Understanding Instructors' Beliefs and Obligations within Cultures of Exclusion

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We present a study of how five early-career college math instructors using active learning describe their role as instructors and situate these descriptions in two existing theoretical frameworks: Herbst and Chazan's theory of practical rationality and Louie's culture of exclusion. This overlayed theoretical perspective, grounded in our case studies, points to levers for faculty professional development and instructional change.

Keywords: Beliefs, Equity, Active Learning, Instructor Development, Professional Obligations

While the general pedagogical category of "active learning" in college mathematics classrooms is widely regarded to be better for student learning than traditional lecture (Conference Board of the Mathematical Sciences, 2016; Freeman et al., 2014; Theobald et al., 2020), many questions remain in how to best support college math instructors to adopt such practices, and carry them out to most successfully and equitably support student learning. We take it as given that instructor practices and beliefs have important and nuanced interactions in their effects on student learning. Thus, learning environments are improved by attending to both instructor beliefs and practices. The goal of this particular study is to better understand some of the beliefs held by instructors using active learning (in this case, beliefs related to how they view their role as an instructor), while recognizing that these beliefs are pieces of a more complex instructor ecosystem. Our research questions are the following:

> RQ1: How do early-career math instructors using active learning describe their role as instructors?
>
> RQ2: What professional obligations and aspects of the culture of exclusion are present in these descriptions?

Literature Review

Numerous studies across STEM fields have investigated instructor beliefs (Czajka & McConnell, 2019; Luft & Roehrig, 2007; Moore et al., 2015). Scholars working with post-secondary mathematics instructors have attempted to categorize instructor beliefs while establishing connections to their teaching practice, particularly those related to active learning (Päuler-Kuppinger & Jucks, 2017; Raychaudhuri & Hsu, 2012; Vishnubhotla et al., 2022). Päuler-Kuppinger and Jucks (2017) found that scholars in "hard disciplines," like mathematics, are more likely to have a static understanding of knowledge that corresponds with content- or teacher-centered teaching methods. The findings of Raychaudhuri and Hsu (2012) complicate those of Päuler-Kuppinger and Jucks (2017) in that instructors held ontological views of mathematics as a connected and deep discipline that conflicted with their teacher-centered, behaviorist pedagogical views. Vishnubhotla and colleagues (2022) found that in investigating instructors' practices when utilizing inquiry-based learning (IBL) approaches, instructors who believed that lecture positively contributed to learning were more likely to emphasize lecture in their IBL instruction. These findings reflect earlier claims regarding the relationship between beliefs and practice in mathematics teaching more broadly.

Previous findings, such as Leatham (2006), pushed for researchers to study beliefs in ways that aim to build connections between beliefs and view them as sensible systems. Ernest's earlier work (1989) enhances this notion as he asserts that connections or inconsistencies between beliefs and practice can be explained not only by how the instructor relates their beliefs to one another, but also the amount of awareness an instructor has of their beliefs and the institutional systems that surround the instructor. These claims are consistent with Thompson (1992), who argued that the relationship between beliefs and practice is complex and influenced by factors including instructors' views regarding the nature of mathematics as well as instructors' interaction with social and political contexts. These claims complement those of Speer (2005) who summarizes these conceptualizations of beliefs well: "Beliefs appear to be, in essence, factors shaping teachers' decisions about what knowledge is relevant, what teaching routines are appropriate, what goals should be accomplished, and what the important features are of the social context of the classroom" (p. 365).

While the previously referenced findings (Päuler-Kuppinger & Jucks, 2017; Raychaudhuri & Hsu, 2012; Vishnubhotla et al., 2022) focus on individual factors that shape teachers' decisions without taking into account much of the surrounding context, several scholars have emphasized the importance of *context* in understanding the relationship between beliefs and practice (Ernest, 1989; Speer, 2005; Thompson, 1992). Johnson and colleagues (2019) examined how individual and situational factors influenced the instructional practices of mathematics instructors. They found that individual factors, such as personal beliefs, were more likely to explain instructional differences across instructors than situational factors. Interestingly, Johnson and collaborators chose not to investigate how situational factors influenced the individual factors (beliefs, knowledge, and goals) for instructors. Several other studies investigate this problem through what Herbst and Chazan (2012) refer to as practical rationality, who argue that the justifications teachers use for their beliefs and practices can be understood by investigating their professional obligations to their content discipline, individual students, interpersonal interactions in the classroom, and institutions such as departments, schools, and districts. Scholars in post-secondary mathematics education have taken up this work, particularly as it pertains to active learning (Mesa et al., 2020; Shultz, 2022).

