Constructing Instructors' Classroom Practices From Students' Survey Responses

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This preliminary report shares an outcome from a summer professional development (PD) activity with university instructors. Instructors participated in four PD meetings, then immediately taught a five-day summer workshop using inquiry, working primarily with first-generation minoritized students. While instructor participants' exit interviews of the project identified their experience in the summer PD as pivotal to their development, we know little of how students experienced the instructors' teaching during the workshop. Our analysis focuses on two items from student post-workshop survey wherein students shared their feedback of their instructor and their experiences more broadly. This analysis allowed us to get a good sense of the instructors' individual practices and revealed convergence in their practices. Pedagogically, instructors utilized groupwork and deemphasized direct instructions, while prioritizing students' engagement in discussions and struggling through conceptual ideas. Relationally, instructors were responsive to students' mathematical needs and created a respectful, safe, and welcoming classroom environment.

Keywords: professional development, equity, inquiry

Project Adelante was a three-year professional development (PD) project, aimed to support university instructors to develop skills in teaching with inquiry methods while simultaneously disrupting deficit narratives about minoritized students in mathematics (Adiredja et al., 2024). Broadly, the PD's goal was to develop culturally responsive mathematics teachers (Ladson-Billings, 1995; Zavala & Aguirre, 2023). The project was motivated by the ongoing educational inequities in undergraduate mathematics for minoritized students, and the need to develop skilled university instructors who are responsive to such inequities. In this way, we joined other scholars and national studies with similar foci (e.g., Leyva, 2022; Smith et al., 2021). However, the project engaged instructors and students in several activities where they explicitly discussed the role of race and gender in STEM to build empathy and solidarity. Each year's cohort of students and faculty participated in critical conversations at the university's cultural centers. Instructors conducted Funds of Knowledge-inspired (Moll et al., 1992) interview of a minoritized student from their class. This report focuses on a PD activity as part of a summer bridge program.

The year-long PD started in the summer. Our participants, instructional faculty and graduate students, participated in four meetings in July in preparation to teach a five-day inquiry-based learning (IBL) summer math workshop. The workshop served primarily first-year first-generation minoritized students who were enrolled in the courses: Pre-Calculus, Calculus I, II, Vector Calculus, and Linear Algebra in the following Fall semester. Topics of the meetings included deficit discourse in mathematics education, teaching with IBL, Funds of Knowledge, anti-deficit teaching, and IBL worksheet development. The PD used immediate implementation, and live coaching to give instructors hands-on experience with inquiry. Exit interviews with the instructors pointed to this summer activity as pivotal to their development as instructors. Here, we focus on analysis of students' feedback of their instructor and examine: *What can we learn about the instructors' teaching practices in their classroom based on the students' feedback? And to what extent did the teaching practices meet the goal of the PD?*

Conceptual Framework

We draw on Zavala and Aguirre's (2023) conception of Culturally Responsive Mathematics Teaching (CRMT) to set the landscape of desired practices with our instructors. The authors built their framework by leveraging the well-developed research in K-12 mathematics education around professional development. It is theoretically rooted in three research traditions: Math Pedagogical Content Knowledge (Grossman et al., 2005), Culturally Responsive Pedagogy (Gay, 2002), and Rehumanizing Mathematics (Gutiérrez, 2018). The authors have articulated components of CRMT and organized them into three strands and nine dimensions.

Table 1. Culturally Responsive Mathematics Teaching (CRMT) Tool.

Knowledge & Identities	Rigor & Support	Power & Participation
• Centering Cultural and Community Funds of Knowledge • (Re)Humanizing Mathematics • Honoring Student Thinking and Ideas	• Sustaining High Cognitive Demand • Scaffolding Up • Affirming Multilingualism	• Distributing Intellectual Authority • Disrupting Status and Power • Analyzing and Taking Actions

This framework articulates concrete aspects of "equity" in teaching. Fostering equity in the classroom has been articulated as one of the pillars of Inquiry Based Mathematics Education (IBME; Laursen & Rasmussen, 2019). More critically, the framework embeds active learning goals as part of culturally responsive math teaching. For example, the CRMT framework adds to "inquiring into student thinking"—a different pillar of IBME—the notion of honoring such thinking to emphasize the importance of shifting deficit narratives about URM students in mathematics (Adiredja, 2019). Power and participation issues are the focus in implementing collaboration among students and teachers. In other words, CRMT ensures that active learning strategies serve the goal of inclusive teaching.

