

The Culture of Exclusion in Mathematics Education and Its Persistence in Equity-Oriented Teaching

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In this article, I investigate the influence of the dominant culture characterizing mathematics education—which I term the *culture of exclusion*—on efforts to teach for equity. Analyzing a year of observations in an urban high school mathematics department, I found that this culture structured everyday instruction even for teachers who expressed strong commitment to equity and who participated in ongoing equity-oriented professional development. Through their classroom practice, the 4 focal teachers in this study often framed mathematics as a fixed body of knowledge to be received, and they positioned students as deficient, unintentionally excluding many students from rich learning opportunities. However, these teachers also asserted alternatives to the culture of exclusion, showing how resistance to this culture might take shape in everyday mathematics instruction.

Keywords: Equity; Frame analysis; Teacher learning

For centuries, a distinctive culture has characterized mathematics education in the United States. Within this culture, the teacher’s task is to state rules, present examples, and pose exercises that are quite similar to the examples. Textbooks ranging from Pike’s *Arithmetic* (originally published in 1788, making it America’s first major mathematics textbook) to *Saxon Math* (Hake, 2012) follow this structure exactly. Numerous studies, beginning with Joseph Mayer Rice’s (1893) groundbreaking survey and continuing up to the present (e.g., Schoenfeld, 1988; Stigler & Hiebert, 2009; Webel & Platt, 2015), have found that mathematics instruction typically proceeds according to this template. The corresponding role for students is to listen carefully and follow directions with speed and precision to compute answers to formulaic problems (Boaler, 1998; Boaler & Greeno, 2000; Cobb, Gresalfi, & Hodge, 2009; Rice, 1893). This way of framing mathematics learning largely omits the sense making, experimentation, communication, and

The research discussed in this article was supported by grants from the University of California, Berkeley; the Institute for Education Sciences predoctoral training Grant R305B090026 to the University of California, Berkeley; and a fellowship from the Spencer Foundation. The views expressed are those of the author and do not represent the views of the funding organizations. Alan Schoenfeld, Evra Baldinger, and the editor and anonymous reviewers at *JRME* provided constructive feedback on versions of this manuscript. The author also wishes to thank the teachers whose work is partially represented here.

creativity that play prominent roles in the formal discipline of mathematics (Lakatos, 1976) and in calls for school mathematics reform (e.g., National Council of Teachers of Mathematics, 2000; National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010). Narrow definitions of mathematical activity also exclude many individuals, making it natural to see those whose ways of thinking and knowing do not neatly correspond to these definitions as irreparably “bad at math” and ignoring strengths that are relevant to a more broadly conceived mathematics (Boaler & Staples, 2008; Featherstone et al., 2011). Thus, the restrictive and hierarchical culture that has historically dominated American mathematics education—which I term the *culture of exclusion*—limits all students’ access to rich and meaningful mathematics learning experiences and further limits many students’ opportunities to develop identities as mathematically capable learners and thinkers.

The effects of the culture of exclusion in mathematics education are not limited to mathematics classrooms. Unlike ability in many other disciplines across the arts and humanities, mathematical ability is seen as “a foundational component or proxy for intelligence” (Clark, Johnson, & Chazan, 2009, p. 49). Through the lens of the culture of exclusion, students who appear mathematically gifted are viewed as intelligent, whereas others are myopically perceived as “slow,” “remedial,” and “special needs.” These perceived differences are used to justify stratification such that the culture of exclusion in mathematics education shapes access to intellectually stimulating learning opportunities, prestigious educational programs, lucrative careers, and high-status identities. Furthermore, because ability categories are mapped onto other socially constructed categories, the culture of exclusion is both a product of and a tool for the maintenance of racial, gender, linguistic, economic, and other hierarchies (R. Gutiérrez, 2002; Martin, 2009). Thus, one of the “grand challenges” facing the mathematics education community is the task of “changing perceptions about what it means to do mathematics” and, with it, perceptions about who can do mathematics, as Stephan et al. (2015, p. 139) have suggested in the pages of *JRME*.

This article emerged from a study that investigated the practice of equity-oriented mathematics teachers who expressed commitment to expansively redefining what counts as “good at math” and who can have this status (see also Louie, 2015, 2016, 2017). The central question of this article is: How does the culture of exclusion affect the classroom instruction of mathematics teachers who explicitly aim to advance equity?

