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Experiencing tensions of nepantla with inner-departmental change groups

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This study explores the experiences of three Networked Improvement Communities (NICs) within mathematics departments as they work to critically transform their introductory mathematics programs. Drawing on the framework of dominant and critical axes of equity, we identify three key tensions experienced by the NICs: identity neutrality versus identity centrality, power over versus power with, and students as novices versus students as experts. These tensions are framed as productive enactments of working to change systems from within, highlighting the challenges and opportunities inherent in navigating the liminal space of nepantla. We argue that engaging with these tensions is crucial for fostering critical transformations and offer recommendations for leveraging the roles of identity, power, and student partnership to promote more equitable and inclusive mathematics education environments.

KEYWORDS

critical, math education, change efforts, equity, tensions, transformation

1 Introduction

Barriers to equitable learning outcomes and inclusive learning experiences in mathematics education have been widely researched and include issues of implicit bias (Greenwald and Banaji, 1995), microaggressions (Leyva et al., 2021), instructors' minimization of existence and impact of microaggressions (McNeill et al., 2022), negative instructor relationships (Battey and Leyva, 2018; Hill et al., 2010), stereotype threat (Steele et al., 2002), and sense of isolation (Good et al., 2012). Research shows that mathematics stakeholders (including students, instructors, and administrators) at the departmental and institutional levels are aware of differences in outcomes and experiences among students with marginalized social identities (e.g., race, gender, socio-economic status, disability status; Apkarian et al., 2021). So, why have not math stakeholders effectively addressed these issues of equity related to student experiences?

In part, this is because math stakeholders are aware of the need to attend to equity, but are often unfamiliar with how to accomplish this or feel disengaged from these conversations due to a lack of training (Apkarian et al., 2021; Voigt et al., 2021). As such, stakeholders need support to

develop understandings of the factors contributing to differences in outcomes and experiences for marginalized students and to translate their understanding into action. It is not enough to interpret differences in outcome solely on essentialist factors like access and achievement. Stakeholders need to engage in critical perspectives by creating programmatic change based on the qualities that ensure their students with marginalized identities thrive (Harper, 2010).

However, applying a critical perspective to the work of making change requires recognizing how the current system marginalizes students and envisioning a new system. This can be especially hard to do from the vantage of working within existing systems (Dancy and Hodari, 2023). Changing the system we are operating in requires that we better understand how to support math stakeholders to develop nuanced understandings of these systems and implement action plans to change them. As such, the ACT UP Math¹ project is studying the role and impact of research-practice partnerships (Penuel, 2017; Penuel et al., 2020) between mathematics education experts and mathematics department faculty to critically and systematically initiate transformative efforts to improve the experiences of students who are members of marginalized identity groups in introductory mathematics programs.

In Spring 2022, leaders from three mathematics departments worked in collaboration with mathematics education researchers to form an overarching ACT UP Math Networked Improvement Community (NIC). The leaders at each of the three institutions also formed NICs at each of their institutions to initiate improvement cycles intended to critically transform their introductory mathematics programs. Each of these local NICs is composed of stakeholders who hold a variety of roles (i.e., instructors, administrators, and students). Each local NIC collected data (including survey data and student focus group data) to document the issues needing to be addressed; then they met to reflect and discuss what they were seeing in the data and develop a plan for programmatic changes to be implemented in Fall 2022–Spring 2023 (similar to four-phase improvement cycles; e.g., LeMahieu et al., 2017). We, the mathematics education researchers, articulated to the NICs that their improvement cycles should be motivated by data-informed decision-making and that each iteration of this cycle should follow the observe-reflect-plan-act structure. Throughout this process, we worked with the local NICs to support their understanding of critical transformations, develop action plans, and collect data to better understand the experiences of the NICs. This paper explores the shared experiences we, as members of the ACT UP Math project, encountered while fostering critical transformations during the initial stage of the improvement cycle (Fall 2022–Spring 2023) We focus on the tensions that surfaced and frame these tensions as expected and productive components of the process of critical change. We write this paper primarily for both change agents working toward critical transformations, including faculty, administrators, and students as partners in this work (Bolick et al., 2024), as well as researchers investigating and supporting this work.

We are guided by the following research question: What productive tensions are experienced by research-practice partnerships as mathematics department stakeholders work together to critically transform their introductory mathematics programs?

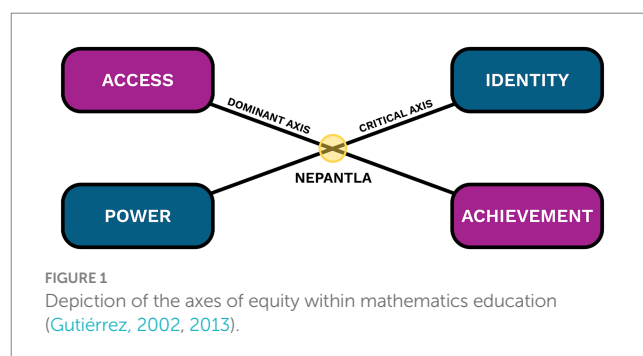
2 Framing critical transformations and tensions

We begin by defining what we mean by the term “critical transformation.” We use the word transformation to indicate that we come from a transformative paradigm (Mertens, 2007), seeking to research a phenomenon and change it with social justice as the goal. We use the word critical to emphasize that we mean to critique and challenge the existing structures that create mathematical experiences that are racialized, gendered, classist, etc. (Bronner, 2017; Gutiérrez, 2002, 2013; Leyva et al., 2022; Okun, 2021), and we seek to make improvements that extend beyond the confines of these systems. These systems include the mathematical content we teach, the way we teach it, the support programs for students, the departments that house these programs, the advising processes placing students into these courses, and much more.

As we work in partnership with math department stakeholders to make changes to introductory mathematics programs from within these programs, we draw on Gutiérrez (2002, 2013) distinction between the dominant and critical axes of equity in mathematics education.

As shown in Figure 1, the dominant axis centers achievement and access, and is the primary - and sometimes only - component of equity that undergraduate mathematics stakeholders attend to when they discuss the importance of equity (Tremaine et al., 2022). Equity efforts that focus on the dominant axis—access and achievement—results in changes that uphold and perpetuate the existing systems—what Gutiérrez (2009) refers to as “measur[ing] how well students can play the game called mathematics” (p. 6). For example, bridge programs increase access and support higher achievement among students who were not afforded quality mathematics preparation before college (Raines, 2012). In a recent systematic review of articles about diversity-focused STEM intervention programs, Palid et al. (2023) found that the great majority of these programs provided support within the existing system, including supplemental learning, mentorship, skill building, financial support, socializing, and bridge programs. While such programs can be important for supporting students from marginalized identities to be more successful (Palid et al., 2023), such programs do nothing to change the system that these students are entering and can actually function to maintain these systems of oppression rather than reform them (Martin, 2019).

To discuss equity fully we must also attend to the critical dimension, which centers identity and power. Attention to the critical dimension emphasizes not only the importance of representation and success of a diverse population within a current system, but also valuing the changes



1 <https://scimath.unl.edu/act-math/>

that population may require or contribute to the system. This necessitates working to change the existing system—what [Gutiérrez \(2009\)](#) refers to as “build[ing] critical citizens so that they may change the game” (p. 6). For example, the recent changes to the California State University mathematics pathways for students have altered what introductory college mathematics programs entail ([Ganga and Mazzariello, 2018](#)), and these changes were based on recognizing the racialized, gendered, and classist impacts of the previous introductory mathematics program on students’ mathematical successes and experiences.

[Gutiérrez \(2009\)](#) draws on the indigenous Nahuatl word *nepantla* to emphasize the tensions that exist within the intersection of the dominant and critical axis, as shown in [Figure 1](#). *Nepantla* describes the in-between, liminal space between worlds. [Anzaldúa \(2002\)](#) states that “transformations occur in this in-between space, an unstable, unpredictable, precarious, always-in-transition space lacking clear boundaries,” and that *nepantla* is associated with “being in a constant state of displacement - an uncomfortable, even alarming feeling” (p. 243). [Gutiérrez \(2015\)](#) emphasizes the power of these tensions: we will experience tensions within this transformative and liminal space of *nepantla*, but these tensions are necessary to critically transform mathematics education.

In this study, we explore the tensions observed as the NIC members work within the systems of introductory college mathematics programs to change these very programs. By operating from within the existing systems, one must have experienced some degree of success within that system; all of the NIC members are either working to complete a mathematics degree, or, for the vast majority, already hold graduate degrees in mathematics, mathematics education, or a related field. They are all either students, mathematics department employees or administrators at the university where they are attempting to bring about change. Recognizing the success the NIC members have experienced in these systems does not ignore the marginalizations and struggles they themselves experience or have experienced; it acknowledges their unique and precarious positions to see and critique the very systems of which they are a part. This analysis identifies tensions that were expressed and/or observed in some form across all three NICs. Drawing on the framing of *nepantla* ([Anzaldúa, 2002](#); [Gutiérrez, 2009](#)), we emphasize that these expressions of tensions are evidence of the transformations occurring within these departments as they move within one world (attending to the dominant dimensions of equity) to transform into another (attending to the critical dimensions of equity). [Gutiérrez \(2009\)](#) states that “Being able to name the dimensions helps us move toward highlighting tensions between the dimensions so that we might be more reflective about how we can successfully balance attending to them all” (p. 6, 2009). We hold these expressions of tensions up as productive enactments of working to change the systems from within them. We deeply respect and value the NIC members for engaging in this work and sharing their experiences and associated explicit and implicit tensions.

