

Aspects of Culture and Context which Shape Frames of Teaching and Learning

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Sociopolitical lenses applied to frames research have affirmed that frames are culturally constructed. A subsequent curiosity, then, is to uncover what aspects of culture and context shape an instructor's frames with respect to teaching and learning mathematics. To this end, this study followed three mathematics graduate student instructors during their semester of teaching for the first time. Through a grounded theory design, informed by critical theories, the author found themes within beliefs, values, and norms were salient in these teaching experiences. One consequence of this study is giving names to the aspects of culture and context which shape frames. This insight is valuable for understanding how to shape asset-based frames.

Keywords: frames, culture, sociopolitical, critical lens, graduate student instructors

Culture is ever-present in our lives. The collection of cultures we attached ourselves to, both willingly and by birth, informs how we move through society. It ranges from the small things to the large, like what utensils are used to eat or how language is used. Culture is typically an unspoken force that informs ways of living, with its major elements being symbols, language, norms, values, and artifacts (e.g., Conerly et al., 2021). In addition, the context which an individual is in may dictate what aspects of their culture they draw upon. For example, a school cafeteria, a fancy restaurant, and one's kitchen all dictate different behaviors and norms.

Consequently, culture and context also shape instructors' ways of teaching (e.g., Hofstede, 1986). A review of college mathematics teaching in proofs-based courses found that whether an instructor used instructor-centered or student-centered approaches was largely informed by the instructors' beliefs of what is the best form of teaching (Melhuish et al., 2022). In addition, the norms instructors enact may also differ if the type of course they teach is a computational course or a proof-based course (e.g., Dawkins, 2009). Focusing on culture and context together, Dreher et al. (2020) explored how East Asian (Taiwan) and Western (German) cultures approach teaching and found that different cultural norms informed their different ways of teaching.

This report uncovers the aspects of culture and context which shape an instructor's way of teaching. This study followed three mathematics graduate student instructors (GSIs) teaching as the main instructor for the first time and focused on their frames of teaching and of learning as a proxy to understand their ways of teaching. Teaching for the first-time is a formative period of one's instructional career, where students become educators (e.g., Smollin & Arluke, 2014). This period provided a space for me to notice the aspects of culture and context which inform these GSIs' understandings of what it means to teach and learn mathematics. Thus, this report is guided by the research question: *What aspects of culture and context were salient in the experiences of mathematics graduate students teaching as instructors for the first time which could be attributed to influencing their frames?*

The influence of culture and context on frames has been demonstrated and exemplified (e.g., Jessup, 2023; Scheiner, 2021). However, these studies discussed how the general concepts of "culture" and "context" shape instructors' teaching practice. This contributed report named aspects of culture and context which shape frames of teaching and of student learning. This report also aims to address the culture of exclusion (Louie, 2017) by unveiling and naming parts of *any* culture which could pervade mathematics classrooms.

Theoretical Perspective

The theoretical stance of this study is that an instructor's ways of teaching can be understood from the ways the instructor has framed their teaching and their students' learning. In general, frames are used by individuals to understand a given situation and quickly interpret information, filter the details, and decide how to appropriately respond (Goffman, 1986). In one way, frames have been understood as a facet of noticing – the ways in which instructors attend, interpret, and respond to teaching situations (Louie et al., 2021; Scheiner, 2021).

This study focused on instructors' frames of their teaching and their students' learning by building upon the analytic framework in Cristobal (2024). Frames of teaching can be understood as interpretive contexts that support instructors' perception and enactment of (1) what their role is in the classroom as the instructor, (2) what professional knowledge (Kunter et al., 2013) is relevant or valuable in the act of teaching mathematics, and (3) what type of interactions are favored or useful in fulfilling their role and achieving the intended mathematical learning goals.

Similarly, an instructor's frames of (student) learning can be understood as interpretive contexts that support instructors' perception and enactment of (1) what instructors must do for students to learn intended content, practices, and orientations, (2) what content, practices, and orientations should instructors attend to in the classroom, (3) what type of interactions are favored or useful in fulfilling their role and achieving the intended mathematical learning goals, and (4) where the class fits into students' schedules (or career paths) and what challenges competing responsibilities could pose to their learning.

Inspired by Louie, Adiredja, and Jessup (2021), this study drew upon critical race theory (CRT; Delgado & Stefancic, 2001; Ladson-Billings & Tate, 1995) in order to understand the culture and context which entrench teaching. I further drew upon two CRT-informed frameworks: community cultural wealth (Yosso, 2005) and critical whiteness study (Harris, 1993). In this view, culture referred to "behaviors and values that are learned, shared, and exhibited by a group of people" (Yosso, 2005, p. 76). Furthermore, this study was primarily concerned by the context that these GSIs were teaching in a predominantly white institution (PWI). More specifically, this study aimed to understand how the four functions of 'whiteness as property' (Harris, 1993) surfaced in the ways GSIs framed their teaching and their students' learning. See Figure 1 for a summary of each function. The study was concerned if these four functions materialized in how GSIs viewed mathematical knowledge.

