

Equity Does as Equity Feels: Perspectives on Equity and Active Learning in Collaborative, Problem-solving Courses at an HSI

Jocelyn Rios
University of Northern Colorado

Guadalupe I. Lozano
University of Arizona

In this study, we explore notions of HSI servingness and equity in practice as perceived by instructors, facilitators, and students in active learning collaborative, precalculus and calculus problem-solving courses. These courses were part of a grant-funded, scholars program for minoritized student populations. While program outcomes on student achievement, engagement and confidence (discussed elsewhere) are promising, our intent here is to identify and characterize how equity was understood and experienced in practice by those taking and facilitating the courses. Our analysis suggests that instructors and students agree on the learning themes where equity played a role within these active learning courses, but differ in their conceptions of equity within these themes, and in how they saw equity being enacted in practice.

Keywords: active learning, precalculus, calculus workshops, equity, HSI servingness

Purpose of the Study

As Hispanic/Latine populations grow, more universities are being designated as Hispanic-Serving Institutions (HSIs). Yet, Latine representation in STEM remains stagnant, urging HSIs to prioritize making mathematics learning more equitable for Latine and other minoritized students (e.g., Lozano et al., 2018). One popular response approach is scaling student-centered, evidence-based practices, like active learning (Theobald et al., 2020). But how does equity take form in active learning spaces? And to what extent does it serve minoritized populations?

As active learning uptake increases (Patrick, 2020), more needs to be learned about how it is experienced and enacted in practice to promote equity, particularly in gateway mathematics courses. One approach to do this is learning how different stakeholders—researchers, institutions, instructors, and students—understand equity and perceive it in practice. While equity can mean enhancing student achievement and learning, it is also tied to enriching students' experiences, affirming their identities and values, and promoting human flourishing.

In this paper, we seek to understand equity in practice from the perspective of different stakeholders, in the context of active learning, problem-solving (PS) courses (henceforth, PS courses) intended to support the transition to the university for particular minoritized populations. We analyze how facilitators and students conceptualized and experienced equity in the (precalculus and calculus) PS courses at a 4-year HSI.

The PS courses centered in this study serve to support an NSF-funded PS Scholar program designed to enhance equity in the transition to the university. As such, the program ran at three sites, including two 2-year HSIs. This paper focuses on the experience in the PS courses at the 4-year HSI. While results on the program's impact on student achievement, engagement and confidence have been preliminarily reported elsewhere and are promising, we focus here on qualitatively understanding how equity was seen and felt in the PS courses. We address two research questions: (RQ1) *In what ways did facilitators see students as equitably supported (or not) in the PS courses and what conception(s) of equity underlie their perspectives?* (RQ2) *In what ways did students see themselves equitably supported (or not) in the PS courses and what conception(s) of equity underlie their perspectives?*

Relevant Literature

Active learning practices have been shown to improve outcomes for traditionally minoritized populations by reducing achievement gaps (Laursen et al., 2014; Theobald et al., 2020). Successful examples include the Emerging Scholars Program (ESP) calculus workshops, inspired by Uri Triesman’s work with Black and Latine students at UC Berkeley (Hsu et al., 2011). These workshops, now implemented across the U.S., support minoritized students by creating small, diverse classrooms where students work collaboratively on rich mathematical problems, just as in the PS Scholar program grounding this study. Research indicates that these workshops can lead to improved course grades and increased persistence in STEM (Duncan & Dick, 2006; Moreno & Muller, 1999). One qualitative study by Oppland-Cordell and Martin (2015) highlights the positive impact the workshop had on Latine students’ mathematical and racial identities. However, McNeilly (2021) notes a need for deeper understanding of how students experience these active learning workshops and how different practices promote equity.