3 Methods

3.1 Networked improvement communities in STEM

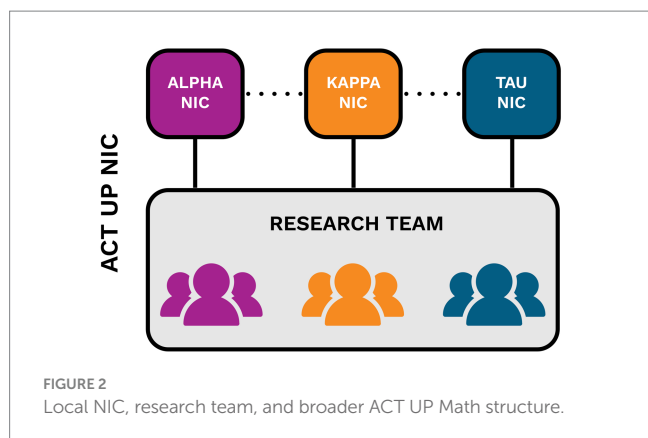
There has been an increased focus on the important role that STEM education plays for students across all grade levels, and this

focus has led to a surge of initiatives aimed at improving the STEM student experience, including in higher education contexts. Change initiatives (and studies of those initiatives) have focused on individuals, departments, and entire universities (e.g., [Kezar, 2014](#); [Henderson et al., 2011](#); [Laursen and Rasmussen, 2019](#); [Weaver et al., 2016](#)). A consensus is emerging that “the department” is a prime locus for change (e.g., [Austin, 2011](#); [Reinholz and Apkarian, 2018](#); [Smith et al., 2021](#); [Voigt et al., 2023](#)). Successful change initiatives need to be grounded in related research, acknowledge complexities inherent in transformational change, attend to the processes of change, and be adapted to fit local contexts ([Henderson et al., 2011](#); [Kezar, 2014](#); [Kezar and Gehrke, 2015](#)).

Based on the work of [Penuel et al. \(2020\)](#), ACT UP Math local stakeholder groups are organized around the principles of Networked Improvement Communities (NICs). In a NIC, a group of stakeholders convenes around a common aim, conducts a problem analysis, engages in continuous improvement cycles, and shares information across the network to contribute to collective progress. NICs use improvement cycles to develop new approaches or adapt successful strategies to local contexts ([Penuel et al., 2020](#)). These departmental groups comprise faculty, staff, and students from within mathematics departments, but also may include members from other associated STEM departments or institutional bodies. In this sense, they differ slightly from groups described as Departmental Action Teams (DAT; [Corbo et al., 2015](#); [Quan et al., 2021](#)) although many of the same group dynamics and power relations are applicable. ACT UP Math NIC members are change agents who are working to instigate critical transformations within their departments. Change agents provide the impetus for change while also attending to the change process and fitting the change efforts to the local culture (or positioning the change efforts to critically transform the culture). Recent work has highlighted the interrelated importance of change agents, professional development, and communities of practice to support change within STEM departments ([Laursen and Rasmussen, 2019](#); [Smith et al., 2021](#)). Below we outline the structure of our entire ACT UP Math NIC, including each of the three local NICs and the positionality of the ACT UP Math Research Team.

As a research practice partnership, the ACT UP Math NIC consists of the research team and the leaders of the local NICs. We all meet as a group once a month. In [Figure 2](#), we illustrate how the local NICs and the research team interact to form the broader ACT UP Math NIC.

Alpha University is a public Master’s degree-granting university with moderate research activity ([The Carnegie Classification of Institutions of Higher Education, 2024](#)). Alpha university is located on the East Coast of the United States and has state laws that are supportive of DEI in higher education. Alpha University is both a Hispanic-Serving Institution (HSI) and an Asian American Native American Pacific Islander Serving Institution (AANAPISI). Introductory math courses are taught primarily by faculty members in small classes using active learning strategies. The NIC is composed of two faculty leaders, two faculty members, one lecturer, one graduate student instructor, and two undergraduate transfer students. The NIC met every 2 weeks for 2 h during Spring 2023. After a first iteration of their data exploration, the NIC has been driven by a goal to create positive relationships between students and mathematics. With this goal in mind they developed plans to disrupt the placement system for lower division mathematics courses.



Tau University is a public, doctoral degree-granting, comprehensive university with high research activity and two campus locations. Tau University is located in the Southern United States whose state has introduced laws to restrict DEI in higher education. Most math courses are taught by faculty in small classes with some instructors using active learning strategies. The Tau NIC includes 11 members and is led by three faculty leaders. Nine members are instructors in the Mathematics Department, with two NIC members in department-level administration and one at college-level administration. The NIC met monthly via Zoom during Spring 2023, partly due to their institution being spread across two campuses, and the leaders met monthly to plan each NIC meeting. One of the leaders recruited the other two co-leaders, and together they encouraged other faculty members to join with a mass email describing the project. After a first iteration of their data exploration, the NIC has decided to focus on improving individual instructor pedagogy given the varied nature of the data they observed and cultural values about instructional autonomy.

Kappa University is a private not-for-profit highly-selective doctoral degree-granting university with high research activity. Kappa university is located in the SouthEast United States in a state that has passed laws restricting DEI in higher education. Introductory math courses at Kappa are taught primarily in large courses by teaching faculty with a group-work focused recitation once a week led by a graduate teaching assistant. The Kappa NIC includes eight members, six of whom regularly attended meetings. Of these, four are administrators outside of the mathematics department and four are mathematics instructors and/or coordinators, including the two co-leaders. Similar to the Tau NIC, the Kappa NIC met monthly via Zoom during Spring 2023. Many NIC members had personal relationships with the co-leaders and joined because of those relationships and their trust in the co-leaders. Interestingly and not intentionally, all regularly attending NIC members identify as women. After a first iteration of data exploration, the Kappa NIC decided to restructure their group membership by including undergraduate and graduate students from the mathematics department, after recognizing student voices as valuable qualitative insight into the mathematics courses at their institution. At the same time they removed administrators from outside the department. They are purposefully recruiting male students to join the NIC.

The **ACT UP Math Research Team** as of Spring 2024 consisted of mathematics and engineering education researchers housed at institutions across the US. Recognizing that identities are fluid

constructs that manifest differently at different times and in different spaces, we share here our collective positioning as it pertains to the ideas discussed and finalized in this manuscript. We represent a variety of racial, ethnic, gender, and sexual identities across differing career stages within mathematics and engineering education. A more detailed description of our identities is shared in the [Appendix](#). Although our identities and experiences have some variance of commonalities and differences, we all acknowledge that we operate within academic systems designed to center whiteness and hierarchies. With this acknowledgement and our commitment to equity and reflexivity, we acknowledge that this collective positioning has shaped (1) our individual motivations for engaging in this work, (2) how we understand and interpret this work, and (3) the power dynamics at play within our team and in our relationships to the local NIC members. Due to our work on equity within mathematics and engineering departments, we do not stop at this acknowledgment; however, push through the uncomfortability to foster dynamic, fluid, and accountable research spaces. Part of this effort to address inequities within our work involves reflexive journaling as researchers, engaging in discussions around biases and blindspots in our understanding or approaches, and fostering an environment of autonomy and agency across our research practice partnerships. While conducting this NSF-funded project, we also seek out and address ways in which policies from the funding agency could also be constraining our work.

The research team is divided into three subteams, each directly working with one of the local NICs, as illustrated in [Figure 2](#). This leads to, for example, both a Kappa NIC and a research subset working with the Kappa NIC, referred to as the ‘Kappa research team’. At the time of the data collection used in this manuscript, there were 11 research team members who worked together and also primarily with one of the three local NICs: three worked primarily with Alpha, five primarily with Tau, and three primarily with Kappa. Additional members have joined the team since Spring 2023. The research team members are all external to the three NIC institutions.

Prior to our first meeting with the local NICs in Fall 2022, the research team created data dashboards ([Bolick and Voigt, 2023](#)) drawing from extant, disaggregated data from 21 US institutions, including each of the local NIC institutions, about students’ experiences in introductory college mathematics (see example in [Figure 3](#)). We encouraged NIC members to explore their data and institutional comparisons by filtering various social identities, including race and ethnicity, gender, first generation status, and sexuality. Then, we asked them to reflect on what they noticed, what they wondered, and how they might use the data to inform their NIC action plans. We expand on some of their observations in the Findings section.