Methods

We analyzed student feedback from the student exit survey to investigate the instructors' teaching practices in the classroom. The survey was administered to students at the end of the summer math workshop during each year of the project from 2021-2023. The workshop and the project were conducted at a research university in the Southwest of the US, which is also a Hispanic Serving Institution. In this report, we only focused on the 2023 cohort. The workshop session was led by six instructors, each teaching one course as shown in Table 2. There was a total of 71 students who attended all five days of the workshop. Sixty one of the 71 students (85.9%) responded to the exit survey. Students self-identified their race and ethnicity and might have included more than one descriptor: 38 students identified as Hispanic/Latinx/Mexican American, 26 as White, 18 as Asian/Japanese/Korean/Indian/South Asian/Pacific Islander, seven as Black/African American, three as Native American, and one as Middle Eastern.

We focused on the two questions from the survey which pertained to the instructors' teaching in the workshop. The first question asked students to give feedback to their respective workshop leader/instructor by providing at least one thing which their workshop leader/instructor did well

and one thing they could improve upon. The second question asked students to provide any additional comments they might have about this program, that were not elicited previously in the survey. Each of the students' responses were first analyzed for each instructor individually, to find common themes, and then aggregated to find similar classroom practices across instructors.

Table 2. Instructor course and demographics

Instructor	Course Taught	Title	Race	Gender
Barbara	Pre-Calculus	Career-track faculty	White	Cis-woman
Jinwoo	Calculus I	Career-track faculty	Asian	Cis-woman
Aarav	Calculus I	Graduate student	South Asian	Cis-man
Julian	Calculus II	Graduate student	Hispanic/Multi-race	Cis-man
Caspian	Vector Calculus	Graduate student	White	Non-binary
Daniel	Linear Algebra	Postdoctoral scholar	White	Cis-man

Since each student's response can contain multiple ideas, we deconstructed every response into different sentences, each consisting of a single idea. We kept track of each sentence by identifying the corresponding instructor and student. We filtered the sentence that described the pedagogical practices the instructors engaged in from the general student experiences. Starting with one instructor, we created categories by comparing and grouping the sentences with similar themes. We used these categories to group a second instructor's sentences from their students and created new categories based on the remaining unsorted sentences. We iterated this process for the remaining instructors. We then collected the data in each category for all the instructors and examined the categories shared across most or all instructors.

For example, one student responded that their instructor "[was] very good at pacing and drip-feeding concepts while we work on problems." This response was then split into two sentences: CAS_3_a: A student was comfortable with the pacing in the course, and CAS_3_b: Students were engaged with concepts while working on problems. CAS was the first three letters of the instructor's pseudonym, in this case, Caspian with 3 being the third student who responded from this instructor's class. We note that students' negative sentiment, such as they wished the instructor would lecture more was still informative. We placed that sentence into the category that says that the instructor de-emphasized the use of direct instruction.

The three authors started the analysis with survey responses for the first instructor. The second author continued the analysis of the rest of the responses for the remaining instructors with the third author. Since the second author was a past participant of the workshop, the third author led the analysis of their students' responses. Disagreements were resolved first by the second and third authors, and in some cases with the first author.

Findings

We identified ten categories, which describe classroom practices that the instructors engaged in from the student surveys. We focus on the following six categories which were commonly shared within four or more instructors' feedback: (a) Fostering a classroom environment that is safe, comfortable, and respectful; (b) Offering students opportunities to experience productive struggle; (c) Organizing the classroom around students' engagement with discussions and group work; (d) Focusing on students learning with conceptual understanding; (e) Responding to students' mathematical needs; and (f) De-emphasizing the use of direct instruction. Table 3

shows the distribution of distinct student responses within each category by instructor. Due to space constraints, we will share details about four categories in part due their richness.