In everyday classrooms, active learning practices are not always inherently equitable (e.g., Johnson et al., 2020; Reinholz et al., 2022; Rios, 2023). For instance, Rios (2024) demonstrates how multilingual students of color at HSIs were often positioned in deficit ways during group work, while Leyva et al. (in press) demonstrate that group work could either support or hinder Latine students’ access to supportive, “racially-affirming communities” (p. 1). Additionally, there are varying perspectives among mathematics instructors on the role of equity within active learning. Bennet et al. (2022) found that instructors often view equitable teaching as a subset of active learning, yet Williams et al. (2022) reported that instructors did not explicitly address equity in their understanding of active learning. Moreover, research also suggests varying perspectives on the relevance of social identities, like race, when conceptualizing equity (Garcia et al., 2020). Some studies suggest that color-neutral instructor attitudes are linked to less effective equitable practices (Aragón et al., 2017; Garcia et al., 2020). Addressing these gaps, our study explores how students and instructors perceive and enact equity in active learning classrooms, focusing on critical notions of equity that center the whole learner.

Theoretical Framing

Several theoretical frameworks distinguish between critical notions of equity—centering identity, cultural capital, and lived experiences—and equity in academic achievement. Gutiérrez’s (2007) equity framework in mathematics education, for example, comprises two axes: the dominant axis, which focuses on access and achievement, and the critical axis, which emphasizes identity and empowerment. The dominant axis conceptualizes equity as granting access to resources—such as quality teaching, instructional materials, and a supportive classroom environment—to ensure student learning and achievement (Gutiérrez, 2011; Rubel, 2017). The critical axis highlights the importance of considering students’ identities and the power dynamics within the classroom. It acknowledges that students’ cultural, racial/ethnic, gender, and linguistic identities play an important role in their educational experiences. Gutierrez (2007) argues that to champion equity, classrooms must increase access *and* create spaces that affirm and empower students’ identities, allowing thriving without sacrificing who students are.

In the context of HSIs, Garcia (2017) introduces a framework describing four institutional identities HSIs may embody in serving students. In alignment with Gutiérrez’s (2007), Garcia’s framework is built upon two key dimensions. The *outcomes* dimension captures Latine retention and graduation rates. The *culture* dimension reflects how the campus environment affirms Latine students’ identities and enhances their educational experiences. Garcia’s term, *servingness*—an

institutional commitment to advancing both of these dimensions—connotes the embodiment of support for Latine student flourishing alongside academic achievement (e.g., Garcia, 2017).

We argue that the alignment between Gutierrez’s and Garcia’s frameworks suggests that when equity beliefs and practices include aspects of both the dominant and critical axis, the classroom environment mirrors and supports an institutional identity of HSI servingness.

Methods

The PS courses centered in this paper were taught at a large, urban 4-year HSI in the Southwestern U.S. They were open to all students concurrently enrolled in main precalculus or calculus course, including student participants in the NSF-funded PS Scholars program grounding this study (see Study Purpose). PS Scholars participants at the 4-year HSI included 2-year HSI transfer students and students with STEM majors belonging to certain specific minoritized populations: first-generation students, Latine women, and Veteran students.

The PS courses were interactive, co-curricular problem-solving courses utilizing evidence-based practices, including active and collaborative learning. Students met once a week and worked collaboratively (in groups of 3-4 students) directly on whiteboards for the two-hour class period, discussing and eventually co-solving 3-4 challenging problems shared with the class a week prior to each course meeting. Students were expected to think about/sketch ideas for solving each problem ahead of class. During class, instructors and facilitators actively listened, observed, asked questions and offered as-needed feedback as students worked on the boards.

The participants in this study were ten course facilitators (faculty, graduate and undergraduate student teaching assistants) and nine students enrolled in the program. Nine of the facilitators were either inferred as being white or self-identified as white during the interview. In contrast, student participants self-identified as being Mexican, Mexican American, or Hispanic (five), and African American (one). Three other students self-identified as White. Semi-structured interviews were conducted using two different interview protocols—one for facilitators and one for students. The protocols focused on understanding participants' takeaways from the course, and perspectives on equity. Interviews were recorded and lasted approximately one hour.