3.2 Data and analysis

Our analysis draws on approaches from critical ethnography, which is an ethnographic research method that seeks to explicitly critique systems of oppression and inequitable power relations with the goal of fostering social change ([Palmer and Caldas, 2015](#)). Specifically, this study takes a participatory research approach using research-practice partnerships. The researchers and the local NIC participants engage in ongoing dialog and operate together as a

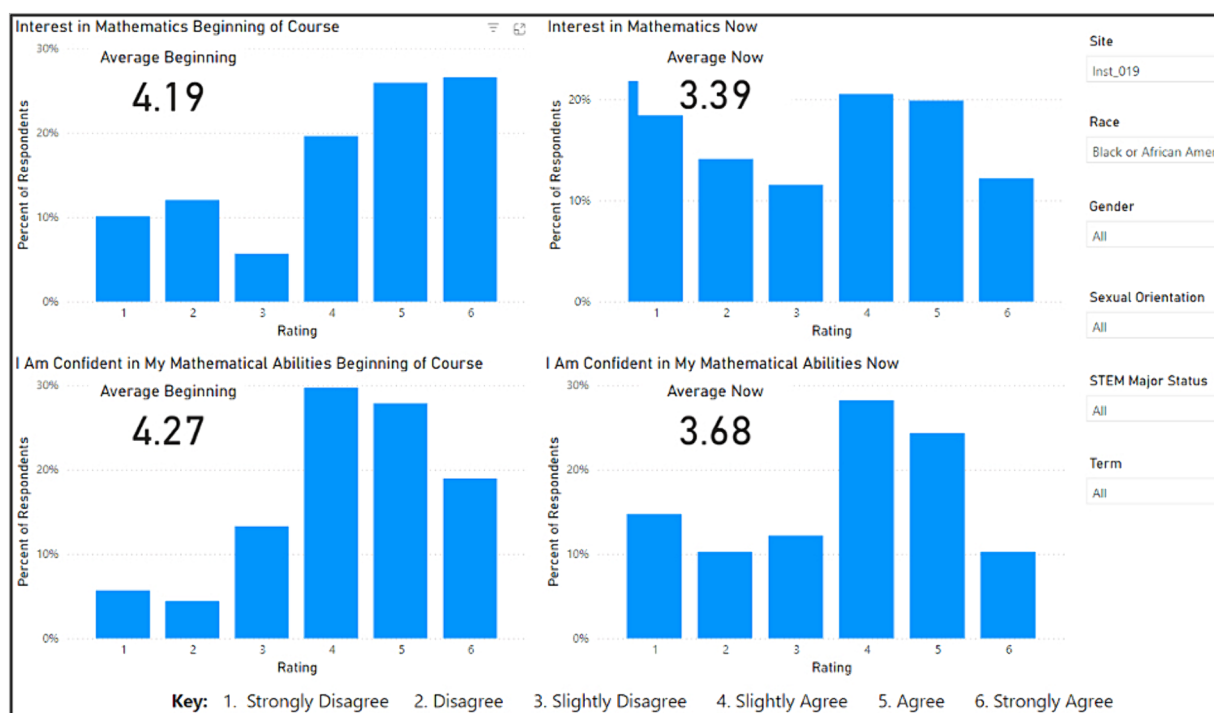


FIGURE 3 Data dashboard results for interest and confidence in math, filtered for Black or African American students at Tau University, that Tau NIC explored during a meeting.

research-practice NIC, practices that align with ethnographic methodologies. By collaborating with the participants, our research team is explicit in setting out to bring about changes in the departments and cultures we are working with, rather than solely setting out research findings so that others may use them to make changes. This approach reflects the critical orientation of our work. In line with this, our data analysis approach is informed by critical ethnography and simultaneously shaped by the narrative process of story telling and sense making among researchers working with departments to critically transform them. Here, we detail our process of reflecting on the first semester working with the local NICs to identify the primary stories arising from each site, and using these stories to guide the deeper analysis of this data set.

The data from this analysis comes from structured field notes of NIC meetings, semi-structured interviews, and reflexive journals completed by NIC members. The structured field notes were completed by a researcher who attended each of the NIC meetings and documented observations, reflections, successes, challenges, noteworthy language, and observed power dynamics (see Appendix A). Summaries of the field notes were sent to the NIC leaders for review and edits as a form of member checking. The semi-structured interviews of the NIC members occurred at the end of Spring 2023 through online video-conferencing (Zoom). The interview protocols (see Appendices B–D) asked NIC members about their experiences over the last semester, how they became a part of the NIC, how they engaged in exploring data, and the role of equitable decision making of goals for the NIC. The interviews were audio recorded and transcribed. NIC members engaged in reflexive journaling throughout the semester, completing 2–5 journal entries

from provided prompts (See Appendix E). In line with affective research topics, reflexive journaling allows for emancipatory dialog with the data and can help mitigate power relations between participants (Malacrida, 2007; Tillman, 2003).

In alignment with an ethnography methodology, the research subteams immersed themselves in data about the NICs throughout the Fall 2022–Spring 2023 data collection period. This included reading all reflexive journal entries, observing and taking notes during NIC meetings and planning meetings, conducting individual interviews, and listening to NIC leaders share about their NICs during cross-site meetings. During Summer 2023, each of the three subteams conducted a preliminary analysis of each NIC's experiences over a full year (i.e., a complete NIC cycle) to identify stories in the data, similar to narrative coding (Saldaña, 2013), which is an appropriate method “as a preliminary approach to the data to understand its storied, structured forms, and to potentially create a richer esthetic through a retelling” (p. 132). Each research subteam presented these stories to the entire research team in a storytelling manner using slides and narration. During this storytelling, we identified storylines that were shared across the NIC sites, and recognized that these stories could each be thought of as a tension related to working to change the departments from within, and specifically how they could be thought of as part of experiencing nepantla (Gutiérrez, 2009). After initially identifying these tensions, members of each research subteam revisited all of their team's data from the year, and organized data related to each tension into a research memo. This research memo allowed us to look across the local NICs to identify commonalities and differences of how the tensions were expressed and experienced, and to develop shared definitions of each tension based on the data.

Because of the diverse professional experiences our research team brings, including experience as students instructors, and administrators of introductory mathematics programs, we naturally engaged with multiple perspectives and interpretations of this data and these definitions. As we refined these definitions, we came to a greater understanding of how each of these tensions could be understood as a tension between the world the departments were starting in (specifically a dominant perspective of equity) and the world we were collectively working to transition the departments into (a critical perspective on equity).

Across all three sites, members joined their NICs with a variety of experiences related to equity reform in mathematics education and for a variety of reasons (Tremaine, 2024). Some of the members, including the leaders, had experience with institutional change efforts, while others responded to an email from colleagues who were “assembling a team of stakeholders” to “initiate transformative efforts to improve marginalized students’ experiences and outcomes in our introductory mathematics program.” In this way, the NIC members initially conceptualized the goals and purpose of their NIC from a variety of perspectives. For instance, although we shared key principles of networked improvement communities with NIC leaders in ACT UP Math meetings, such as collecting common measures and using disciplined inquiry to warrant and drive improvement (e.g., LeMahieu et al., 2017), it was unclear how individual members internalized these principles. Many of the NIC members are mathematics faculty and instructors who care deeply about their students and recognize a need to do more to support their students, especially students with marginalized identities; but they do not necessarily come to this work with education and training specific to equity. With this knowledge in mind, a component of our work is providing opportunities for professional learning related to equity within mathematics education, and we approach this work by viewing the NIC members as partners. After recognizing and naming each tension within the research team, we shared the tension with the local NIC leaders and invited them to respond and react via an anonymous Jamboard. In the findings, we share the definitions developed for each tension, how they can be understood as providing a bridge between the dominant and the critical dimensions of equity, how the tensions were experienced at each site, and reflections from the NIC leaders related to each tension.

4 Findings

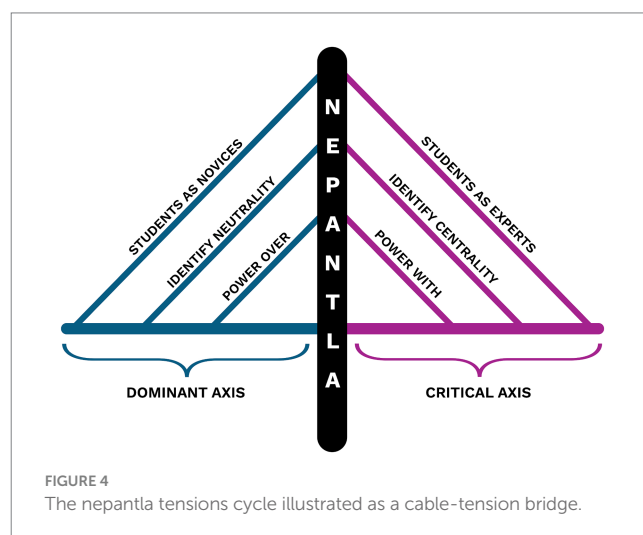
The analytic process described above allowed us to identify ways that each tension was experienced by each of the local NICs. In our findings below, we illustrate each tension by centering the ways that tension was experienced by a particular NIC complemented by evidence of how that tension was experienced by the other NICs. We draw on Anzaldúa’s use of a bridge as a metaphor for *nepantla* (Anzaldúa, 2002) to express each tension as in between two worlds—dominant discourses vs. critical discourses—and present the tensions as a bridge connecting these worlds, as illustrated in Figure 4.