In the context of mathematics education, Louie (2017) argues that the dominant culture of exclusion is likely to influence the beliefs, knowledge, and skills of individual teachers. Across several studies, Louie (2017, 2018) and colleagues (2021) have shown that the culture of exclusion in mathematics, characterized by narrow definitions of mathematical activity and ability, prevents teachers and instructors from enacting instructional practices in ways that disrupt existing inequities. This applies to current efforts to understand instructor beliefs about active learning in two ways. First, it further supports the notion that focusing on individual beliefs without considering broader context is insufficient. Second, when examining contextual factors such as professional obligations, it is crucial to view these obligations as being embedded within the culture of exclusion. In doing so, professional obligations become potential reproducers or disrupters of the culture of exclusion. We will argue later that understanding the beliefs of instructors via their professional obligations within the culture of exclusion allows us to identify potential levers through which we can influence instructors' active learning practices in a direction that is inclusive and equitable.

Theoretical Framework

Our investigation assumes a complex interaction of instructor practices and beliefs, and also situates these interactions in an ecosystem that includes contexts with obligations, as well as the

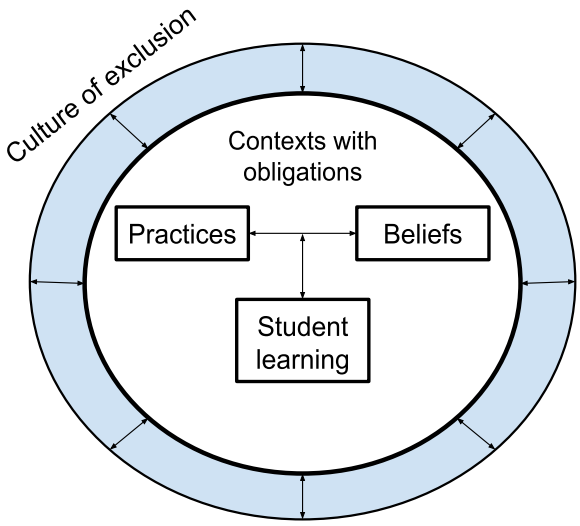

Figure 1. Illustration of theoretical framework

pervasive culture of exclusion (see Figure 1). From the extant literature, we conceptualize beliefs as factors influencing teachers' decisions regarding teaching and learning, consistent with Speer (2005). This conception of beliefs is in line with Leatham's (2006) in which the emphasis is not on the strength of the beliefs but rather their connections to the individuals' other beliefs and practices.

We also contend that an instructor's beliefs are informed by the professional obligations (Herbst & Chazan, 2012) with which they contend. Herbst and Chazan (2012) name four obligations: disciplinary, individual, interpersonal, and institutional. We see these four obligations as being situated within the culture of exclusion (Louie, 2017), which is characterized by narrow views of mathematical activity and ability. Each of the professional obligations has the opportunity to resist or reinforce the culture of exclusion. Figure 2 adapted from Louie (2017, p. 496) with obligation descriptions from Herbst and Chazan (2012), illustrates our proposal for how this might occur.