Transcripts were analyzed using thematic analysis (Braun & Clark, 2022), read multiple times, then coded in two rounds using deductive and inductive coding schemes (Fereday & Muir-Cochrane, 2006). The first round of coding was deductive and yielded two principal codes developed based on Gutiérrez’s (2007) notion of dominant and critical equity. This first round served to parse out our understanding of the various meanings of equity discussed by students and instructors. The second round of coding was inductive and focused on analyzing the data to identify emergent codes. Specifically, we were interested in developing codes that captured the course features and teaching practices students and instructors identified as relating to equity (both dominant and critical). Using an iterative open coding scheme, emergent codes were identified and refined. Once the final codes were developed and defined, the data was carefully re-coded to ensure consistency and accuracy. The final stage of analysis organized the data into a content log based on three organizational categories: (1) student vs. facilitator data, (2) dominant vs. critical equity notions (3) equity themes tied to course features and teaching practices.

Findings

We identified three themes surrounding student and instructor perceptions of equitable support in the co-curricular courses: (1) access to facilitator support, (2) engaging with problems geared towards critical thinking, and (3) collaborating with others in groups. However, our analysis reveals differences in whether students and instructors felt that the practices described

by each theme were, in fact, equitable, as well as differences in their underlying conceptions of equity (i.e., equity understood from the dominant or critical axis). For example, while both facilitators and students felt that theme (1), access to facilitator support, enhanced student learning, students expressed wishing they could interact with faculty who shared their cultural and language identities. Similarly, while both students and facilitators appreciated the rich problem sets in the course (theme 2), one student expressed wanting the problem contexts to be more relevant to everyday life.

In this paper, we focus on exploring theme (3), group work (Figure 1). Facilitators' perceptions about equity in group work were primarily aligned with dominant conception of equity, that is with notions of equity tied to access and achievement. Most Facilitators did not

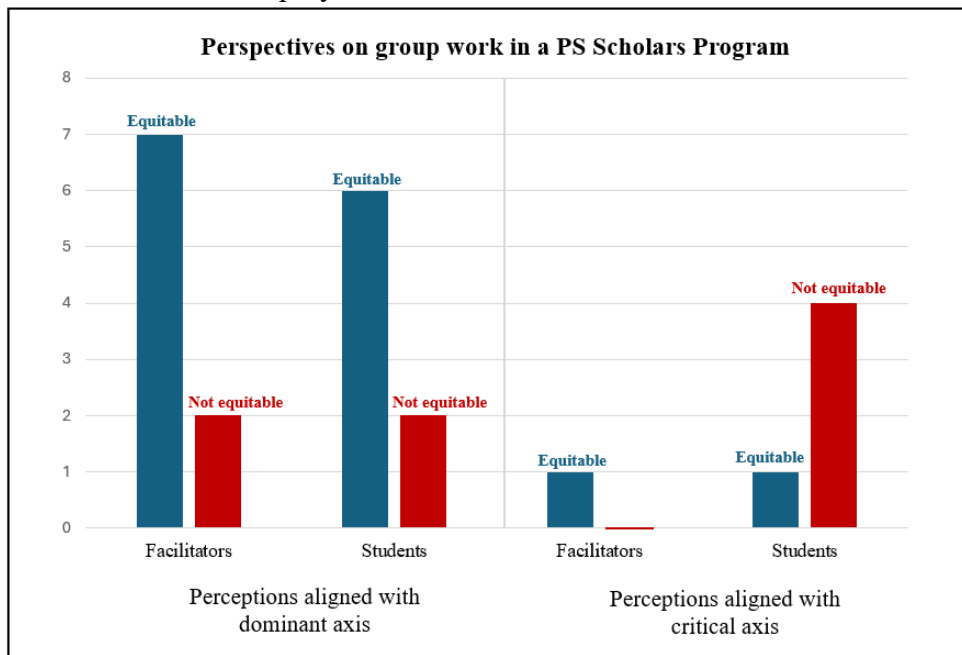


Figure 1. Number of facilitators and students who discussed group work as equitable (or not equitable). The left shows examples coded as aligning with the dominant axis, the right shows examples coded as aligning with critical.