4.1 Identity neutrality vs. identity centrality

The three NICs are positioned in nepantla between two worlds: the dominant world of seeking improvement changes for all students, thus

not naming specific social identities of students to center, and the critical world of centering students with marginalized identities in their change efforts. This tension describes the difference between critical efforts that explicitly name the identities of students to support and their unique experiences (e.g., efforts to improve the mathematical experiences of Black students or first-generation students, or Black first-generation students) vs. those that remain identity neutral in discourse (e.g., efforts to support all students). While the NICs did attend to student identity in their data explorations (see Bolick and Voigt, 2023 for more detail), they generally did not attend to a specific identity group in their action plans. The Alpha NIC members exclusively focused on lower division courses and the students who take those courses, and, while they have discussed race as an important student identity at their institution, they did not explicitly center identity within their action plans. The Kappa NIC members expressed interest in focusing on students who persist in the calculus sequence and those who do not, as well as students who did not have access to Calculus before college. The Kappa NIC recognized that students of color were leaving mathematics coursework in disproportionate numbers within Kappa, but chose not to center these students’ experiences because they understood a critical approach to mean a focus on systems rather than students.

Here, we share more detail about the Tau NIC’s initial discussions while exploring the data dashboards and the role that student identity played in them. Similar to the other two NICs, the Tau NIC did consider and pose questions about results related to student identity during their data dashboard exploration, but did not center a student identity in their subsequent action plans. At a meeting in Spring 2023 when the all-faculty Tau NIC was exploring the data dashboards, some members noticed that the grades students expected to earn in their math course differed across race/ethnicity at their institution. Ethan noted that there was a “jump” for average expected grade where “many more African American [students] expected to get Cs” while white students expected to get Bs. He hypothesized that it “maybe says something about self-efficacy.” Connor noticed in a different set of graphs that, when comparing students’ perceptions of mathematics from the beginning to the end of the course, their enjoyment levels decreased. He said, “If you filter by [institution], the drop is worse [for Tau] than for all [other] institutions. I do not have a proposed solution.



[It] just looks bad.” Kayla followed with, “Is there a question we can ask our students to get more info about that? Because that [data is] upsetting.” And finally, Connor noticed that filtering the data about course perception by student race highlighted a disparity: “If you filter that result by [race], African American [or] white, the disparity or fall is higher for Black students than white students.” Connor noticed that student perceptions regarding their interest in math and confidence in their math abilities decreased more for Black/African American students than for white students over one semester. These excerpts show how NIC members made critical observations about their institutional data related to student identity and experiences. [Figure 3](#) presents one screen of the data dashboard that Tau NIC members explored during this conversation.

While Tau NIC members asked some follow-up questions about the data, the discussion ended with NIC members not knowing what to do with this observation or how to move forward. As one member pointed out, the NIC was having “difficulties with looking at the data and narrowing down a focus” for their action plans. At this same meeting and at the following meeting, Abel mentioned that he was interested in the experiences of international students, but this focus was not taken up by other NIC members. Later, Abel asked about the experiences of students who commute to campus, who he thought had some connection to international students. Since the dashboard did not contain information about commuting, one NIC leader suggested that they might look into this in the future, and Abel dropped his inquiry.

In later meetings, the Tau NIC selected the goal of “motivating all students to engage and succeed in mathematics,” with no attention brought to any specific student population. They identified two key markers of engagement as class attendance and active participation during class, which are aligned with a dominant, rather than critical perspective of equity. The NIC was primarily composed of instructors (10 of the 11 members taught undergraduate math courses that term), and their focus shifted toward collecting and examining data at the classroom level to improve their instructional practices. For instance, Abel, Jordan, and Connor debated whether it was “equitable for all students” if they honored requests from individual students (like deadline extensions). During this discussion, Jordan stated, “Students come from different backgrounds. Some students are extremely good in math and some are extremely weak. How are we supposed to bridge the gap?” One researcher who regularly observed the NIC meetings noted her interpretation of this meeting in a memo:

In light of today’s meeting I do think that the early conversations of being inclusive to particular groups of students, e.g., international students, is not on anyone’s radar, at least right now. [...] Right now, the groups of concern are “weak” v. “strong” students. Personally, I am concerned about the potential for instructor bias in organizing students in this way, especially if they do not plan to use data on students’ mathematical strengths to do so, but just general perceptions of ability/overall test scores.

In other words, the researcher observed how the Tau NIC’s shift toward being identity evasive might influence their action plans to be overly focused on student performance, particularly regarding their personal perceptions of students’ strengths and weaknesses based on assessments.

While we chose to not share this research memo with the NIC, we did share our observation of the identity central/neutral tension with NIC leaders from all three NICs. Multiple NIC leaders agreed

that this is a tension in our work, and they voiced various reasons for not centering a specific population of students. For instance, they expressed that “students cannot be boiled down to one [identity];” “many identities aren’t visible, and guessing identity might be problematic,” and wondering “How can we do this without generalizing student experience?” NIC leaders also recognized the potential harm that can come from “for all” improvements, including that these may not “address the needs of specific groups of students” and that “the average is covering up individual differences and experiences.”

4.2 Role of power: power over and power with

The three NICs are positioned in nepantla between two worlds: the critical world of leading from within their departments to make collective changes to them, and the dominant world of leading through hierarchies and power dynamics. While striving to increase equity and inclusion in the learning communities within mathematics departments, we are finding that power dynamics, and awareness of power dynamics, add nuance to NIC participants’ understanding of their roles and responsibilities.

Discomfort with the notion of power can lead to power avoidance among leaders. We recognize power avoidance as a tension among the various leaders seeking to lead from power with others rather than power over other individuals. The Kappa NIC exemplified this tension, even naming their experience with power as a tension before the research team recognized and shared the broader theme of this tension. Skylar, one of the two women co-leaders of the Kappa NIC, reflected on the first semester of the NIC by sharing:

I’m a co-facilitator and so I plan the meetings. I try to keep us on track during the meetings and try to sort of keep us on track, do a lot of things outside the meetings. The tension is that I’m also an instructor and I have my own thoughts and goals as an instructor and as a coordinator. And Tiersa [NIC co-leader] both do. And we are, we are very on the same -- She and I have been talking about these issues, but we really did not want to put our agenda -- We did not wanna make our agenda the NIC’s agenda. We were really trying to have the NIC organically come up with its goals and its priorities.

Tiersa independently shared a similar sentiment, expressing that she did not want her “random ideas” to guide the direction of the NIC, and worrying that she had an “outsized impact” on the direction. Skylar and Tiersa work together as the co-leaders of the NIC and also often work together in their department as part of the teaching faculty team who lead their introductory math program. They were both engaged as part of a prior grant initiative and have been actively working to improve mathematics education in their program for years. They are both very well respected by colleagues and well connected across campus, which is reflected in the membership of this NIC.

Skylar and Tiersa believed it would be valuable to bring university administrators onto the NIC to help support any big changes they wanted to enact. The administrators who joined pointed to their trust in Skylar and Tiersa as a primary reason for joining ([Tremaine, 2024](#)),

with one administrator noting that “Skylar and I have known each other for probably 4 or 5 years. And I, I love so much about how she approaches her work, and anything Skylar asks me to do, I will do.” Thus, while the NIC members looked to Skylar and Tiersa as leaders with informed perspectives and experiences, both leaders were hesitant to influence the direction of the NIC, instead prioritizing democratic decision making and equitable participation. Multiple NIC members agreed that the participation was equitable, and both Skylar and Tiersa noted this as a strength of the semester. However, NIC members and Skylar and Tiersa identified that, while equitable discussions took place, multiple NIC members did not assert themselves as decision makers for various reasons, and instead “acquiesced to [the leader’s] guidance” (Juniper, administrator). This left Skylar and Tiersa seeming to feel guilty for how the semester ended, feeling that they each spoke too much and had an “outsized role” in discussions, but also bemoaning the lack of a group goal, with Tiersa sharing that “not a ton of decisions have been made” by the end of the term, and Skylar reflecting that “Senna and Tiersa and I have goals. I’m still not sure that the NIC has goals.”

Throughout the ACT UP Math work, we witnessed a tension with the responsibility to exert power over others, especially when many of us have negatively experienced these forms of power. We have come to recognize this as a discomfort with an image of power that we are most experienced with - power over - and are working to lean into leadership roles and responsibilities while simultaneously continuing to nurture relationships built on collective power and responsibility to enact power with (Allen, 1998). Allen (1998) defines power with as “the ability of a collectivity to act together for the attainment of a common or shared end or series of ends” (p. 35), contrasted with power over, which she defines as “the ability of an actor or set of actors to constrain the choices available to another actor or set of actors in a non-trivial way” (p. 33). The tension we see related to power describes the difference between enacting leadership through power over others via hierarchies and top-down decision making vs. enacting leadership through power with others, which emphasizes democratic decision making and a rejection of hierarchies. Power with also includes leveraging and acknowledging the strengths and knowledge of those involved in making decisions (Allen, 1998).