Rights of Disposition Whiteness can be transferred ownership.	Right to Use and Enjoyment Whiteness can be used to accomplish and exercise power and enjoyed through affordances of privilege.
Reputation and Status Property Whiteness has a reputation, a thing of significant value, and having that meant having a certain status.	The Absolute Right to Exclude Whiteness can be interpreted, not by an inherent unifying characteristic, but by the exclusion of others who are "not white".

Figure 1. Summary of the four functions of 'whiteness as property' from Harris (1993)

CRT afforded the understanding that culture, of whiteness or of students of color, can either empower or discourage individuals. As a lens for empowerment, community cultural wealth extended the notion of 'wealth' which members of communities (of color) may draw upon for empowerment (Yosso, 2005). As a lens for discouragement, the culture of exclusion (Louie, 2017) can be understood as parallel to whiteness as property wherein mathematics knowledge is treated as property which can be transferred, used to exercise power, enjoyed for its privileges, has a reputation in society, and which individuals may be excluded from receiving.

Data and Method

The interview and observation data used in this report came from a larger study of three mathematics GSIs teaching for the first time as instructors of record: Andy, Carlos, and Jacob (pseudonyms chosen by the participants). “Instructors of record” are responsible for the content-delivery and assessments of an undergraduate mathematics course. These GSIs taught at a large, Midwestern, public predominantly white research university. Interviews were conducted before, throughout, and after the fall semester, a total of five interviews with each GSI. Weekly classroom observations were gathered throughout the semester for each GSI. The GSIs taught intermediate algebra, college algebra, or a mathematics course for liberal arts.

Following a grounded theory format (Charmaz, 2006), multiple rounds of coding were done to address the research question. The first rounds identified salient themes inductively (Miles et al., 2019) within each GSIs’ interviews, with close attention to how each discussed teaching and learning mathematics. Using the observation data, further trends were identified, either substantiating a theme found in the interviews or becoming new themes. Then, the themes were grouped under categorical labels aligned with the aspects of culture which surfaced. To address context and whiteness as property, the themes were coded as either treating or not treating mathematics knowledge as property, using the guiding question: “does this theme speak towards one of the functions of property? If so, is it challenging the notion or perpetuating it?” These themes were further labeled using the four functions identified in Harris (1993). Finally, using the analytic framework, connections were made between themes and the supports frames of teaching and of learning provided to the instructor.

Results

In these findings, I name the aspects of culture (behavior, values, and norms) and aspects of the context (of being at a PWI and the lens of ‘mathematical knowledge as property’) which surfaced in the analysis of GSIs’ experiences with teaching for the first time.

Aspects of Culture

Behaviors refer to how individuals act. Across these GSIs, it was an unsurprising theme that they behaved like novice instructors such as with classroom management. Furthermore, this behavior materialized in a fear of appearing incompetent or unprepared while they teach. Another behavior that was salient across was attending to students who were silent during group work. When asked how they decide which table group to approach during their group work sessions, all interpreted the silence as not knowing what to do or ask. For Carlos, silence even took precedence over vocalized struggle.

Carlos (Week 5 Interview): Something that would take precedence is if... they’re just like looking at it like this, staring without writing anything. At least the other people... they’re talking and like sort of trying. And so, a table that can’t even start a problem... that would take precedence over a table that is like struggling with a problem.

Values refer to what individuals consider to be important or beneficial. In this case, the focus was on what the GSIs valorized about teaching, learning, and overall experience during their semester which informed their teaching practice and the beliefs about their practice. Here, each GSI spoke of instances when their expectations and beliefs about teaching were challenged by the realities of teaching. This could be a positive challenge. For example, Jacob found the experience fun as opposed to scary.

Jacob (Week 15 Interview): It was less scary than I expected. I think that they [Course Convener] did a good job of like giving us support... I was sort of unsure about [teaching mathematics for liberal arts], but it was actually a lot of fun.

But it could also be a negative challenge. Since he valued providing extensive feedback, Carlos found that grading and providing written feedback took up more time than anticipated. Andy found that students preferred the quick ways of solving a problem rather than what she preferred: the most general (and sometimes technical) way of solving a problem. Across all of them, they discussed the challenge of being both a graduate student attending to their coursework and an instructor attending to their students' learning.