perceive group work as connected to critical dimensions of equity. In contrast, students' perceptions of equity in group work aligned both with dominant and critical notions of equity, hence touching on aspects of what Garcia calls a Latine-serving HSI identity. While both students and facilitators saw group work as largely supporting equity in access and achievement in alignment with Garcia's Latine-producing HSI identity (blue bars vs. red bars, Figure 1, left), students also saw group work as undermining critical dimensions of equity (hence servingness), including identity and power (blue bars vs. red bars, Figure 1, right). We expound on the facilitator and student perspectives underlying these findings next, parsing them out in terms of Gutierrez's framework of dominant and critical equity. We come back to both Gutierrez's and Garcia's frameworks in the discussion.

Dominant Notions of Equity

Most facilitators and students perceived group work as aligned with equity in access and achievement and as mostly supporting (rather than undermining) equity in access and achievement (blue bars, Figure 1, left). Two facilitators and two students also perceived aspects of group work as undermining equity in access and achievement (red bars, Figure 1, left).

Facilitator Perspectives: *Group Work as Equitable.* Most facilitators viewed group work as a “key feature” of the course that supported equity. When discussing this, facilitators made arguments related to access and achievement. For example, they felt that group work gave students access to peers with different ideas and ways of thinking about mathematics, which supported their learning and success in the course. Several facilitators also mentioned group work naturally facilitated participation among students. One instructor noted that students “worked together beautifully” and that it was easier for them to “make mistakes” among peers than “in front of the whole class.” Instructors also felt the challenging problems encouraged equitable participation. James explained, “everyone is struggling together,” so there no dominant voice over the group work.

Facilitators also shared two practices they often used to ensure participation during group work was equitable: (1) monitoring student participation and stepping in as needed to ensure all were “actively participating,” and (2) “mixing up” the groups frequently to ensure that “stronger” and “weaker students” worked together and helped each other learn. Some instructors described the utility of using colored markers to see that everyone was participating; others shared ways of bringing all students to actively participate by asking directed questions like “How would you explain that?” This was seen as helping everyone learn, by everyone sharing what they knew.

Several instructors commented on how regrouping allowed “students that did well” to share their knowledge with different student cohorts and benefit most of the class. Garrett sensed some students disliked regrouping, but felt it amplified students’ access to knowledge and learning:

For equity, one of the most important things was to make sure the groups were different every time so they all had access. /.../ I don’t think students loved randomized groups, there was pushback on that. /.../ Of course, students who speak Portuguese will naturally gravitate to students who speak Portuguese or we have a lot of students from China who tend to stick together because they have a very shared experience and they can help each other survive through the process.

Garret acknowledges that students may naturally gravitate toward peers who share aspects of their identity, but believes promoting equity involves focusing on students’ mathematical backgrounds to ensure equal access to learning.

Facilitator Perspectives: *Group Work as Not Equitable.* Two instructors raised concerns group work did not equitably support all students. James and Ashley observed that some students were “resistant” to group work. Despite the strategies used, “weaker” students at risk of failing tended to “hide in the background,” showed less progress, and were reluctant to participate. James noted some students prefer to “lead” while others “follow,” and the followers often fall into hard to break habits, likening it to an elastic band that wants to snap back to their “comfort zone”. Other instructors perceived some students put minimal effort and let those who seemed more capable do the work. Overall, instructors felt all students gained something from group work, with James commenting that “just being there was enough” to support their learning.

Student Perspectives: *Group Work as Equitable.* Several students noted that group work equitably supported them in the course by enhancing their access to learning opportunities. They explained that collaborating in groups improved their understanding of mathematics by exposing them to different ways of thinking about and solving problems. For these students, the advantages of group work align with the dominant axis of equity. Alberto commented:

To work in a collaborative setting is being able to get different perspectives. Since not every professor teaches the same way, each student will understand it differently. Having your peers explain it in different ways, that was really helpful.

Another student, Lucía, notices the presence of Hispanic peers yet seems to value the benefits of group work in terms of seeing different mathematical backgrounds:

We were a pretty diverse set of individuals and we were mostly made up of Hispanic students, so it was nice being able to share ideas and different ways of learning things.