We see in Skylar and Tiersa’s positioning of themselves as “co-facilitators” and not co-leaders as indicative of their aversions to stepping into a role of leadership from a power over perspective. We recognize a strong desire to instead facilitate a democratic and collective action approach, which can show up as power with, if the leaders acknowledge and leverage their own strengths and knowledge as valuable to inform decision making. While we see aspects of this tension within the Alpha and Tau NICs, we note the unique membership composition of the Kappa NIC as all women, and believe this may have amplified this tension. As Karis, one of the administrators on the Kappa NIC observed, “But also I think we are all women, so I think it’s also a different, I guess, like hyperawareness. But those items exist, so I think that also provides a different nuance when it comes to having these conversations.” This “hyperawareness” seems to have influenced a hypersensitivity to leading through power over, and instead staying in facilitator roles rather than stepping into leadership roles.

When we shared the power tension and got anonymous feedback from NIC leaders, there were two responses that expressed alignment with this tension. One NIC leader shared “This one resonates with me!

I have a goal next semester to share my ideas and visions for change while also making space for the ideas and visions of others” while another shared “We are very aware of this tension and trying to structure conversations to distribute power, but feeling conflicted about imposing structure/direction as ‘power over.’” Interestingly, a third NIC leader did not resonate with this tension, sharing “Perhaps I’m oblivious, but I have not noticed power-over tensions, despite the fact that we have college-level and department leadership working alongside junior faculty.” Last, one participant emphasized the positioning of leaders that is implicit with this tension: “this seems to go with perceptions of leaders as “experts” and not feeling enough like experts (yet).”

4.3 Students as novices vs. students as experts

The three NICs are positioned in nepantla between two worlds: the critical world of viewing students as experts of their own experiences and the dominant world of viewing students as novices without informed perspectives. This tension was manifested within each of the NICs as they grappled with how to include students within the NIC membership, and how they perceived the relative value of student perspectives gained through focus groups and qualitative survey data. In their work toward adopting more critical views of teaching mathematics, all three NICs have recognized the importance of students’ voices in telling their own stories, but encounter tension when implementing policies that reflect this belief due to dominant structures and policies within their institutions. The stories of each of the three NICs reflect this idea in different ways: Alpha has included student members in their NIC, Kappa has come to the realization that they wish to go beyond gathering student feedback as data to also incorporate students into the structure of their NIC, and Tau has transitioned from thinking of student voice as something present on course evaluations to a meaningful perspective that can be actively sought out as qualitative data.

In the following section, we primarily detail how this tension arose within the Alpha NIC since they included undergraduate and graduate students within the NIC membership and subsequently created action plans informed by students’ perspectives. The intentional inclusion of students in the Alpha NIC introduced unique tensions related to the power imbalance between students and faculty. While faculty were aware of and took steps to mitigate such imbalances, students still expressed hesitation to fully engage in NIC meetings and activities without explicitly naming or identifying the presence of these power imbalances.

Alpha NIC members were cognizant of the power imbalances arising within the NIC, and as a research team we explicitly noted this dynamic occurring at the onset of the NIC formation in field notes that were shared with NIC leaders. One faculty NIC member, Caroline, explicitly called out the power dynamics within the NIC, acknowledging in an interview that there was a “power dynamic between faculty [of different ranks/positions] and students in the NIC.” The student/faculty power dynamic was viewed as naturally occurring since faculty members were the ones leading the NIC meetings; a NIC faculty member recognized this in a journal entry stating “faculty are planning and facilitating the NIC meetings, there is a power imbalance.” Even when students engaged in NIC activities, faculty members viewed them

as shy or nervous. When asked about power dynamics, a NIC faculty member responded “people who take classes are a bit more shy to answer questions at times but I think it is because they are used to [being] students.” We noticed how the faculty attributed NIC power imbalances to “natural” hierarchies (student/instructor), logistical aspects (who leads the meeting), or the result of student characteristics (shyness); yet, the reasons for the power dynamics could be addressed by leaning further into critical perspectives and having student leaders plan the meetings or by selecting student members who are not in classes with faculty members.

Alpha NIC leaders acknowledged the importance of student perspectives and viewed all members of the NIC as “equal participants.” At the same time, faculty recognized that viewing students as partners in creating change introduced limitations as time and effort must be spent attending to faculty-student and leader-follower dynamics. For example, Jeremy, a NIC faculty member, noted, “There’s a little bit of trying to balance how much do the lead[er]s lead vs. how much does the community take those next steps, and like, you know, process them in a slower way, maybe with more conversation in light of the fact that we have limited time,” articulating a tension between time constraints and ensuring that everyone in the group is able to contribute. NIC leaders attempted to mitigate this power differential by creating inclusive spaces for students to hold equal weight in the conversations through intentional pairings of instructors and students, small group discussions and share outs, and a democratic voting system to decide next steps. Diversity in perspectives, including student perspectives, was repeatedly cited as a benefit to the NIC; however, while the use of a democratic process of voting within the NIC was intended to introduce a measure of equality in decision-making, it did not counter the authority of faculty perspectives in decisions as faculty members outnumbered the students in the NIC. Even with the democratic voting system, there were times when faculty members failed to recognize or take up the specific forms of knowledge and expertise that students brought to the conversation, particularly when students themselves were not feeling comfortable sharing their knowledge due to existing power dynamics.

Students did not outwardly express their recognition of power imbalances occurring across students and faculty, but alluded to scenarios of potential discomfort while in NIC meetings. To illustrate, Chelsea, a student NIC member addressed power dynamics in a journal entry, “as for the power dynamics in the group, I do not really feel there are any. I know I still have a hard time calling my professors by their first name...” Although this student does not explicitly name the power dynamic within the NIC, Chelsea’s discomfort in calling instructors by their first names may be the effect of a power dynamic that harkens to a hierarchy of roles within academic settings. Another student, Chase, described a lack of acknowledgement of differing opinions saying, “there’s not really much voice to be heard, but I’m pretty sure everyone had their vote, and I’m sure that we had very similar views as to what was important.” Chase described power dynamics in the NIC through an assumption of collective agreement regarding “what was important,” with group discussions lacking individual voices. This could mean that personally held values were implicitly dismissed by the group.

In response, students placed the tension of the implicit power dynamic on themselves, perceiving themselves as being shy, nervous,

or uncomfortable in NIC meetings. Chelsea took ownership of the discomfort felt within the NIC, confiding:

The only concerns that I have about the group are about myself. I worry that I will not be helpful, that I may say something and it will be misunderstood or taken the wrong way...that people may not think I'm taking it as seriously because I'm not participating as much.

Another student cited that “I’m not a shy person really, some kind of settings like this make me a little bit nervous” and continued that “it is a bit intimidating having professors in the group, especially since three are current professors of mine.” In identifying their own discomfort without recognizing the power imbalance, students placed the blame on themselves. Students continued to discuss faculty members as those with power, making statements such as, “[faculty members] made sure to make sure I was comfortable.” Yet, students still addressed feeling uncomfortable interacting within the NIC.

In spite of the challenges related to the “students as novices vs. students as experts” tension, it’s important to emphasize that the Alpha NIC leaders were acting as trailblazers in terms of incorporating student members and student voices into their NIC. During meetings across the entire ACT UP Math NIC, Alpha NIC leaders shared their experience and even inspired other NIC leaders. One Kappa NIC leader referenced conversations with the Alpha NIC about student NIC membership, “...takeaways that I had were maybe it would be nice [and] the NIC would feel balanced differently if we did not have administrators in the NIC and instead had some students.” At the end of Spring 2023, the Kappa NIC began planning to recruit student members to their NIC and to collect more student-centered data to guide their action plan. As of Spring 2023, the Tau NIC had yet to incorporate students within the NIC, but individual instructors conducted focus groups with students in their own classes. Members of the Tau NIC expressed that they found the student perspective valuable, and they were looking for ways to collect reliable feedback from students.

In addition to practical concerns such as IRB requirements, members across all three NICs were faced with questions about what counts as usable data for enacting transformations. One NIC faculty member felt that although student comments in student focus groups provided a helpful “perspective on teaching, and how students perceive their learning,” the information gained was “not quite data,” partially due to low attendance of the focus group. This sentiment was echoed in other NIC members’ interviews, with many faculty participants expressing uncertainty about whether the data they collected is acceptable or even useful. This was especially the case when some students’ feedback seemed to contradict others. One instructor explained, “So some students say I really like that, and I see how, you know, metacognitive, whatever. And then other students are like, this is just a waste of time, this is just busy work, or— So I do not know. And I do not know how useful that will be.” In other words, instructors were beginning to listen to multiple student voices and view students as experts on student experiences, but they continued to wrestle with how to incorporate student perspectives as a source of data within their institution.