Background: The Dominant Culture of Mathematics Teaching in the United States

Drawing on hundreds of observations in nine different countries, Stigler and Hiebert (1998, 2009) concluded that teaching is “a cultural activity”: “Much of what happens in the classroom,” they wrote, “is determined by a cultural code that functions, in some ways, like the DNA of teaching” (Stigler & Hiebert, 2009, p. xii). Without neglecting teachers’ agency or the existence of teaching that

diverges significantly from the norm (e.g., Boaler & Staples, 2008; Lampert, 2001), I argue here that a cultural code does indeed govern mathematics teaching and that exclusion is central to this code. Here, I describe two interconnected dimensions of this exclusion: (a) exclusion from meaningful engagement with disciplinary ideas and practices through narrow definitions of mathematical activity and (b) exclusion from positive identities as learners and doers of mathematics through narrow and hierarchical definitions of mathematical ability. I ground my discussion in the metaphor of mathematics learning as travel on a single “narrow path” along which learners are supposed to acquire progressively more complex pieces of knowledge (Parks, 2010). Research has shown that mathematics learning does not always occur in a linear and hierarchical fashion; for example, a number of studies provide evidence that young children can understand and produce algebraic generalizations before they have learned their times tables (Blanton & Kaput, 2011; Carraher, Schliemann, Brizuela, & Ernest, 2006). In addition, mathematics encompasses a multiplicity of ways of thinking and understanding; it is not a unified, monolithic body of knowledge (Boaler & Staples, 2008; Ernest, 1991). However, the metaphor of the narrow path continues to permeate mathematics education discourse, from preservice teacher education and in-service teacher talk to published textbooks and policy documents (Parks, 2010).

Narrow Definitions of Mathematical Activity

Along the narrow path, students are typically excluded from generating and even making sense of mathematics. Instead, they are restricted to receiving theorems, formulas, and other prepackaged mathematical knowledge (as found by, e.g., Boaler & Greeno, 2000; Cobb et al., 2009; Gresalfi, Martin, Hand, & Greeno, 2009; Schoenfeld, 1988). For example, students in Boaler and Greeno’s (2000) interview study described mathematics as a subject in which “there’s only one right answer and you can, it’s not subject to your own interpretation or anything it’s always in the back of the book right there” (p. 179) and “you have to memorize these little steps, there’s always an equation to solve something and you have to memorize stuff in the equation to get the answer and there’s like a lot of different procedures” (p. 181). These students had learned that mathematics is a collection of procedures and answers to be presented by the textbook or teacher. They had also learned that their role should be limited to memorizing and executing the procedures they had been shown in order to arrive at the answers sanctioned by the textbook’s or teacher’s authority.

Narrow Definitions of Mathematical Ability

The narrow path as a metaphor for learning in turn produces hierarchical metaphors for learners. If learning is essentially a process of absorbing and accumulating knowledge along a trajectory from basic to advanced, then some students seem clearly ahead, some on track, and others behind (Parks, 2010). These positions are understood as manifestations of students’ aptitude, as in a statement made by one of Parks’ interns: “What do you do with a 2nd-grader who’s really awesome

in math—who’s really *far ahead* of everyone else?” (p. 84). It is assumed that students who are “ahead” are “awesome in math” and are naturally or at least unalterably more capable than their peers. This ideology makes persistently unequal mathematics achievement appear normal, even inevitable. It excludes many students from the realms of those who are “good at math,” positioning them instead near the bottom of hierarchies of mathematical ability.

Hierarchies of mathematical ability are especially problematic because they are made to coincide with other social hierarchies. A “racial hierarchy of mathematical ability” (Martin, 2009, p. 310) for example, constructs African Americans, Latinxs,¹ and American Indians as academically and intellectually inferior to Whites and some Asians (Shah, 2017). More work is needed to illuminate the intersections of mathematical identities and identities that are racialized, gendered, classed, and (dis)abled, but it is clear that hierarchies of mathematical ability do not apply in a neutral or just way across all people but rather serve to reproduce other social hierarchies (R. Gutiérrez, 2002; Oakes & The RAND Corporation, 1990; Shah, 2017).

Reproduction and Alteration: How Culture Is Lived

Culture is often treated as a template for human behavior. Taking a particularly extreme stance, Durkheim (2013) wrote that

Collective ways of acting and thinking possess a reality existing outside individuals. . . . The individual encounters them when they are already completely fashioned and he cannot cause them to cease to exist or be different from what they are. (p. 45)

Studies revealing the stability of educational practice in the face of reforms would seem to confirm this perspective (e.g., D. K. Cohen, 1990; Tyack & Cuban, 1995). But the link between culture and activity is not unidirectional; moment-to-moment activity is simultaneously born from and gives birth to culture (González, 2005; K. Gutiérrez & Rogoff, 2003; Saxe, 2012). Cultural ways of noticing, interpreting, and doing shape the possibilities for thought and action that are available at a given time and place, but through their interactions, people alter as well as reproduce cultures.