Student Perspectives: *Group Work as Not Equitable*. Two students felt that aspects of group work did not equitably support their access to learning and achievement. For example, Chantel described the problems she was expected to collaborate on as feeling "like a different language." She did not feel like she "understood" enough math or had the confidence to engage with problems, especially in front of peers. Chantel shared that if the goal of the course was to help students "get better at math", it was "helping her [group members] get greater at math" while she felt that she could not take "advantage" of the course.

Critical Notions of Equity

All but one facilitator perceived group work as neither supporting nor hindering critical dimensions of equity. Students, however, talked about identity and power when addressing group work, and saw this practice as mostly undermining critical dimensions of equity (Figure 1, left).

Facilitator Perspectives: *Group Work as Equitable*. One facilitator, Hannah, provided examples of equitable teaching practices related to group work, which suggest a conception of equity that also considers identity and power. Hannah described "intentionally" grouping women together and Veteran students together. Hannah worried that female students might feel "super overwhelmed and walked over" in groups with only men. Additionally, coming from a military family, Hannah recognized "nontraditional students" may not "relate" to "students in their 20s". Thus, having another Veteran student to work with would help them feel "validated".

By and large, facilitators did not seem to consider students' racial identities in their decisions or perspectives toward equity during group work. We see this in Garrett's quote described above. Similarly, Tamra commented there "was a relatively diverse ethnic group in the class," but added, "I don't feel like any of those differences [impacted] how well [students] participated in the classroom and how effective the classroom was for them."

Student Perspectives: *Group Work as Equitable*. For Stacie, group work affirmed her identity as a Veteran, in alignment with critical dimensions of equity—she felt "engaged and connected," less isolated when tackling problems by having other Veteran students in her group. Stacie appreciated sharing military collaborative practices with her group and felt her instructor, raised by military parents, created a space that felt "comfortable" and supportive for Veteran students.

Student Perspectives: *Group Work as Not Equitable*. Other students, primarily of color, felt group work interfered with supporting identity and power in the classroom. Several students felt the course lacked opportunities to meaningfully connect with peers who shared their cultural backgrounds. Anisia, for example, valued connecting with other peers from Mexico who understood her culture, language, and music, but struggled to "find [her] community" in class. She suggests group work can be challenging for connecting with peers when you are "forced to discuss math".

Other students, like Chantel, a first-generation "African American student" studying STEM, felt disempowered during group work. Raised by a single mother who was "always afraid of math" and with "parents who could not afford tutoring" Chantel felt overwhelmed and "dumb" when working with peers who appeared more confident and knowledgeable:

When it comes to doing math in front of other people who seem to have it all together, like they really understand it conceptually, it makes me not want to do it because I feel dumb /.../ even if I think I have the right answer, I don't have the confidence to believe in myself. Chantel shared that "where I come from, like my background, I think that was a hard factor for me in that class".

Similarly, Mateo noted "power dynamics" between "minority students" and "white students", who have had more "exposure" to advanced math courses at "wealthy high schools". He shared: Even though we are HSI, I feel like most Hispanics come in with the idea that there's definitely a power difference. If you go into a classroom, who is most likely to speak up is white students /.../ I feel like that's something that's kind of hindering this process of making everyone feel like they're part of the classroom.

Mateo wished that facilitators in the course would have focused on "trying to get rid of that power dynamic and making sure everyone's on the same playing field".

Discussion

Facilitators and students identified three themes that felt relevant to equity in the courses (facilitator support, rich problems, group work). These have been noted as core pillars of active learning and IBL (Apkarian et al., 2024; Laursen & Rasmussen, 2019). Focusing on equity in practice, however, our findings suggest differences in how facilitators and students viewed equity within these themes. Facilitators tended to focus on dominant notions of equity that center access and achievement. In contrast, students expressed a more holistic view of equity aligned with access and achievement as well as identity and power. Facilitators and students primarily agreed that the courses supported dominant notions of equity, which is consistent with traditional active learning design and measures of active learning success. Students' reflections on critical dimensions of equity—like identity and power—suggest the PS courses (which preceded the HSI designation by several years) embodied a Latine-producing HSI identity (Garcia, 2017) not quite yet fully embracing *servingness*. In other words, instructor and student perceptions suggest more can be done to embrace servingness at the classroom level in active learning PS courses, in ways that center identities, values, and lived experiences of all students.