We again shared our observation of the students as experts/novices tension with NIC leaders from all three NICs and invited them to reflect on the tension and type their thoughts in an anonymous post. One NIC leader expressed excitement about

including students in their NIC in the upcoming semester. Another NIC leader agreed that students are experts of their own experiences but clarified that their expertise does not extend to the department, stating that our description of tension was a “nice overview of students as experts of their student experience, but perhaps novices of the math department experience, and how they might feel that dichotomy.” Another NIC leader questioned how to navigate the voice of students within this tension: “Also the tension of does a single student voice count as “data” to inform changes? That is a tension between quant then being too overarching.”

5 Discussion and implications

Our findings, shown in [Figure 4](#), highlight the main tensions NICs face as they move from ideation to execution in their change efforts. The first tension involves a nepantla positioning between identity neutrality (dominant world) and identity centrality (critical world) in setting equity-focused goals. Although all NICs operated in the critical world during data exploration (e.g., examining Black students’ interest and confidence in math), they chose to implement action plans within the dominant world (e.g., motivating all students to engage and succeed in mathematics). The second tension lies between power over (dominant world) and power with (critical world) in the functioning of the NICs. While leaders volunteered or were appointed, many exhibited power avoidance tactics when it came to addressing inequitable power dynamics. The third tension is between viewing students as novices (dominant world) and as experts (critical world). Despite recognizing the importance of students’ voices, NICs experienced tension when basing decisions solely on students’ perspectives due to dominant institutional structures and policies. Across these three nepantla positionings, we found it crucial to strive toward criticality by using tension as a driving force and by focusing on the roles of identity and power, as well as students as partners.

Just as bridges use a network of cables under tension to stabilize and support the bridge deck (as illustrated in [Figure 4](#)), we view the tensions experienced by the NICs acting as supportive cables bridging the space between dominant and critical perspectives centered around the supporting girder of nepantla. One cannot exist without the other and they reside within a unique system of support that we believe can be used to re-envision a fair, justice-oriented, and equitable mathematics education. As NICs engage in additional improvement cycles, we envision the bridge iterating with multiple points of tension and girders of nepantla experienced resulting in a fully realized cable-tension bridge connecting dominant and critical worlds.

5.1 Toward criticality: tension as a driving force

Nepantla is a space of tension that fosters collective discomfort, dialog, and decision-making to drive action plans toward creating equitable learning environments. Throughout the three key tensions, we observed a distinction between exploration/research and implementation/action. All three NICs recognized the importance of

exploring datasets with an eye toward understanding the experiences of students who identify as members of marginalized identity groups, collaborating with NIC members to cultivate a democratic community, and encouraging students to share their personal stories. These activities took place during the exploration phase when NICs were considering data to inform decisions on goals, leadership, and implementation. However, when it came to setting goals and action steps, NICs reverted to more dominant practices—adopting a “for all” approach to goals ([Leyva et al., 2022](#); [Martin, 2003, 2019](#)), leaders avoiding exerting power, and seeking additional data to inform action plans beyond students’ narratives. This tendency to shift from critical exploration to familiar practices is common in academia. Prior research indicates that successful change initiatives need to be grounded in related research, acknowledge complexities inherent in transformational change, attend to the processes of change, and be adapted to fit local contexts ([Henderson et al., 2011](#); [Kezar, 2014](#); [Kezar and Gehrke, 2015](#)). Our research also showcases that equity-focused change initiatives should embrace tensions as productive liminal spaces and explicitly attend to power and identity in all aspects. As scholars, we often know how to discuss critical issues but struggle to translate these discussions into action, defaulting to familiar (dominant) approaches. Nepantla offers a valuable position if we can harness this discomfort to drive change.

Change is often accompanied by conflict, particularly the internal conflict we face when striving toward criticality. Many of these tensions stem from how we have been conditioned to view equity within our systems and fear the unknown. By addressing our internalized discomfort, we can begin to express our tensions in dialog with others. For example, NICs acknowledged that “students cannot be boiled down to one [identity]” while also recognizing that “for all” improvements might not “address the needs of specific groups of students.” Despite seeing the drawbacks of both perspectives, they defaulted to implementing “for all” improvements because these are traditionally valued and widely accepted (e.g., [Martin, 2019](#)). This systemic preference of “for all” approaches causes the disconnect. We believe one way to mitigate this disconnect is to encourage NIC members and others seeking to improve mathematics education to be transparent in discussing their biases and perspectives. As such, it is important to note that each of the NICs were operating in different political climates that surely impacted the discourses and discussions when implementing change. It is hard to see the water we swim in, and given our research design we did not ask about the influence of state and local laws; however, we did note that the Alpha NIC which was in the most supportive state setting was also able to implement more critically-focused change efforts (e.g., self-placement). By making the unknown and underlying structures visible we can begin to set action goals that are still critical but also improve experiences for all students. To achieve this, we need to leverage the roles of identity and power and engage students as partners ([Cook-Sather et al., 2023](#); [Bolick et al., 2024](#)).

5.2 Toward criticality: the roles of identity and power

Intentionality in addressing identity and power dynamics within the NICs is crucial for advancing criticality and enacting

meaningful change. The primary tensions related to identity stemmed from the NICs' goal of promoting fairness for all students. These tensions manifested as color-evasiveness and gender neutrality. McNeill et al. (2022) identified that gender neutrality and color-evasiveness prevailed among undergraduate mathematics faculty with regard to their perceptions of instructional events that were potentially marginalizing for students of color and women students. Leyva et al. (2022) found that students of color and women in college precalculus and calculus classes recognized when their teachers enacted 'supportive-for-all practices' and found these helpful but insufficient to create equitable learning environments, leading the authors to state that "equity-oriented calculus instruction requires confronting racism and patriarchy that reproduce oppression in mathematics education" (p. 341). The primary tensions felt with respect to power were based on the intentions of mitigating power dynamics within the NIC. These power tensions appeared as power avoidance. Although all three NICs appointed leaders, these leaders expressed contradictory feelings of being too authoritarian at times and needing to exert power for the NIC to make progress at other times.

Although the intentions behind the NICs' decision-making was notable, we understand that intention is not the same as impact when it comes to equity. Therefore, we have to work toward understanding the central ways with which identity and power must be engaged in order to make critical transformations. Examining the way the identity neutrality was reproduced in the NIC, our research team emphasized the need to require the NICs to confront racism and patriarchy within their introductory mathematics programs and to center these experiences to motivate their action plans. Although we recognize this requirement as a power tension within research-practice partnerships, one must acknowledge the role that power plays within the systems they are working to change: "power relations exist in all interactions and relationships, [and] there is no neutrality in education and research" (Aguirre et al., 2017, p. 126). We encourage change teams (such as the NICs) to confront tensions with identity avoidance, feeling like novices in equity for math education, and not wanting to dominate over others' ideas through productive conversations as a research-practice partnership. As stated earlier in the discussion, by confronting the discomfort and engaging with dialog, change teams are more likely to enact equitable action plans that explicitly engage with identity and power in mathematics education.

5.3 Toward criticality: students as partners

Students as Partners (SaP; Matthews et al., 2018) is a way to shift toward criticality by implementing an identity-central, power-with approach. This approach does not eliminate tension but rather encourages confronting and addressing inequitable dynamics. For instance, involving students as partners can disrupt power hierarchies, promote teamwork, and support participants to recognize everyone as experts in their own right. However, this process requires time and effort to navigate the tensions arising from power imbalances. The Alpha NIC serves as a prime example (see Bolick et al., 2024 for greater details).

The Alpha NIC was the first to involve students, followed by the other two NICs after the first improvement cycle. Our research team observed that faculty attributed power imbalances within the NIC to "natural" hierarchies (i.e., student vs. instructor), logistical factors (i.e., meeting leadership), or student characteristics (i.e., shyness). While faculty were aware of these imbalances and attempted to mitigate them, students still hesitated to fully engage in NIC meetings and activities, often attributing their reluctance to personal shortcomings. Although students acknowledged that faculty made efforts to create a comfortable environment, their concerns reflected broader perceptions of their roles relative to faculty members. The Alpha NIC worked diligently to address these discomforts, grappling with the tensions that arise from engaging Students as Partners and striving to build a respectful, reciprocal, and responsible relationship (Cook-Sather et al., 2014).

Our research team encourages department change teams (such as NICs) to center their commitment to critical perspectives by assigning leadership roles to students (e.g., planning a meeting) and selecting students from outside their courses to reduce coercion and influence. We urge change teams to view students as experts capable of identifying problems and proposing solutions, acting beyond the role of advisors providing feedback on faculty ideas. Additionally, we recommend involving students in decision-making processes and fully integrating their expertise into the work of the change groups.