Table 3. Distribution of distinct student responses within each category by instructor

Category	Barbara	Jinwoo	Aarav	Julian	Caspian	Daniel	Total
(a) Classroom environment that is safe, comfortable and respectful	2	2	4	2	1	1	12
(b) Opportunities to experience productive struggle	1	0	3	2	2	1	9
(c) Students' engagement with discussions and group work	2	1	4	4	2	1	14
(d) Students learning with conceptual understanding	0	0	1	2	3	2	8
(e) Responding to students' mathematical needs	3	2	3	3	2	7	20
(f) De-emphasizing the use of direct instruction	1	3	3	3	1	1	12

Within the category of *Fostering a classroom environment that is safe, comfortable, and respectful*, 12 total students across all six instructors' classroom identified how their respective instructor contributed to creating an environment that fostered student respect and feelings of safety for students to engage with math. Many responses spoke to how the instructor was kind and respectful, but we also found that instructors created space for exploration, mistakes, and questions. One of Daniel's students expressed that he provided less formal and open explanations that allowed the student to feel like they could learn without fear of being treated like they were dumb. Similarly, responses from Aarav's class expressed that he created an environment where he was approachable for questions and where there were "no wrong answers" or "dumb questions." The instructors fostered a classroom where students were supported and encouraged to make mistakes and ask questions.

Among nine student responses categorized as *Offering students opportunities to experience productive struggle*, we found evidence that five instructors engaged in such practices. These responses identified that students were responsible for most of the cognitive load in the classroom and were given opportunities to make sense of material on their own. In Julian's class, a student identified that he gave them freedom to learn theorems on their own. Moreover, a response from Aarav's class indicated that he did not give students explicit directions while solving problems and encouraged them to explore ideas. Instructors created classrooms where students were given space to explore, struggle, and make sense of material on their own. Some instructors also incorporated a balance between struggling on problems and the big picture ideas of the course. For example, a student expressed that Caspian gave students opportunities to struggle with solving problems on worksheets while also striking a balance with getting students back to the big picture ideas.

The category of *Organizing the classroom around students' engagement with discussions and group work* appeared in 14 students' responses across all six instructors' classrooms. This category provided evidence that these instructors engaged their students in collaborative group

work, but also gave us insight into the nature of class discussions that occurred in the classroom. A student in Barbara's class indicated that Barbara told her students to work [in groups] on vertical whiteboards. In Jinwoo's class, a student expressed they did not like the inquiry-based learning. They said they prefer being taught explicitly where they could take notes, solve practice problems and being corrected. Both these responses, despite reflecting a negative sentiment in Jinwoo's case, were placed in this current category.

Focusing on students learning with conceptual understanding was our smallest shared category with only eight students across four instructors, but it exemplified an important facet of the instructor's teaching practices. We found evidence that the instructors emphasized process and big ideas over procedures and memorization within their classrooms. In Caspian's class, a student expressed that their learning focused on conceptual ideas and problem-solving methodologies over finding computational answers. Similarly, a student in Julian's class expressed that they proved mathematical rules through problem solving and generalized these rules to solve other problems. The focus shifted from knowing a rule to getting a hands-on experience of understanding the derivation of that mathematical rule.

Discussion

Our analysis methods proved fruitful. We were able to construct our instructors' individual classrooms and the practices they engaged in during the workshop by analyzing their students' responses to the two survey items. Moreover, comparing the categories across all the instructors revealed some degree of convergence in the kinds of practices they were engaged in after the summer PD, which was an encouraging result as they are consistent with the practices we advocated during the preparation meetings. We now reflect on these findings relative to the Culturally Responsive Mathematics Teaching framework (CRMT; Zavala and Aguirre, 2023).

Considering the nine dimensions of CRMT, we found consistencies between our categories and several of the dimensions. These dimensions include, (Re)humanizing Mathematics, Honoring Students' Thinking and Ideas, Sustaining High Cognitive Demand, Scaffolding Up, Distributing Intellectual Authority, and Disrupting Status and Power. We did not find evidence for Centering Cultural and Community Funds of Knowledge, Affirming Multilingualism, and Analyzing and Taking Actions. In some ways, this result allows us to think about how much culture was centralized in the summer preparation meetings. On the other hand, we actually did not expect all nine dimensions to be reflected at this early point of the PD. It will be interesting to complement this analysis with other data point from the project where the instructors have participated in critical conversations about racial and gender stereotypes and conducted the Funds of Knowledge-inspired interview with one of their workshop students.

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