The field's emphasis on dominant dimensions of equity when it comes to active learning may have prevented some instructors from thinking more critically about why students might choose not to participate or may not have access to participation. Rubel (2017) reports that the myth of meritocracy, feelings of "I can't relate", and colorblindness were three reasons White school teachers struggled to engage with critical equity-oriented practices. These reasons also emerged as themes in our data. For example, the perception that students who do not participate simply need to put in more effort aligns with ideas of meritocracy. These suggest an area for professional development (PD) to better support HSI faculty in cultivating equitable practices. Such PD could include facilitating conversations about the role of identity in students' STEM experiences (Adiredja et al., in press) and designing and implementing place-based, culturally responsive curriculum (Lozano, 2023).

We close by noting that, historically, much of the work on calculus workshops has used quantitative methods to assess normative outcomes as measures of success (McNeilly, 2021). While we are not questioning the impact of these programs, our work suggests that focusing exclusively on dominant understandings of equity—aligned with access and achievement—may overlook how equity is intended, perceived, and felt by minoritized students in the classroom, and shortchange opportunities for instructors to learn about and enact critical equity practices.

References

- Apkarian, N., Voigt, M., Hagman, J. E., Tremaine, R., Street, C., Martinez, A. E., & Guglielmo, J. (2024). Critical, Intersectional, Quantitative Analyses of Instructional Practices and Changes in Undergraduate Students' Math Affect. *International Journal of Research in Undergraduate Mathematics Education*, 1-32.
- Adiredja, A., Civil, M., & Jarnutowski, B. (in press). Project Adelante: An Anti-deficit Professional Development Program for University Mathematics Instructors [Poster Abstract]. To appear in *Proceedings of the 26th Annual Conference on Research in Undergraduate mathematics Education*. Omaha, NE.
- Aragón, O. R., Dovidio, J. F., & Graham, M. J. (2017). Colorblind and multicultural ideologies are associated with faculty adoption of inclusive teaching practices. *Journal of Diversity in Higher Education*, 10(3), 201.
- Bennett, A. B., Uhing, K., Williams, M., & Kress, N. (2023). A set theory analysis of the relationship between active learning and equitable and inclusive teaching. *International Journal of Mathematical Education in Science and Technology*, 54(9), 1765-1784.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101.
- Duncan, H. and Dick, T. (2000). Collaborative workshops and student academic performance in introductory college mathematics courses: A study of a Treisman model math excel program. *School Science and Mathematics*, 100(7):365-373.
- Ernest, J. B., Reinholz, D. L., & Shah, N. (2019). Hidden competence: Women's mathematical participation in public and private classroom spaces. *Educational Studies in Mathematics*, 102, 153-172.
- Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International journal of qualitative methods*, 5(1), 80-92.
- Garcia, G. A. (2017). What Does it Mean to be Latinx-serving? Testing the Utility of the Typology of HSI Organizational Identities. *AMAE Journal*, 11(3).
- García, G. A., Koren, E. R., & Cuellar, M. G. (2020). Assessing color-neutral racial attitudes of faculty at Hispanic-serving institutions. *AERA Open*, 6(3), 2332858420944906.
- Gutiérrez, R. (2007). (Re)defining equity: The importance of a critical perspective. *Improving access to mathematics: Diversity and equity in the classroom*, 37-50.
- Gutiérrez, R. (2011). Context matters: How should we conceptualize equity in mathematics education?. In *Equity in discourse for mathematics education: Theories, practices, and policies* (pp. 17-33). Dordrecht: Springer Netherlands.
- Hsu, E., Murphy, T. J., & Treisman, U. (2008). Supporting high achievement in introductory mathematics courses: What we have learned from 30 years of the Emerging Scholars Program. *Making the connection: Research and teaching in undergraduate mathematics education*, 73, 205.
- Johnson, E., Andrews-Larson, C., Keene, K., Melhuish, K., Keller, R., & Fortune, N. (2020). Inquiry and gender inequity in the undergraduate mathematics classroom. *Journal for Research in Mathematics Education*, 51(4), 504-516.
- Laursen, S. L., Hassi, M. L., Kogan, M., & Weston, T. J. (2014). Benefits for women and men of inquiry-based learning in college mathematics: A multi-institution study. *Journal for Research in Mathematics Education*, 45(4), 406-418.
- Laursen, S. L., & Rasmussen, C. (2019). I on the prize: Inquiry approaches in undergraduate

