialized-gendered space. When asked if being in a mathematics class impacted how students select collaborators, she said, "You unconsciously go towards people that look like you… Yeah, because… stereotypes. If you're Latina… 'Girls are not good at math. Latina, Hispanic girls are just raised to end up being housewives… [or] pregnant'... They don't take you seriously… in a group project." Groupwork was a racialized-gendered space where stereotypes disallowed productive peer collaboration. Indrid recalled an instance of racial stigma when a white female groupmate proposed working on textbook problems independently followed by assuming that she could afford to buy the book and not trusting her to borrow it. Being low-income also stigmatized Indrid during groupwork.

[3] We used language consistent with how students described their identities, including their interchangeable use of terms for their race (e.g., Latinx, Hispanic, Mexican) and gender (e.g., female, girl, woman) during the interview.

"Have a Community That Understands the Math and… Without Feeling Ashamed"

Participants viewed racialized dynamics in groupwork limiting opportunities to find and build community that supported their Latin* identities. We now show how exclusion in groupwork was reinforced or disrupted for Kayla and Oliva, impacting access to community.

As a white-passing Mexican-American female, Kayla grappled with tensions of concealing her Latin* pride (e.g., not speaking Spanish) to contribute more in groupwork, "[A white person] hears me speaking Spanish, they're like, 'Oh, you're not white?'… I also grew up knowing what I can and cannot do [as a Latin* person], and sometimes the white-passing helps with the things I'm able to do… They treat you differently once they find out [you're Hispanic]." In addition to such linguistic racism in groupwork, she saw white peers' backgrounds with "parents having higher education" as reinforcing inequities of available support. As a first-generation college student, Kayla saw her family limited in offering support for her in mathematics because her parents did not attend college, "I can't ask him [Kayla's father] for help. He never finished high school… They [Kayla's parents] don't know the level of math that I'm trying to learn." Racial inequities in terms of families' educational backgrounds and access to peer support were left unchallenged in Kayla's mathematics classroom where she lacked a community of support, "It would be nice to have a community that understands the math and I can go to them without feeling ashamed." Even with groupwork, she was on her own to succeed mathematically.

In contrast to Kayla being denied community in groupwork, Oliva shared a recent classroom moment allowing her to overcome fears of racialized judgment that isolated her and to collaborate with a racially-diverse group who became close friends. Her instructors opened the course with a discussion about recognizing social diversity and prioritizing mutual respect.

> First day of instruction… they're [instructors] like, 'We're going to have a conversation… We respect everybody.' That changed the aspect of the class completely… We were able to sit down, have a conversation, and be like, 'Okay, I am this, but I am also this. Intersectionality is a real thing.'… That's probably why I feel really strongly about that class. I was able to talk to people in other races and genders…and still be able to collaborate.

Oliva perceived this practice of encouraging students to be identity-conscious and respect each other as establishing a "sense of community," which facilitated positive groupwork experiences with classmates across social differences and thus disrupted racialized segregation in groupwork.

"There Was Just Much More Communication… That Opened Up A Lot of Doors For Me"

Latin* students' groupwork experiences that lacked a racially-affirming sense of community constrained opportunities to experience servingness as mathematics learners. Kayla viewed having a community that understood her struggles and motivated her pursuits of academic success as central to being served as a first-generation Hispanic female at Sonoma State. She saw being in a multicultural sorority providing a racially-affirming community missing in mathematics. "The sorority that I am rushing, a lot of them [are] first-gens, low-income… which makes me feel more [of a sense of] belonging… I'll have somebody that have gone through the same struggles as I have." The racialized space of groupwork, where Kayla navigated white peers' judgment for her questions and marginalization as a contributor, left her without a community where she felt seen and supported like in the sorority space. Kayla saw hiring Hispanic mathematics tutors fluent in Spanish as one way to increase Latin* students' access to such a peer community, "A lot of the tutors… are students and not many of them are Hispanic, especially in math… I tend to use Spanish to get my points across and sometimes we can't really

do that with someone that doesn't speak Spanish." Mathematics groupwork free of racialized judgment and an openness to speaking in Spanish would promote Kayla's vision of servingness.

Indrid's oppressive experience in groupwork restricted access to a community where she felt seen for her financial struggles, which played a major role in her view of being served as a low-income Mexican college student, "Honestly, it's [servingness is] just more financial help… Luckily for me, I got FAFSA. That helped with my tuition… groceries, just basic needs. And then housing is a struggle sometimes." Racialized tensions with white groupmates, such as the female peer who denied loaning her a textbook, reinforced structural inequities that limited Indrid's access to learning opportunities and therefore servingness in mathematics. When asked the extent to which Sonoma State serves Latin* students in mathematics, she critiqued the lack of faculty diversity, which she saw impacting comfort in seeking support unavailable in groupwork.