Frames and Framing

One way that culture writ large is negotiated from moment to moment is through the active process of *framing*. Sociologist Erving Goffman (1974) described frames as interpretive contexts that communicate to participants in any situation an answer (or answers) to the question, “What is it that is going on here?” In learning settings, this includes information about what kinds of knowledge and skills are required and expected to be produced as well as information about how

¹ The term “Latinx” is used to communicate the fluidity of gender identification and is an alternative to the masculine “Latino” and to “Latin@,” which maintains a masculine and feminine binary.

participants are expected, entitled, or obligated to act (Greeno, 2009; Hammer, Elby, Scherr, & Redish, 2005). For example, the “doing school frame” discussed by Hand, Penuel, and Gutiérrez (2012) assigns students “rather passive roles,” framing their task as recall and answer-getting (p. 256). Hand et al. (2012) contrasted this with the “productive disciplinary engagement [Engle & Conant, 2000] . . . frame,” which “involves students in authoring, justifying, and disputing ideas and procedures in a discipline in order to further collective sense-making” (p. 256; cf. Engle, 2011).

Ways of framing that are repeated time and time again thicken and become the default to which participants automatically orient themselves. In this respect, dominant frames are not unlike the “practical rationality” that undergirds any practice (Herbst & Chazan, 2003, 2011). As Herbst and Chazan (2003) have described it, practical rationality “regulates how instances of the practice are produced. . . . And, often, practical rationality also erases its own tracks, making practitioners believe and make believe that these practices themselves are ‘natural’” (p. 2). Thus, the majority of framing activity that takes place in moment-to-moment interaction reflects and contributes to the dominant culture without anyone’s conscious awareness or intention. Examining the tacit framing or rationality behind teaching mathematics is therefore important; it allows the field to better understand obstacles to as well as leverage points for change.

Reframing

Framing can be a fully conscious, deliberate activity, as when people work to unsettle the dominant culture by asserting alternative frames. For example, educators may strive to alter the culture of exclusion by actively “reframing” mathematics teaching and learning in ways that expand students’ opportunities to learn (Hand, Penuel, & Gutiérrez, 2012, p. 265). The case of the Railside High School mathematics department shows that this is possible (Boaler, 2008; Boaler & Staples, 2008; Horn, 2007; Nasir, Cabana, Shreve, Woodbury, & Louie, 2014). At Railside, teachers used a pedagogical approach called Complex Instruction (CI; see E. G. Cohen & Lotan, 1997, 2014; Tsu, Lotan, & Cossey, 2014) to transform their practice, creating “multidimensional classrooms” in which many dimensions of mathematical activity—represented by behaviors such as “asking good questions, rephrasing problems, explaining well, being logical, justifying work, considering answers, and using manipulatives”—were critical for success (Boaler & Staples, 2008, p. 629). This in turn created opportunities for students with different strengths to “contribute ideas and feel valued” (p. 629). Boaler and Staples (2008) contrasted this with the “unidimensional” classrooms in the other, more typical schools that they studied, classrooms in which one practice was “valued above all others”: “executing procedures (correctly and quickly)” (p. 629). In those classrooms, the “narrowness by which success [was] judged” supported some students to “rise to the top of classes, gaining good grades and teacher praise, whilst others [sank] to the bottom” (p. 629). Students in Railside’s multidimensional classrooms

outperformed their peers at the other schools, and they reported greater enjoyment of and interest in pursuing mathematics (Boaler & Staples, 2008).

Railside's example illustrates that the culture of exclusion can be displaced. However, such displacement is no simple task. As Hand et al. (2012) observe, innumerable "cues [take] place in moment-to-moment interaction that preserve the hegemony" of the dominant culture (p. 260). The point of dominance is that it provides the default context for any given activity, so that any particular move is likely to be understood in terms of dominant frames. For example, a teacher telling students to "work in your groups and help each other out" might wish to reframe mathematical knowledge as something that students actively construct not by listening to an expert but by working together. Alternatively, she might mean that students who are more capable should help their less capable peers, assimilating group work (a strategy often associated with reform) to the culture of exclusion. Either way, what students hear will be influenced by their past experiences. The historical dominance of the culture of exclusion makes a hierarchical interpretation sensible and automatic while rendering alternative interpretations invisible. To deliberately shift this or any culture requires strong and consistent signals "that the predominant cultural frame is no longer at play" (Hand et al., 2012, p. 260). Thus, it is entirely possible for actors (such as teachers) to invoke nondominant frames without meaningfully altering the dominant culture by layering dominant frames over alternatives in such a way that the alternatives are barely visible.