5.4 Reflections and future work

When we first set out to support mathematics departments to critically transform their introductory mathematics programs from within, we purposefully chose to not specify any populations of students that we wanted the NICs to center in their action plans. Specifically, we did not encourage the NICs to explicitly attend to race, gender, or sexuality, or other social identities and instead encouraged them to identify the population of students experiencing marginalization and differential success within their programs. We believed the NIC members' engagement with the data dashboards would naturally lead to the identification of populations of students at their institution for whom critical transformations to their introductory mathematics program would be especially impactful or beneficial. After engaging with the data from the initial improvement cycle (Fall 2022—Spring 2023) we reflected that we, as the research team, did not communicate this assumption or expectation to the local NICs, which may have influenced the identity neutral stance that emerged. While writing this manuscript in Spring/summer 2024, we recognize that our choice as researchers may have perpetuated identity avoidant stances within the ACT UP Math work and that we initiated this work with our own form of identity neutrality rather than identity centrality. As we progress and continue in this work, we reflect on our role in enacting identity neutrality and how to move toward identity centrality while creating the space for math departments to identify the student populations experiencing harm in their contexts. We have adopted a new norm of asking the NICs to name the student population on whose

behalf they are working to improve math experiences at multiple stages of their transformation work. We balance this with the understanding that identity neutrality is a frequent starting place among mathematics department members and we are working to exist within the space of nepantla, with the associated discomfort and liminality.

Naming the tensions within the NICs related to power was similarly important and transformative for our research. After recognizing that the power-avoidance among the NIC leaders was related to a tension between different conceptions of power, our research team reflected on how power was affecting our work as a research practice partnership, a structure which aims to disrupt the hierarchies between researchers and practitioners. We recognize experiencing a tension related to power as the researchers supporting the three NICs, feeling a push and pull between wanting to share information and direction and support while also not wanting to dominate and reinforce a hierarchy. Informed by research related to creating equitable research practice partnerships (Denner et al., 2019; Noble et al., 2021; Ryou et al., 2015), we continue to work within this tension. We, and our NIC partners, recognize that the researchers bring specific expertise that we should be sharing to the NIC leaders, and that the NIC leaders bring expertise about their departments' needs and contexts. We work to model experiencing this tension related to not wanting to enact power over while also stepping into the roles of power and knowledge we hold. We also hope that the work of the NICs will continue long beyond our support, which is a helpful reminder to avoid enacting power over and instead find ways of working together to identify and develop the most generative research questions, foci, and approaches.

Our study includes change efforts in math departments occurring at three doctoral-granting institutions, and aims to provide rich qualitative descriptions of these efforts as they unfold. This work is theoretically grounded and methodologically sound, adding deep understanding about the process of critical change to the literature and to practice. As such, our results are not meant to generalize to all change efforts occurring within higher education. Future research should delve deeper into the nuances of these tensions, exploring how they manifest in different institutional contexts (e.g., community colleges, liberal arts colleges, historically black colleges or universities) and how understanding the change effort can be leveraged to drive meaningful change. In addition, this work is occurring in mathematics departments, which have a strong history of discourses related to brilliance, objectivity, and neutrality (Leslie et al., 2015; Shah, 2019; Bolick et al., 2024). We suggest conducting this research with broader disciplinary teams to understand how these discipline-specific discourses impact efforts toward equity. Additionally, further investigation into the role of students as partners in such transformative efforts is warranted, as their unique perspectives and expertise can significantly contribute to creating more equitable and inclusive mathematics education environments. We look forward to future work that explores students as partners as one of multiple potential strategies to work through the tensions inherent in engaging in critical equity work from within those departments. Ultimately, by understanding and leaning into the space of nepantla within which these tensions exist, we can work toward a future where mathematics education is truly equitable and empowering for all students.

Data availability statement

The datasets presented in this article are not readily available because the data drawn on for this manuscript cannot be deidentified while retaining meaning. Requests to access the datasets should be directed to wsmith5@unl.edu.

Ethics statement

The studies involving humans were approved by University of Nebraska-Lincoln Institutional Review Board (IRB) IRB #: 20220320749EX. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

JH: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Writing – original draft, Writing – review & editing. MV: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. AB: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Supervision, Validation, Writing – original draft, Writing – review & editing. FN: Visualization, Writing – original draft, Writing – review & editing. MB: Conceptualization, Formal analysis, Investigation, Visualization, Writing – original draft, Writing – review & editing. LP: Conceptualization, Formal analysis, Investigation, Writing – original draft, Writing – review & editing. NK: Conceptualization, Investigation, Writing – review & editing. KQ: Conceptualization, Formal analysis, Investigation, Writing – review & editing. RT: Conceptualization, Investigation, Writing – review & editing. RF: Conceptualization, Investigation, Project administration, Writing – review & editing. PW: Writing – review & editing. WS: Conceptualization, Funding acquisition, Investigation, Supervision, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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References

- Aguirre, J., Herbel-Eisenmann, B., Celedón-Pattichis, S., Civil, M., Wilkerson, T., Stephan, M., et al. (2017). Equity within mathematics education research as a political act: moving from choice to intentional collective professional responsibility. *J. Res. Math. Educ.* 48, 124–147. doi: 10.5951/jresmetheduc.48.2.0124
- Allen, A. (1998). Rethinking power. *Hypatia* 13, 21–40.
- Anzaldúa, G. (2002). "Preface: (Un)natural bridges, (un)safe spaces," in *This bridge we call home: Radical visions for transformation*. eds. G. Anzaldúa and A. Keating (New York: Routledge), 1–5.
- Apkarian, N., Kirin, D., Gehrtz, J., and Vroom, K. (2021). Connecting the stakeholders: departments, policy, and research in undergraduate mathematics education. *PRIMUM Probl. Resour. Issues Math. Undergrad. Stud.* 30, 17–36. doi: 10.1080/10511970.2019.1629135
- Austin, A. E. (2011). Promoting evidence-based change in undergraduate science education. In *The fourth committee meeting on status, contributions, and future directions of discipline-based education research* (Vol. 1).
- Batthey, D., and Leyva, L. A. (2018). "Making the implicit explicit: Building a case for implicit racial attitudes to inform mathematics education research," in *Toward equity and social justice in mathematics education. Research in mathematics education*. ed. T. Bartell (Cham.: Springer).
- Bolick, M. A., Pai, L., Funk, R., Voigt, M., and Rader, B. (2024). "Learning to engage students as partners in critically-oriented reform of tertiary mathematics," in *Pre-proceedings of the fifth conference of the international network for didactic research in university mathematics*. Barcelona. Available at: https://indrum2024.sciencesconf.org/data/pages/PreProceedings_INDRUM2024_comprimido.pdf
- Bolick, M. A., and Voigt, M. (2023). Using interactive data dashboards to address diversity, equity, and inclusion in introductory math programs. *Focus* 43, 14–17.
- Bronner, S. E. (2017). *Critical theory: A very short introduction* (2nd Ed.). New York: Oxford University Press.
- Cook-Sather, A., Bovill, C., and Felten, P. (2014). *Engaging students as Partners in Learning and Teaching: A guide for faculty*. Germany: Wiley.
- Cook-Sather, A., Salmeron, D., and Smith, T. (2023). Humanizing STEM education through student-faculty pedagogical partnerships. *Front Educ* 8, 1–16. doi: 10.3389/feduc.2023.1153087
- Corbo, J., Reinholz, D., Dancy, M., and Finkelstein, N. (2015). "Departmental action teams: Empowering faculty to make sustainable change," in *Paper presented at Physics Education Research Conference 2015*, College Park, MD. 91–94. Retrieved April 10, 2024, from <https://www.compadre.org/Repository/document/ServeFile.cfm?ID=13844&u0026amp;DocID=4262>.
- Dancy, M., and Hodari, A. K. (2023). How well-intentioned white male physicists maintain ignorance of inequity and justify inaction. *Int. J. STEM Educ.* 10:45. doi: 10.1186/s40594-023-00433-8
- Denner, J., Bean, S., Campe, S., Martinez, J., and Torres, D. (2019). Negotiating trust, power, and culture in a research–practice partnership. *AERA open* 5:233285841985863. doi: 10.1177/2332858419858635
- Ganga, E., and Mazzariello, A. (2018). *Math pathways: Expanding options for success in college math*. Denver: Education Commission of the States.
- Good, C., Rattan, A., and Dweck, C. S. (2012). Why do women opt out? Sense of belonging and women's representation in mathematics. *J. Pers. Soc. Psychol.* 102:700. doi: 10.1037/a0026659
- Greenwald, A. G., and Banaji, M. R. (1995). Implicit social cognition: attitudes, self-esteem, and stereotypes. *Psychol. Rev.* 102, 4–27. doi: 10.1037/0033-295X.102.1.4
- Gutiérrez, R. (2002). Enabling the practice of mathematics teachers in context: toward a new equity research agenda. *Math. Think. Learn.* 4, 145–187. doi: 10.1207/S15327833MTL04023_4
- Gutiérrez, R. (2009). Framing equity: helping students "play the game" and "change the game". *Teach excellence and equity in mathematics* 1, 4–8.
- Gutiérrez, R. (2013). The sociopolitical turn in mathematics education. *J. Res. Math. Educ.* 44, 37–68. doi: 10.5951/jresmetheduc.44.1.0037
- Gutiérrez, R. (2015). "Nesting in Nepantla: The importance of maintaining tensions in our work," in *Interrogating whiteness and relinquishing power: White faculty's commitment to racial consciousness in STEM classrooms*. eds. N. M. Russell, C. M. Haynes and F. Cobb (New York: Peter Lang), 253–274.
- Harper, S. R. (2010). An anti-deficit achievement framework for research on students of color in STEM. *New Dir. Inst. Res.* 2010, 63–74. doi: 10.1002/ir.362
- Henderson, C., Beach, A., and Finkelstein, N. (2011). Facilitating change in undergraduate STEM instructional practices: an analytic review of the literature. *J. Res. Sci. Teach.* 48, 952–984. doi: 10.1002/tea.20439
- Hill, C., Corbett, C., and St Rose, A. (2010). *Why so few? Women in science, technology, engineering, and mathematics*. Washington, DC: American Association of University Women.
- Kezar, A. (2014). *How colleges change: Understanding, leading, and enacting change*. New York: Routledge.
- Kezar, A., and Gehrke, S. (2015). Communities of transformation and their work scaling STEM reform. Monograph from Pullias Center for Higher Education, Rossier School of Education, University of Southern California. Retrieved from <https://pullias.usc.edu/wp-content/uploads/2016/01/communities-of-trans.pdf> (Accessed November 3, 2023).
- Laursen, S., and Rasmussen, C. (2019). I on the prize: inquiry approaches in undergraduate mathematics. *Int. J. Res. Undergrad. Math. Educ.* 5, 129–146. doi: 10.1007/s40753-019-00085-6
- LeMahieu, P. G., Grunow, A., Baker, L., Nordstrum, L. E., and Gomez, L. M. (2017). Networked improvement communities: the discipline of improvement science meets the power of networks. *Qual. Assur. Educ.* 25, 5–25. doi: 10.1108/QAE-12-2016-0084
- Leslie, S.-J., Cimpian, A., Meyer, M., and Freeland, E. (2015). Expectations of brilliance underlie gender distributions across academic disciplines. *Science* 347, 262–265. doi: 10.1126/science.1261375
- Leyva, L. A., Amman, K., Wolf McMichael, E. A., Igbinosun, J., and Khan, N. (2022). Support for all? Confronting racism and patriarchy to promote equitable learning opportunities through undergraduate calculus instruction. *Int. J. Res. Undergrad. Math. Educ.* 8, 339–364. doi: 10.1007/s40753-022-00177-w
- Leyva, L. A., Quea, R., Weber, K., Batthey, D., and López, D. (2021). Detailing racialized and gendered mechanisms of undergraduate precalculus and calculus classroom instruction. *Cogn. Instr.* 39, 1–34. doi: 10.1080/07370008.2020.1849218
- Malacrada, C. (2007). Reflexive journaling on emotional research topics: ethical issues for team researchers. *Qual. Health Res.* 17, 1329–1339. doi: 10.1177/1049732307308948
- Martin, D. B. (2003). Hidden assumptions and unaddressed questions in mathematics for all rhetoric. *Math. Educ.* 13, 7–21.
- Martin, D. B. (2019). Equity, inclusion, and antiblackness in mathematics education. *Race Ethn. Educ.* 22, 459–478. doi: 10.1080/13613324.2019.1592833
- Matthews, K. E., Dwyer, A., Hine, L., and Turner, J. (2018). Conceptions of students as partners. *High. Educ.* 76, 957–971. doi: 10.1007/s10734-018-0257-y
- McNeill, R. T., Leyva, L. A., and Marshall, B. (2022). "They're just students. There's no clear distinction": a critical discourse analysis of color-evasive, gender-neutral faculty discourses in undergraduate calculus instruction. *J. Learn. Sci.* 31, 630–672. doi: 10.1080/10508406.2022.2073233
- Mertens, D. M. (2007). Transformative paradigm: mixed methods and social justice. *J. Mixed Methods Res.* 1, 212–225. doi: 10.1177/1558689807302811