- mathematics. *International Journal of Research in Undergraduate Mathematics Education*, 5, 129-146.
- Leyva, L. A., Byrne, M. H., Asada, M., Mitchell, N. D., Posada-Castaneda, R. & Lopez-Bazan, R. (in press). Groupwork as a site for servingness among undergraduate Latin* mathematics students. To appear in *Proceedings of the 26th Annual Conference on Research in Undergraduate mathematics Education*. Omaha, NE.
- Lozano, G., Franco, M., & Subbian, V. (2018). Transforming STEM education in Hispanic serving institutions in the United States: A consensus report. *Available at SSRN 3238702*.
- Lozano, G. I. (2023). Grounded in place: A culturally affirming precalculus curriculum. In M. Strutchens, G. Krause, D. Y. White, & J. Bay-Williams (Eds.), *Antiracist Mathematics Education: Stories of Acknowledgment, Actions, and Accountability* (pp. 7-22). TODOS: Mathematics for ALL.
- McNeilly, J. R. (2021). *Math Merit Program: Academic performance and experiences of student participants in an Emerging Scholars Program* (Doctoral dissertation, University of Illinois at Urbana-Champaign).
- Moreno, S. E. and Muller, C. (1999). Success and diversity: The transition through first-year calculus in the university. *American Journal of Education*, 108(1):30–57.
- Oppland-Cordell, S., & Martin, D. B. (2015). Identity, power, and shifting participation in a mathematics workshop: Latin@ students' negotiation of self and success. *Mathematics Education Research Journal*, 27, 21-49.
- Patrick, L. E. (2020). Faculty and student perceptions of active learning. *Active learning in college science: The case for evidence-based practice*, 889-907.
- Reinholz, D., Johnson, E., Andrews-Larson, C., Stone-Johnstone, A., Smith, J., Mullins, B., ... & Shah, N. (2022). When active learning is inequitable: Women's participation predicts gender inequities in mathematical performance. *Journal for Research in Mathematics Education*, 53(3), 204-226.
- Rios, J. (2023). Language, comfort speaking, and collaboration: A QuantCrit analysis of multilingual students' experiences in introductory college mathematics courses. *International Journal of Research in Undergraduate Mathematics Education*, 1-31.
- Rios, J. (2024). Positioned as a burden: Analyzing the participation of multilingual students of color in undergraduate mathematics courses that use groupwork. *The Journal of Mathematical Behavior*, 74, 101148.
- Rubel, L. H. (2017). Equity-directed instructional practices: Beyond the dominant perspective. *Journal of Urban Mathematics Education*, 10(2).
- Theobald, E. J., Hill, M. J., Tran, E., Agrawal, S., Arroyo, E. N., Behling, S., ... & Freeman, S. (2020). Active learning narrows achievement gaps for underrepresented students in undergraduate science, technology, engineering, and math. *Proceedings of the National Academy of Sciences*, 117(12), 6476-6483.
- Williams, M., Uhing, K., Bennett, A., Voigt, M., Funk, R., Smith, W. M., & Donsig, A. (2022). Conceptualizations of active learning in departments engaged in instructional change efforts. *Active Learning in Higher Education*, 1–20. <https://doi.org/10.1177/14697874221131300>