> In the group, I was always the social one, so I had to email the teacher… We should have a more diverse faculty… If we had a Latino or Latina math teacher… that would be good too because Hispanic, Latino students will most likely be more comfortable talking to them and reach[ing] out for help than a white teacher that they are most likely intimidated by.

Indrid viewed having Latin* professors for mathematics increasing access to support for overcoming struggles in groupwork. Presence of Latin* mathematics faculty would enhance servingness for Indrid by expanding her community of racially-affirming support at Sonoma State, which can mitigate oppression due to stereotypes and structural inequities in groupwork.

Unlike Kayla's and Indrid's groupwork experiences that departed from their conceptions of servingness, classroom norms of mutual respect and social awareness that guided groupwork in Oliva's classroom aligned with her views of being served as a Mexican female at Sonoma State. She perceived open dialogue in her mathematics classroom as resonating with her Mexican family's value for communication, which she described as important to her success, "There was just much more communication [in the class], which I personally need, especially… coming from the family that's mostly just speaking to each other on how to get points across. I feel like, at least in that class, I thrived." With the classroom experience of "having that conversation" about mutual respect being likened to communication practices in her family, this instructional practice advanced servingness for her because it established a collaborative space attuned with her values in her family and culture as a Hispanic mathematics learner. Oliva perceived Sonoma State serving her as a Mexican female by providing transformative educational opportunities that go beyond those that her family can offer and will inspire future generations.

> I have the opportunity to continue in education… That's something I don't come from. My family, definitely not… It's what I've been told, 'This is what you can do to better yourself and everyone that comes before and after you.' So, just the fact that I'm given the opportunity to be able to do that… I'm truly grateful... When you say [Sonoma State] serves me… that's what it is… A home away from home, but with more opportunities… It changes you as a person… I'm also first-gen, low-income, have younger siblings and other people at home I gotta impress, pave the way, [and] get there so they can get there with a little more support. But it just makes you a stronger person at the end of the day.

Personal transformation through education in Oliva's perspective on servingness is evident in the long-term positive impact of open dialogue in her mathematics classroom. She shared, "That [the

value of communication in class] opened up a lot of doors for me… That class has led me to where I'm at right now. I can talk to the professor, not having to be [about] math… That little seed right there has really been pushing me." Such open communication, which established classroom norms of respect, nurtured Oliva's personal growth as a Mexican female. She overcame fears of racialized judgment in peer collaboration and actively sought faculty support, both academic and personal, that motivated her persistence. Thus, the disruption of racial exclusion in groupwork contributed to transformative learning opportunities that Oliva sought in being served at Sonoma State and provided her with a community of support in mathematics.

Discussion

The scholarly significance of our findings is threefold. First, our findings add knowledge to address the lack of clarity about groupwork approaches for equity (Hwang et al., 2022; Reinholz, 2018). Our analysis contributes to research on racially-equitable collaborative learning in mathematics (e.g., Bhattacharya et al., 2020; MacArthur & Dobie, 2023) by elucidating how groupwork expanded and constrained identity-affirming support for Latin* students. Second, the study deepens understandings of equity-oriented instruction in gateway mathematics courses through its focus on a single racially-minoritized group (Latin* students) and a single type of classroom practice (groupwork). By centering three Latin* first-generation college women in the findings, we also shed light on intersectional complexities on how gender overlapped with race, language, and social class to impact equity in groupwork. Third, our study addresses limited inquiry on instructional experiences for servingness in STEM. The findings provide a novel view of how HSI structures that foster community can inform equitable groupwork in mathematics.

Our analysis raises implications for research. Future studies can examine perspectives from mathematics faculty at HSIs on designing groupwork opportunities that promote equity for Latin* students. Exploring how these views converge and diverge from students' conceptions of servingness can orient faculty learning in translating HSI missions of culturally-affirming support into instructional practices. Additional research on student experiences of groupwork and other classroom practices across various HSI contexts with different Latin* populations can inform more robust understandings of servingness in undergraduate mathematics education.

In terms of implications for practice, Latin* students' isolation in racially-segregated groups as well as limited access to faculty and peer support underscore how faculty play a key role in structuring groupwork to mitigate oppression (e.g., Oliva's instructors setting norms for socially-conscious collaboration). Faculty can make informed decisions about grouping arrangements by learning about students' backgrounds and collaboration histories using a short survey at the beginning of the semester. In addition, faculty can structure groupwork tasks with rotating roles and frequent check-ins to ensure Latin* students are collaborating well with peers, engaging deeply with the mathematical content, and receiving adequate support. Latin* participants' references to campus support structures at Sonoma State where they experienced servingness (e.g., Educational Opportunity Program office, multicultural sorority) raise implications for mathematics departments about building partnerships with such offices and units. Mathematics faculty and student support leaders can share their respective struggles and successes in providing Latin* students with a racially-affirming community. Such exchanges can guide faculty to structure instruction, including groupwork, that enhances servingness in mathematics.

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