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Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/feduc.2024.1454303/full#supplementary-material>

- Noble, C. E., Amey, M. J., Colón, L. A., Conroy, J., De Cheke Qualls, A., Deonauth, K., et al. (2021). Building a networked improvement community: Lessons in organizing to promote diversity, equity, and inclusion in science, technology, engineering, and mathematics. *Front. Psychol.* 12, 1–10. doi: 10.3389/fpsyg.2021.732347
- Okun, T. (2021). White Supremacy Culture – Still Here. Retrieved from <http://www.whitesupremacyculture.info/> (Accessed on March 20, 2023).
- Palid, O., Cashdollar, S., Deangelo, S., Chu, C., and Bates, M. (2023). Inclusion in practice: a systematic review of diversity-focused STEM programming in the United States. *IJ STEM Ed* 10:2. doi: 10.1186/s40594-022-00387-3
- Palmer, D., and Caldas, B. (2015). “Critical ethnography,” in *Research methods in language and education, encyclopedia of language and education*. ed. K. King (Cham.: Springer).
- Penuel, W. R. (2017). Research–practice partnerships as a strategy for promoting equitable science teaching and learning through leveraging everyday science. *Sci. Educ.* 101, 520–525. doi: 10.1002/sce.21285
- Penuel, W. R., Riedy, R., Barber, M. S., Peurach, D. J., LeBouef, W. A., and Clark, T. (2020). Principles of collaborative education research with stakeholders: toward requirements for a new research and development infrastructure. *Rev. Educ. Res.* 90, 627–674. doi: 10.3102/0034654320938126
- Quan, G., Corbo, J., Wise, S., and Ngai, C. (2021). “Unpacking challenges in student-faculty partnerships on Departmental Action Teams,” in *Paper presented at physics education research conference 2021, virtual conference*. 353–358. Retrieved March 19, 2024, from <https://www.compadre.org/Repository/document/ServeFile.cfm?ID=15780/u0026amp;DocID=5509>
- Raines, J. M. (2012). FirstSTEP: a preliminary review of the effects of a summer bridge program on pre-college STEM majors. *J STEM Educ. Innov Res* 13, 22–29.
- Reinholz, D. L., and Apkarian, N. (2018). Four frames for systemic change in STEM departments. *Int. J. STEM Educ.* 5, 1–10. doi: 10.1186/s40594-018-0103-x
- Ryoo, J. J., Choi, M., and McLeod, E. (2015). *Building equity in research-practice partnerships*. San Francisco: Research+Practice Collaboratory.
- Saldaña, J. (2013). *The coding manual for qualitative researchers*. 2nd Edn. London: SAGE Publications, Inc.
- Shah, N. (2019). “Asians are good at math” is not a compliment: STEM success as a threat to personhood. *Harv. Educ. Rev.* 89, 661–686. doi: 10.17763/1943-5045-89.4.661
- Smith, W. M., Voigt, M., Ström, A., Webb, D. C., and Martin, W. G., (Eds.) (2021). “Transformational change efforts: student engagement in mathematics through an institutional network for active learning,” in *American Mathematical Society and Conference Board of Mathematical Sciences*.
- Steele, C. M., Spencer, S. J., and Aronson, J. (2002). Contending with group image: the psychology of stereotype and social identity threat. *Adv. Exp. Soc. Psychol.* 34, 379–440. doi: 10.1016/S0065-2601(02)80009-0
- The Carnegie Classification of Institutions of Higher Education (2024). About Carnegie classification. Retrieved from <https://carnegieclassifications.acenet.edu/> (Accessed on May 9, 2024)
- Tillman, L. C. (2003). Mentoring, reflection, and reciprocal journaling. *Theory Pract.* 42, 226–233. doi: 10.1207/s15430421tip4203_9
- Tremaine, R. (2024). Investigating individually expressed motives and collectively generated goals for equity-oriented reform in undergraduate mathematics education. [doctoral dissertation]. Colorado State University.
- Tremaine, R., Hagman, J. E., Voigt, M., Damas, S., and Gehrtz, J. (2022). You don't want to come into a broken system: perspectives for increasing diversity in STEM among undergraduate calculus program stakeholders. *Int. J. Res. Undergrad. Math. Educ.* 8, 365–388. doi: 10.1007/s40753-022-00184-x
- Voigt, M., Hagman, J. E., Gehrtz, J., Ratliff, B., Alexander, N., Levy, R., et al. (2023). *Justice through the lens of calculus: Framing new possibilities for diversity, equity, and inclusion*. Washington, D.C.: The Mathematical Association of America.
- Voigt, M., Smith, W., Kress, N., Grant, D., and Strom, A. (2021). “Culture and equity” in *Transformational change efforts: Student engagement in mathematics through an institutional network for active learning*. eds. I. W. Smith, M. Voigt, A. Strom, D. Webb and W. Martin (Providence, Rhode Island: American Mathematical Society and Mathematical Association of America Press, and the Conference Board of Mathematical Sciences), 277–298.
- Weaver, G. C., Burgess, W. D., Childress, A. L., and Slakey, L. (2016). *Transforming institutions: Undergraduate STEM education for the 21st century*. West Lafayette, IN: Purdue University Press.