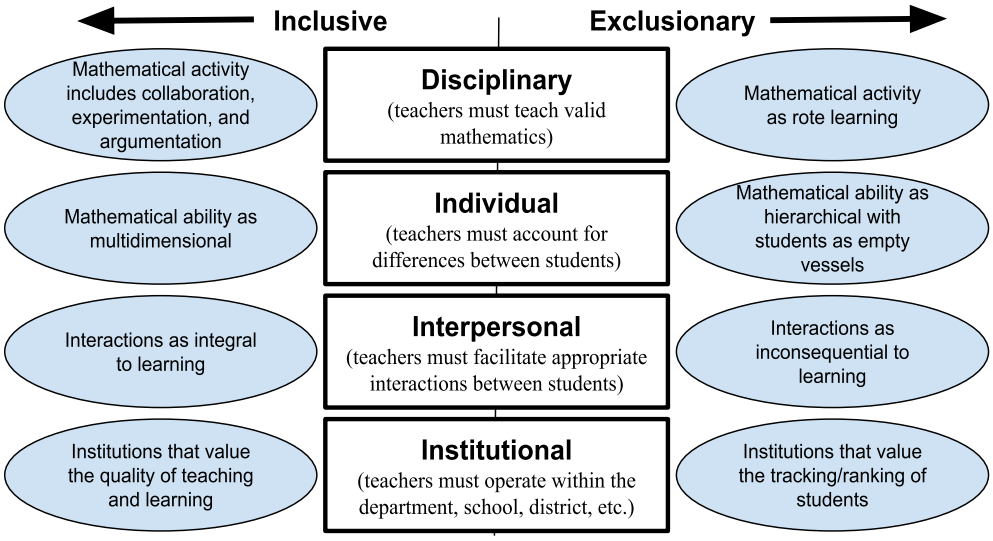

Figure 2. Relationships between professional obligations and the culture of exclusion

Data and Methods

Researcher Positionality

The first author is a white woman with a PhD in mathematics, who grew up in an income-secure household. These identities affect her worldview, often implicitly. Her personal goals as a college math instructor, faculty developer, and math education researcher are to create rich, supportive, and affirming learning experiences in college mathematics classrooms, especially for students who have been historically marginalized in mathematics; these goals explicitly affect her research questions and analyses. The second author is a white man who is a former secondary mathematics teacher and current PhD candidate in mathematics education. His commitments to equity and justice in education ground his approach to research, albeit from the limited perspective of a person with multiple privileged identities.

Participants

This study focuses on early career faculty (graduate students and postdoctoral fellows). The reasons for this are (1) this is a population with more malleable beliefs (Ellis, 2014); (2) this population is responsible for a meaningful percentage of college math courses taught (Ellis, 2014); (3) understanding beliefs of more novice instructors, in particular, yields insights into an important stage of belief development; (4) at the institution of this study, these instructors were overwhelmingly the population teaching with active learning. We invited eight postdocs, representing a wide range of pilot survey responses, to be interviewed; seven agreed to be interviewed. In contrast, the eight graduate student participants were selected on a volunteer basis via a departmental graduate student listserv. Out of those fifteen, we focus on the responses of five in this paper. Those five include four graduate students (two white women and two white men) and one post-doc (a white man), all of whom teach small sections (< 24 students) in multi-section coordinated courses (18 - 100 sections).

Interviews and Analysis

The interviews (15-30 minutes) included three questions adapted from the TBI instrument (Luft & Roehrig, 2007) designed to elicit important instructor beliefs: (Q1) How do you maximize student learning? (Q2) How do you describe your role as an instructor? (Q3) How do you know students are learning? Interview audio was transcribed using rev.ai, and cleaned for accuracy and anonymity. Among responses to Q2 was a surprisingly common response of "coach" (n=5) to describe their roles as an instructor. For the scope of this short paper, we restrict our attention to that recurring metaphor. The first author identified various sub-meanings of "coach" using open coding (Corbin & Strauss, 1990), then refined those meanings through discussions with the second author. The theoretical frameworks described above were not used to create these categories of meanings, but to understand their implications (see next section).

Results

In this section we characterize four different meanings underlying participants' use of the metaphor of coach to describe their role as instructors. We illustrate how each meaning alludes to particular obligations (Herbst & Chazan, 2012), while exploring whether those obligations are leveraged in a way that perpetuates or resists the culture of exclusion (Louie, 2017).

Responsive Supporter (n=4). *...providing responsive support to students; for example, by giving hints when needed or meeting with students one-on-one.* Our examples of this role draw primarily on the obligation to the individual because the interviewees described back and forth

interactions with individual students, giving hints and asking questions; however, there is an implicit obligation to the discipline because the descriptions are focused on getting students to a mathematically correct answer. For example, one participant said: "When they are struggling on something, I try to, you know, give tips in some sense….But…sometimes it's more of leading questions, things like that." Another said: "[I] really try to, you know, fill in gaps in knowledge, that kind of thing." That is, instructors describe responsively interacting with individual students to correct misconceptions and fill in "gaps in knowledge"—disciplinary obligations. Although these are certainly caring instructors, we view both obligations implicit in this role—individual and disciplinary—as being leveraged in ways that perpetuate an exclusive (or dominant) framing of mathematics teaching. The *lack* of attention to the classroom community implies that interactions between students are relatively inconsequential to the instructor. Further, the goals of these interactions presuppose that the student is (mostly) an empty vessel, and the instructor is the knowledge-giver. While Responsive Supporters do acknowledge students as having some knowledge to be built upon, they do not describe their role as instructors as drawing out what students know, or making connections to students' prior knowledge; rather, these instructors describe their role as to correct and redirect, highlighting students deficits rather than assets.