Teachers themselves may struggle to step outside of dominant frames to see alternatives. Decades of work have gone into the development of conceptual and material tools for enacting the culture of exclusion, including informal and official ability categories (e.g., gifted, regular, special, and low), procedurally oriented textbooks, and standardized testing schemes. These tools mediate teachers' understanding and enactment of their practice so powerfully that teachers may intend to adopt new frames (e.g., shifting from traditional frames of mathematics education to reform frames) and even think that they have succeeded in doing so when in fact the changes they have made are sensible only within the old frames (e.g., D. K. Cohen, 1990; Horn, 2007; Webel & Platt, 2015).

Method

Research Setting

This article reports on a study that was conducted at a school called Union High (all school, teacher, and student names are pseudonyms), located in a large urban district in the western United States. The school was racially diverse, with significant Latinx, Asian, Asian American, and African American populations but few White students (under 10%). More than half of the students were classified as English learners, and almost three quarters were classified as socioeconomically disadvantaged. The school struggled with state mathematics tests, with fewer than 20% of students meeting the standards for proficiency in 2012.

I selected the school because its faculty shared a mission of serving underserved students and because mathematics teachers in particular expressed appreciation and pride in their solidarity around that mission. Additionally, within the district, Union's math team was seen as a stronghold for CI, and the entire mathematics department was participating in an equity-oriented, CI-based professional development (PD) program offered by their school district. As mentioned above, CI is a pedagogical approach that directly challenges the culture of exclusion, framing mathematics as a rich and multidimensional subject and positioning students with diverse strengths as intellectual contributors. Ideas and practices developed at Railside High, where teachers' work was grounded in CI principles, formed the basis for much of the PD.

The district supported teachers' engagement with CI in numerous ways. Instructional coaching and workshops throughout the year were designed to support teachers in questioning their assumptions about mathematics teaching and learning. These activities were also designed to help teachers develop pedagogical knowledge for "treating status"—in other words, for leveling hierarchies of perceived ability and worth. In this vein, all of the teachers in the study had many opportunities to learn instructional strategies associated with CI, such as *assigning competence*, using *multiple-ability orientations*, and designing *group-worthy tasks* (all referenced below; see, also, E. G. Cohen & Lotan, 2014). In addition, the district provided support for teacher collaboration, and mathematics teachers at Union had multiple opportunities each week to work together on curriculum and instruction. They typically met once a week as a department and once a week in course teams.

This study focused on the Geometry Team. In the year of the study, all freshmen were placed in Geometry, regardless of whether or not they had passed an algebra course. This change stemmed from the teachers' wish to position all of their incoming ninth-graders as mathematically capable, a goal that had been undermined by tracking some freshmen into Geometry and others into Algebra (the latter being a lower status course). Geometry courses thus offered a unique opportunity to examine teachers' efforts to disrupt the culture of exclusion.

Participants

Out of the 13 mathematics teachers at Union, I recruited four to serve as focal teachers: Ryan, William, Cyril, and Luke. These teachers were selected to capture range along two dimensions: length of time in the classroom and leadership roles with respect to CI. William and Cyril each had 10 years of experience in teaching mathematics, whereas Ryan and Luke were both in their second year of teaching. William and Luke positioned themselves primarily as novices with respect to CI, although William was a veteran and a leader in the math department. In contrast, Cyril positioned himself as a CI expert; he had been part of the district's first cohort of teachers in CI PD 3 years prior, and he had taught alongside a former Railside teacher for 2 years. Ryan was viewed as a CI expert by many of his

colleagues in the district because he had spent a full year at Railside as a student teacher.

Data Collection

I observed each focal teacher's Geometry classes four to eight times over the course of the 2012–2013 school year, as close to once a month as schedules would allow. I also observed routine meetings of the math department and the Geometry Team as well as CI PD sessions. I was therefore with the teachers multiple times each week, and I got to know their practice in different settings and from multiple perspectives. The lessons that I observed appeared to typify each teacher's instruction (rather than representing special lessons for a visitor), as was my goal. Audio recordings, field notes, and photographs of whiteboard inscriptions, worksheets, and other artifacts were produced for each observation. Classroom observations were designed to investigate teachers' framings of (a) what it means to be mathematically capable and (b) who is or can become mathematically capable. Field notes therefore focused on what behaviors teachers explicitly valorized and from which students, the character and distribution of cognitive demand, how teachers addressed confusion and disengagement, and how teachers managed students' interactions with one another. Audio recordings captured whole-class discussions and teacher–student interactions during student work time. All audio recordings were transcribed.

Data Analysis

I aimed to understand each teacher's practice both on its own terms and in the context of broader social phenomena. My initial pass through the transcripts from classroom observations investigated how teachers framed the nature of mathematical activity (i.e., what it means to do mathematics) and the nature of mathematical ability; for this initial pass, I did not attempt to fit teachers' ways of framing into any predetermined scheme. To develop focused codes, I coordinated ways of framing that had surfaced in that initial pass with frames that were documented in the literature (discussed above in association with the culture of exclusion on the one hand and CI and Railside on the other). The italicized text in Table 1 represents the resulting matrix of frames.