Norms largely refer to the rules and expectations with respect to behaviors (Homans, 1966). For this context, norms referred to rules and expectations which govern discussion in the classroom (Cobb, Yackel, & Wood, 1992). All these GSIs faced challenges on what to attend and emphasize in discussions: algorithms versus conceptual ideas and rigor/technical language versus intuition. In Jacob's case, he preferred to interpret students' full understanding of a concept in the class; always responding with "explain your thought process" to a student's answer. But the online exams of his convened course emphasized correct execution of algorithms to input answers in a box. As mentioned before, Andy preferred rigorous explanations as opposed to quick shortcuts, and she learned quickly that intuition is as important as rigor was. As for Carlos, his students expected him to expand on student's answers. For example, Carlos' students might present their final answer to the class, but it became an expectation (according to Carlos) that Carlos would expand on the process laid out by the student.

One salient theme that overlaps behavior, value, and norm within the data was the difference between lecturing on the board and talking with individual students during class or in office hours. Each highlighted an awareness that they can explain things better when they do not have to account for the varied array of learning styles across the classroom. Within individual conversations, Andy, Carlos, and Jacob were able to tailor how they spoke to a student. This related to how each GSI valorized discussion in the classroom, and Andy even considered individual conversations as being where true learning happens.

Andy (Week 7 Interview): I tend to rush when I'm at the board, and I think I tend to do things in less detail at the board, as a sort of appetizer, so to speak... It's for people who want to meet some degree requirements, and then, like small groups is actual learning, I suppose.

Analysis resulted in an understanding that, broadly, each cultural aspect of behavior, value, and norm had influence on each GSIs frames in one way or another. For one, being novices influenced their frames of teaching. For example, Andy struggled with her role as the instructor with respect to classroom management, because the behaviors she relied on as a novice instructor focused on lecturing and attending to students' questions. The GSIs' particular attention to silence in the classroom also informed their frames of students' learning. An important aspect of learning, to them, was discussion between students and between instructor and individuals. They all understood that their teaching and their students' learning benefited from smaller group interactions.

The conflicts raised from expectations versus reality, algorithms versus conceptual ideas, rigor versus intuition also informed the GSIs' developing frames. For Carlos, he may have

valued giving extensive feedback to students as part of his frames, but the reality of being a GSI meant he needed to prioritize other aspects of teaching and learning that might be more beneficial to his students. For Andy, coming to terms with the reality that students do not want rigor meant changing what she must do as the instructor in order for students to learn the content promised by the course syllabus. For Jacob, algorithms became something that needed attention alongside the conceptual ideas because of the nature of assessment in his course.

Aspects of Context

Here, I report on the findings which address the concept of ‘mathematics knowledge as property’ as a way to understand the context of teaching mathematics at a PWI. I have opted to keep the discussion and quotes in this section unnamed so as to prevent singling out a GSI. This discussion is not meant to vilify the GSI and their possible contribution to a culture of exclusion. Instead, I focus on how insidious and pervasive these functions or aspects of ‘whiteness as property’ may be in the context of teaching.

In this light, ‘rights of disposition’ materializes in the context of mathematics as treating mathematics as a static body of knowledge which can be given to a person willing to receive it. Therefore, an education in mathematics is simply the passage of knowledge. This was somewhat salient in some GSIs discussion of their role in the classroom as the expert, and skillful instruction entailed flexibility in being able to pass down abstract concepts. However, one GSI added that mathematics as a subject encapsulated many ideas and concepts which cannot be easily essentialized under one definition. They further shared that, beyond just receiving a portion of this large body of knowledge, they hoped their students also learned that:

“[Mathematics] is sort of like a living subject... It wasn’t handed down to us from God, that it was constructed by humans to solve real world problem.”

This spoke towards the collaborative view of teaching and learning these GSIs have, countering ‘the absolute right to exclude’ function of mathematics as property. These GSIs spoke against this function that mathematics could be used to exclude (i.e., a math person versus not). To all of them, learning mathematics involved discussion, participation, and engagement among *all* the students in the classroom. Observations of all GSIs also confirmed their attempt and insistence on every student participating and engaging. This spoke towards their frames of learning in that in order to learn, students must join in the conversation. One GSI made it a goal to teach students how to be “a good classmate” through the mathematics group work they do.

The discussions surrounding their status as novice instructors involved their fear of being perceived as an incompetent instructor. Though it does not directly speak to mathematics as property which afforded them ‘reputation and status property,’ this fear could be interpreted as not having a certain reputation because of mistakes in lecture or answering students’ questions. This spoke towards their frames of teaching; in how they understood their role in the classroom or the expectation of it: a perfect instructor.