Skill Builder (n=3). *...helping students to build skills beyond the content, such as studying for exams, or approaching non-routine problems.* Our examples of this role draw primarily on two sources of obligations: individual and institutional. Descriptions refer to characteristics of students and their needs, not fostering a community or supporting interpersonal interactions, as seen in the following quotation: "I mean a lot of these students are freshmen … this is the first math class they're taking. So a lot of what they encourage us to do…is really trying to instill good, not just math study habits…but…taking exams in general." We also see in the previous quotation two distinct references to institutional obligations: (1) the instructor is enacting what "they encourage us to do" and (2) what's being encouraged is to help students succeed on the institutional measure of exams. Some respondents mention "problem-solving" or "learning from your mistakes", which sound like a disciplinary obligation—how you *do* mathematics. However, when they expand more on what this means in their setting, we saw responses such as the following: "Cause you know, a lot of times, particularly in… that course when you're…solving problems that are about, like, justifying your answer, a student could have a correct numerical answer, but lose points because they didn't provide adequate justification for it. And so it's really important to look at where you've lost points on the other stuff..." That is, the "learning from mistakes" this instructor describes is less about actual mathematical learning, and more about learning to meet institutional expectations.

Preparer (n=3). *...helping students face a challenge on their own, that the instructor has no control over, such as a common exam.* This is distinct from the above role in that it is exam-preparation specific, and less about general skills. However, like Skill Builder above, this role leans heavily on both individual and institutional obligations. The institutional obligation is the more overt obligation in this case, since this role is explicitly about conforming to institutional expectations around exams. However, we also clearly see instructors' obligations to the individual, wanting their students to succeed, in quotations like this one, "You are kind of like trying to get them to the point where they are prepared for this as much as possible...Like they are…being prepared by you in order to [perform] in some situation and you have some amount of, like, personal stakes in it and you really do want to see them succeed." In the previous quotation as well as the following, we also see that the instructor and students are working as a team to overcome this hurdle: "There's going to be, there's going to be this

exam...some adversary that we're all gonna work hard and practice together to get through together," though the consequence of low scores for the instructor are certainly less grave than for the students. Like the Skill Builder examples, it is caring and invested instructors who describe their role in this way. Nevertheless, in the Preparer meaning of the "coach" metaphor we see the iron grip of the institutional obligation to the common exam as supporting a narrow definition of mathematical activity and performance; this exclusionary frame is then also transferred to the individual obligation, by attending to the training and performance of individual students.

Cheerleader (n=2). *... a role of encouragement and emotional support.* Finally, our examples of Cheerleader most explicitly draw on obligations to individuals. However, when this instructor describes her role as "helping build people back up cause it's pretty common for people to have the first exam tear them down and then to, you know, help them get back on their feet and do well on the rest of the semester, which is totally possible," we also see an important underlying institutional obligation. This moral support is in the service of helping students navigate institutional structures and expectations. Rather than affectively supporting student joy around mathematics, we see her affective support as helping students recover from exam-induced trauma. That is, both obligations here are serving the culture of exclusion, rather than resisting it.

Discussion

Our first observation from the roles and obligations above is the absence of the interpersonal obligation. This is surprising given an obvious role of a "coach": helping a team learn to play together. While the role of helping students work together showed up in the larger dataset, it is not part of what instructors meant when they referred to themselves as a kind of "coach". Also notable is that only the role of Responsive Supporter seems particularly specific to an active learning environment, indicating that many components of how an instructor views their role in a college mathematics classroom transcend specific modalities.