In examining framing, I was not concerned with what teachers intended to convey. The intentions of the specific teachers in this study are important in the context of this article's overarching question of how the culture of exclusion affects teachers' efforts to teach for equity; that is, their practices would have a different kind of significance if the teachers had viewed equity issues as irrelevant to their practice or if they had seen themselves as powerless in the face of inequity. However, the ways that teachers' practices actually function may not align with their intentions, and such lack of alignment does not make the frames at play any less significant for students. For example, teachers rarely if ever intend to communicate that students' ideas about mathematics do not matter, yet they frame such

Table 1
Ways of Framing Mathematics and Mathematical Ability

	Exclusionary	Inclusive
The nature of mathematical activity	<p><i>The rote practice frame</i></p> <p><i>Mathematics is a fixed body of knowledge to be absorbed and practiced. Correctness is paramount.</i></p> <ul style="list-style-type: none"> • Presenting standard formulas, algorithms, and so forth • Assigning routine tasks requiring only the application of previously demonstrated algorithms • Asking closed questions in conversation with students • Explicitly stating the importance of repetitive practice • Focusing discussion exclusively on answers 	<p><i>The sense-making frame</i></p> <p><i>Mathematics is about making sense of ideas and understanding connections.</i></p> <ul style="list-style-type: none"> • Assigning open-ended, nonroutine tasks • Asking open-ended questions and pressing for meaning in conversation with students • Explicitly stating the importance of sense making <p><i>The multidimensional math frame</i></p> <p><i>Mathematics includes activities such as collaboration, experimentation, and argumentation, not just rote practice.</i></p> <ul style="list-style-type: none"> • Assigning open-ended, nonroutine tasks • Explicitly naming skills that have not traditionally been seen as mathematical as mathematically important
The nature of mathematical ability	<p><i>The hierarchical ability frame</i></p> <p><i>Mathematical ability is distributed along a linear continuum. Some people have a lot; others have very little.</i></p> <ul style="list-style-type: none"> • Explicitly valorizing speed and correctness • Positioning some students as helpers and others as in need of help 	<p><i>The multidimensional ability frame</i></p> <p><i>Everyone has both intellectual strengths and areas for growth that are relevant to mathematics learning.</i></p> <ul style="list-style-type: none"> • Valorizing skills that have not traditionally been seen as mathematical • Naming a variety of students as resources for their peers' learning • Making statements about mutual dependence (everyone contributes, everyone learns together)

ideas as worthless when, day in and day out, they stand at the front of the room delivering lectures and asking questions that elicit only one- or two-word answers.

In place of teachers' intended meanings, I focused on their instructional practices and the alignment of those practices with particular frames. After generating the matrix of frames (in italics in Table 1), I reread the transcripts, this time open-coding for specific instructional moves that aligned with various ways of framing the nature of mathematical activity or ability. The practices that I identified came

from the data (rather than from an a priori list) and are displayed as bulleted items in Table 1. My contention is not that the practices in the Exclusionary column of the table are always inappropriate but rather that a prevalence of these practices supports exclusionary interpretations of what it means to do mathematics and who can be good at it. For example, it may sometimes be useful to ask students closed questions with one-word answers; however, a classroom in which this is the predominant mode of questioning will tend to support an understanding of mathematics as a fixed body of knowledge that students are to absorb and regurgitate rather than create or make sense of.

To facilitate systematic coding, I divided transcripts from classroom observations into episodes, which provided manageable units of meaning. Framing is sometimes visible in one or two dramatic utterances, but just as often, a single utterance inaccurately represents an instructional practice. For example, a teacher might employ a seemingly open-ended press for meaning by asking a student to “explain your reasoning,” suggestive of an inclusive framing of mathematical activity. However, if the student responds by listing familiar steps without providing any reasoning and the teacher simply moves on, this would indicate that the rote practice frame is functionally at play. Parsing the data into episodes was therefore important to capture contextual information that line-by-line coding would have missed. At the same time, keeping the episodes relatively brief allowed me to capture variations and shifts in framing that might have been overlooked with larger units of analysis. With achieving a reasonable balance in mind, I parsed transcripts into episodes according to the following criteria: During whole-class discussions, a new episode was created at each shift in topic (frequently marked by a transition to a different math problem or to a new speaker’s ideas about the same problem), and during student work time, a new episode was created at shifts in whom the teacher was addressing (a different group during group work or a different individual during individual work time). Digressions that met these criteria but lasted for less than 20 seconds were combined with an adjacent episode (this did not change how the resulting episodes were coded). The resulting episodes ranged in length from 20 seconds to approximately 8 minutes, with the average episode lasting 2 to 3 minutes. (These ranges apply to data from all four classrooms.)