Lastly, the function of ‘right to use and enjoyment’ where mathematics can be used to exercise power and enjoy privileges did not surface in the analysis. Instead, it was counteracted by multiple experiences. For one GSI, they wanted to create an “egalitarian” classroom, where everyone is equal and can contribute to how they want to learn. This also spoke against the previous function of property as regardless of one’s previous mathematical background, they were treated as equal to their peers. Another example of countering this function of property was seen in all GSIs’ discussion of honoring students’ preferred way of learning. All GSIs made

changes to their teaching practice as the semester progressed to accommodate students' preferences. One GSI even dedicated time in their time-constrained class to explicitly address the mid-semester evaluations and how changes would be made going forward in the semester. The changes they made also changed their frames of teaching and of student learning, as they learned what interactions or practices they should enact based on students' input.

Discussion

This contributed report aimed to name aspects of culture and context which shape an instructor's way of teaching. As a proxy to understand an instructor's ways of teaching, this report focused on instructor's frames of teaching and learning. Thus, I asked: *What aspects of culture and context were salient in the experiences of mathematics graduate students teaching as instructors for the first time which could be attributed to influencing their frames?*

This report shared some aspects of culture (behavior, value, and norm) which were salient in these GSIs experiences. Behaviors centered on their novice identities and how silence from students was a sign of confusion during work sessions. Values focused on their expectations versus the realities of teaching and how reconciliation had to be made to accommodate these realities. Norms surrounded their conflicts about what to emphasize in discussion. I found that these aspects of behavior, value, and norm overlapped when each GSI discussed their preference in teaching to smaller groups or individuals as opposed to the full classroom.

Moreover, through a lens of critical whiteness study, this report also shared how aspects of context (teaching at a PWI) surfaced in these experiences, either perpetuating or countering the treatment of mathematics knowledge as property. Some GSIs might have conceptualized mathematics teaching as a passing of knowledge, somewhat perpetuating a view of mathematics knowledge as property. However, all of them fervently countered the notion that mathematics knowledge should be used to exclude through their belief that true learning of mathematics occurred in discussions with peers. All the GSIs professed the value in discussions and working together with peers to learn mathematics and enacting practices that valorized collaboration amongst students. I hypothesize that the view of mathematics as a body of knowledge perhaps stemmed from the convened structure of the courses. In other words, the GSIs were handed and asked to teach a course, its curriculum, and its materials with very little say on what is taught and when in each course. There was no evidence from these GSIs of perpetuating the notion that mathematics can be used for reputation or as a conduit to exercise power and privilege.

These aspects of culture and context both influence these GSIs' frames of teaching and of learning. Behaviors, values, and norms shaped the actions they understood as appropriate in the classroom and what their role was in fulfilling their desired learning outcomes for their students. Furthermore, though this analysis did not address all supports of frames, I infer from these findings that GSIs' understandings of the professional knowledge relevant to their course (frames of teaching) and how their course fits into students' academic career (frames of students learning) may also be informed by the values and culture instructors bring into their classroom.

Implications and Future Direction

The main concern of the study was to uncover aspects of culture and context which shape an instructor's way of teaching in order to understand how frames may be shaped or changed. In that light, behaviors, values, and norms were salient aspects of culture which informed instructors' frames of teaching and frames of student learning. Then, attending to inclusive, collaborative practices were salient aspects of context which informed these frames. With these insights, professional development leaders may focus on a combination of behaviors, values, or

norms which shape future instructors' understanding of what their role is in the classroom and how to better attend to equitable learning experiences for their students. Andy, Carlos, and Jacob were privileged in that the courses they taught were convened which provided structure to their teaching, which may have had its impact on the understanding that teaching is an act of passing down a body of knowledge. But this convened structure may have also forced them to attend to more collaboration as that was the emphasized method of instruction during their department's new instructor orientation. Therefore, a departmental or professional development emphasis on collaboration in mathematics courses may be one way to counteract the pervasive nature of the culture of exclusion of mathematics.

The PWI context where this study occurred motivated the exploration of 'context'. In particular, the study approached 'context' through the specific avenue of how 'whiteness as property' or 'mathematical knowledge as property' surfaced in these GSIs experiences. More research in different regions and contexts should be conducted in order to further understand aspects of context which shape frames. These contexts do not necessarily need to use lenses from CRT, perhaps more simple aspects of context may be explored such as the type of course taught (e.g., computation-heavy versus proof-based) or logistical constraints (e.g., 16-week courses versus 10-week).

Lastly, this study built on the growing literature of mathematics GSI development as instructors and their overall experience in graduate school. While the perspective of the GSI is important, it is also not the only one. Experienced instructors, who have been entrenched in their local community and culture, may have drastically different opinions on what aspects of culture and context have shaped their frames of teaching and of student learning. There is much more ground to explore in this area of frames, culture, and context.

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