Grounded in our observations from our case study of "coach" meanings above, we hypothesize that obligations to the individual, institution, and discipline may have a tendency to perpetuate the culture of exclusion. And, though missing from our sample, we hypothesize that beliefs derived from an interpersonal obligation may more naturally resist the culture of exclusion, since a defining characteristic of an *inclusive* frame towards mathematics learning is seeing "interactions and interpersonal relationships as integral to learning" (Louie et al., 2021, p. 101). These hypothesized tendencies are depicted in Figure 3. It's important to note that the obligations leveraged in our sample straddle this inclusive/exclusionary divide. However, despite some aspects of resisting the culture of exclusion—using groupwork at all, primarily using conceptual tasks, acknowledging that students come with some mathematical resources—the stronger forces (as described above) are in the exclusionary direction.

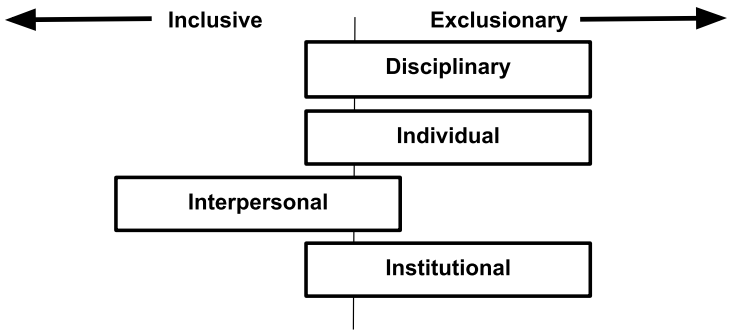

Figure 3. The tendencies of obligations to be inclusive or exclusionary based on case data

Suggestion 1: Reform the Obligation

Our suggestions refuse to view instructors as purely individual actors; rather they are embedded in cultures and institutions that must be considered as central to any change efforts. Our first suggestion follows from Webel's and Platt's (2015) strategy of leveraging existing instructor obligations (Herbst & Chazan, 2012) to effect positive change in practice. We layer onto their suggestion a need to reflect on how such obligations may readily sustain (or resist) the culture of exclusion (Louie, 2017, 2018). Take, for instance, Mesa and colleague's finding (2020) finding that coordinated courses may be an especially salient source of instructor obligations. Layering upon this finding a focus on framing surfaces a new question: how can features and structures of a coordinated course create obligations that *resist* the culture of exclusion, rather than perpetuate it? A requirement or expectation to use groupwork is one example of an institutional obligation that may help point instructors' beliefs and frames in an inclusive direction; but as we discuss in Suggestion 2, that expectation alone is not sufficient. Using coordinated course structures to resist the culture of exclusion may include both breaking down structures that perpetuate exclusive frames (e.g. curved grading schemes designed to rank students, timed exams that valorize correctness and speed) and simultaneously building more inclusive structures (e.g., course grade components that give credit for revising mistakes on exams and homework) and inclusive messaging (e.g., "exit tickets" at instructor meetings that ask instructors to reflect on the many different ways students were "good at math" in the last week).

Suggestion 2: Magnify the Interpersonal obligation

Another implication of our hypotheses is that a source of resisting the culture of exclusion may lie in magnifying instructors' obligations to interpersonal sources. For example, in coordinated courses using groupwork, instructors may settle on the sole purpose of groupwork as being "students do" rather than "students do together," unless course coordinators facilitate explicit, reflective conversations to illuminate the intended benefits of groupwork. A belief that groupwork is valuable simply for its hands-on nature (without respect to its collaborative nature) values student-instructor interactions, but fails to value student-student interactions.

Study Scope and Limitations

The sample size of the overall study (n=15) and the sub-sample presented here (n=5) can in no way characterize college math instructor beliefs across the United States; this is not our goal or claim. A second important limitation of this study is that we have no connection between these professed instructor beliefs and their classroom practices. Relatedly, we are applying an interpretive lens to this instructor discourse, that is colored by our experience as researchers and instructors.

Conclusion

By examining instructor beliefs through the frameworks of obligations and the culture of exclusion, we have pointed to two foci for instructional change: (1) examining the frames surrounding professional obligations with the ultimate goal of reforming obligations themselves to better resist the culture of exclusion; (2) magnifying professional obligations, such as the interpersonal obligation, that may more naturally and readily resist the culture of exclusion. We do not take it for granted that active learning modalities support equity simply by being hands-on; rather, in any pedagogical modality we must interrogate practices, beliefs, and obligations to best support a culture of inclusion.

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