Framing in each episode was subsequently coded as *exclusionary*, *inclusive*, or *mixed*, with the latter capturing combinations of exclusionary and inclusive framing within a single episode. The exceptions were episodes coded as *not applicable* (for example, episodes in which the teacher gave nonmathematical directions or in which the teacher did not interact with students as they worked) and episodes coded as *insufficient information*, in which the quality of the recording did not provide sufficient information to assign another code. (In total, these exceptions accounted for 10% of recorded time.) Teachers’ instructional practices were the basis for coding (following Table 1). Student enactment of a particular frame was not a criterion for coding. This was especially important with respect to inclusive framing. Reframing activity in systems as familiar as mathematics classrooms

typically requires a great deal of persistence, making teachers' efforts to shift culturally dominant frames potentially significant even if they are not obviously taken up by all participants in a given situation in a given moment. To capture these efforts, inclusive framing was coded as such, provided that teachers did not let challenges to it (e.g., students' denials of their own or their peers' competence) go without a response.

Although this study was primarily qualitative, I quantified the relative prevalence of exclusionary versus inclusive framing because of its relevance for my inquiry into the influence of the culture of exclusion on teachers' practice. More specifically, I calculated the percentage of class time in each code for each lesson (out of all coded time in that lesson). I used episode length rather than number of episodes to arrive at percentages to avoid the overrepresentation of very short episodes, which were numerous.

Findings

Recall the central question of this study: How does the culture of exclusion affect the classroom instruction of mathematics teachers who explicitly aim to advance equity? I found that the culture of exclusion maintained a significant presence in each of the focal teachers' classrooms, structuring the tasks that the teachers assigned, how they interacted with students, and how they instructed students to interact with one another. I also found that although the teachers engaged in inclusive framing, such framing was typically co-opted by exclusionary framing within minutes. In spite of the ubiquity of the culture of exclusion, however, I found that one teacher was able to meaningfully assert a more inclusive alternative. I illustrate these points below using percentages, brief transcript excerpts, and detailed analyses of two extended episodes of teacher–student interaction.

The Persistence of Exclusionary Framing

All of the teachers in this study expressed a desire to provide engaging and empowering mathematics learning experiences to all students, especially those who had previously been unsuccessful with school mathematics. For example, William lamented that “we have such a narrow focus of what is smart and what is success in our country.” His goal, he said, was “for every kid to have a good experience learning math, and if I could encapsulate it in a few words, it would be to extend dignity to kids through learning.” He and his colleagues at Union all employed practices that furthered this goal (see the Inclusive column in Table 1), gesturing toward framings of mathematics as a creative, collaborative, sense-making activity and of mathematical ability as multidimensional and universally possessed (though different individuals might have different ways of being mathematically “smart”). However, the teachers also acted in ways that reproduced exclusive frames of mathematical activity and ability, undermining their efforts at inclusive framing (see the Exclusionary column in Table 1). They reproduced culturally dominant frames of mathematical activity as the rote practice of formulas and algorithms that students have little role in generating (the rote

practice frame; see Table 1) and of mathematical ability as hierarchically distributed such that some students are mathematically competent and others are not (the hierarchical ability frame; see Table 1).

Exclusionary framing was not merely incidental—an occasional exception amid largely inclusive framing. Rather, it persisted across all four teachers' practice and dominated the majority of the time in two classrooms (see Table 2). Even in Ryan's classroom, in which the smallest percentage of time was spent in exclusionary framing, more than half (52%) of the time was spent in either exclusionary or mixed framing.

In what follows, I illustrate how exclusionary frames of mathematical activity and mathematical ability are manifested in classroom instruction.

Exclusionary framing of mathematical activity. All the teachers in this study used instructional strategies that have been widely touted among mathematics educators as student centered and inquiry based. In particular, they often began units of instruction with “discovery-based,” “hands-on” explorations (to use their words), and they generally avoided lecturing, spending most of their class time having students work in small groups. In spite of these strategies, however, their teaching often reinforced the rote practice frame by emphasizing the use of routine algorithms and procedures to find a single correct answer.

Introductory activities that were open ended and student centered quickly gave way to formal notation and tidy, efficient procedures presented by the teacher, layering the rote practice frame over framings that highlighted sense making and multidimensionality. For example, to introduce a unit on proportional reasoning and similarity, William used a task that involved shining a flashlight on circular cutouts of different sizes to see how large their shadows would be at various distances from the light source and the ground. In this activity, students worked together to develop and test conjectures about a proportional relationship. The remainder of the unit, however, emphasized setting up proportions based on diagrams of similar polygons and manipulating them to “solve for x ” without reference to the ideas that students generated during the flashlight activity.

The teachers also framed mathematical activity as rote practice through their moment-to-moment interactions with students. A group activity in Luke's class-

Table 2
The Four Teachers' Use of Exclusionary, Inclusive, and Mixed Framing

	Ryan	William	Cyril	Luke
Exclusionary framing	8%	38%	53%	61%
Inclusive framing	48%	10%	7%	16%
Mixed framing	44%	53%	40%	23%

Note. Figures are given as percentages of coded time (i.e., episodes coded as not applicable or insufficient information, 10% of the data collected, were not included in the total).

room exemplifies this phenomenon. Luke had created a task that involved an irregular polygon drawn on a grid with its vertices at lattice points. He instructed each group member to use the Pythagorean theorem to find the length of two or three of the polygon's sides and then share their results so that the group could calculate the perimeter. That is, he specified that students' principal task for the day was to make repetitive use of a formula and a procedure that they had been shown many times before. Luke's subsequent interactions with students, especially his interventions with students who were stuck, also invoked the rote practice frame. For example, when Luke visited Ixchel's group to check on their progress, Ixchel apologized for her confusion, to which he responded by reviewing the steps that she should follow:

- Ixchel:* This is really confusing. I have no idea what the hell I'm doing. Sorry.
Luke: Okay. So you drew out your triangles, that's good, step number one. And then what you need to do is, exactly what she did over there. Take this number—first of all, where's the right angle, in here?
Ixchel: Here.
Luke: Right. Good. Okay. So then Pythagorean theorem says that if you take the two legs and you square them, and add them together, that equals the square of this side.
Ixchel: Oh right!

One of Luke's strengths was his ability to create a classroom environment in which students felt comfortable being themselves, as evidenced by Ixchel's language ("I have no idea what the hell I'm doing") in expressing her frustration. Rather than capitalizing on this comfort to push students to think about mathematics in deeper or more complex ways, however, Luke employed familiar practices that he had experienced as a student (as he described in interviews). In this case, that meant focusing on how to apply a standard formula to compute an answer.

Another way that teachers in this study invoked the rote practice frame was by making explicit statements about the importance of practice. For example, Ryan began a lesson by reviewing a procedure for calculating the volume of a prism and then stated, "If that's a little confusing, it's okay. It's okay. . . . We're going to have more chances to practice that. The first chance we're going to get to practice it is today." Being a mathematics student within this framing was substantially about repeating procedures to the exclusion of other, richer ways of engaging with mathematics.

Exclusionary framing of mathematical ability. Teachers did not use labels like "strong," "high-level," "struggling," "weak," or "low" when talking with their students. However, they did use these terms to describe students in their conversations with one another. Additionally, the exclusionary frames of mathematical ability that these labels reflect and reproduce were evident in teachers' instruction through their positioning of students in relation to ability hierarchies.

Explicitly hierarchical labels appeared regularly in teachers' collegial conversations, reflecting and reenacting culturally dominant framings of intelligence and ability (I coded 96 instances in 28 hours of meetings; see Louie, 2016). For example, in a department meeting on the subject of differentiation, William launched the discussion by saying,

I don't feel like I'm doing a great job with, um. With the kids I'm not targeting my lessons towards. I tend to target my lessons towards the like, if I have to do percentiles, like 10th percentile to 70, 75th percentile. Like not the one or two kids that are just, cannot follow what I'm doing, and not the six, seven, five kids at the high end that are fine without me but, you know, are on the verge of being bored at times.

Echoing William's hierarchical classification of students into percentiles, one of his colleagues later said, "I just recognize, there are students who just learn a lot faster than other students in the class, and in many ways, even a lot faster than you learned when you were in school." With the word *just*, both teachers naturalized the categories they described, suggesting that having students who "just cannot follow" or "just learn a lot faster" is simply the way things are.

In the classroom, teachers enacted hierarchical frames by treating some students as more capable than others. Cyril's different responses to two students, Matthew and Gloria, provide an especially stark contrast. When Cyril noticed that Matthew appeared to be stuck, he initiated the following exchange:

Cyril: You get it?
Matthew: No.
Cyril: Keep working on it. It's a tough one. . . . Break it up into shapes.
Matthew: I already did though.
Cyril: Keep going. It's a good challenge for you, Matthew.

Cyril thus positioned Matthew—one of three Asian American boys in the class and the only student to reach the "dessert" (i.e., challenge) portion of the day's worksheet, as far as I observed—as capable of sophisticated, independent problem solving. However, Cyril gave other students hints on basic problems, pointed out their errors, told them which formulas to use, and at one point took the pencil from Gloria—a brown-skinned girl in a wheelchair—and said, "Let's fix that. I'll fix it for you, okay?" In another instance of asserting an ability hierarchy, Luke concluded the interaction with Ixchel recounted above by telling her, "James is like the master of this, so he'll help you." In doing so, he affirmed Ixchel's positioning of herself as confused and incompetent and positioned James as a more capable savior. Like many of their peers, Ixchel and Gloria were repeatedly positioned as deficient throughout the year, whereas James and Matthew were positioned as superior. This repeated positioning fostered particular identities in relation to mathematics, not all of which were positive, and it undermined teachers' occasional statements framing all students as resources for their classmates.

Connections between exclusionary frames of mathematical activity and exclusionary frames of mathematical ability. Although I have treated them separately above, exclusionary framing of mathematical activity and exclusionary framing of mathematical ability were often linked. One especially natural and seamless way in which this occurred was through teachers' interpretations of differentiation, for example, as embodied in the design and use of tasks that they called menus.

The menus' structure reified both the rote practice frame and the hierarchical ability frame. The assignments began with "appetizers," simple practice problems that all students were expected to complete. The menu that the teachers wrote for the unit on trigonometry began with the problems shown in Figure 1.

The directions at the top of this particular menu explained: "First, you will complete the problems on this page, then check your answers on the top of the back side. You can then choose the problems that you need to practice, always checking your answers as you go." Based on the correctness of their work on the appetizers, some students would continue working on similar problems; the next eight problems on the menu were nearly identical to the three shown in Figure 1 with only the numbers changed. In the meantime, students who answered all of

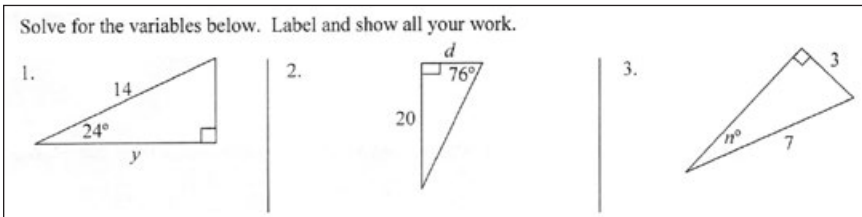


Figure 1. Appetizer problems at the beginning of a menu used by Union's Geometry Team.

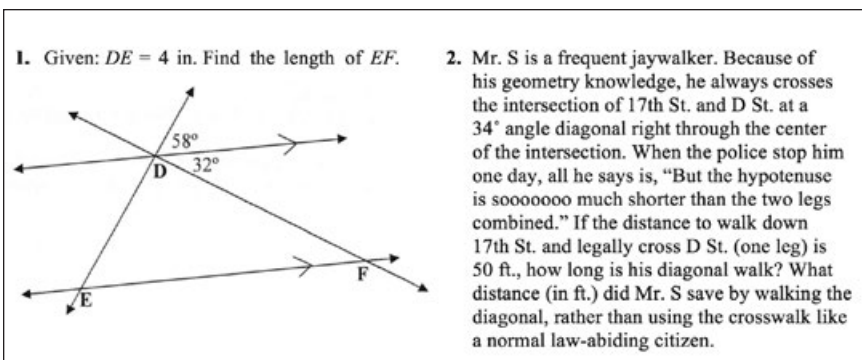


Figure 2. Trig Challenges and Trig Situations near the end of the menu.

the appetizer problems correctly would go on to more complex problems, such as those in Figure 2.

Like all three of the menus I saw at Union (one for each unit in the spring semester except for the last unit, which was cut short to accommodate the standardized testing schedule), this assignment presented mathematical activity as the simple application of discrete skills that the teacher had already demonstrated (e.g., solving for an unknown side length in a right triangle using tangent, sine, or cosine) on problems similar to ones that had already been seen and solved. The dessert problems used these same basic skills but also required students to remember content from other units (e.g., what angles are formed when parallel lines are crossed by a transversal), to interpret more complex diagrams and stories, and to coordinate these various resources in multistep solution processes. These demands began to layer a more expansive, inclusive framing of mathematical activity over the rote practice frame.

For many students, however, the coordination of the hierarchical ability frame with the rote practice frame meant that inclusive frames of mathematical activity remained invisible. In actual use, all but one or two students per class spent the entire period on basic practice, excluded from work on richer problems by the structure of the assignment. Menus both assumed and communicated that some students are capable of tackling challenges, but others are not. Indeed, this was how the teachers talked about students in meetings in which they discussed menus. They expressed concern that students at the “high end” were “bored” and talked about challenge problems as being for the fastest kids, “your 100% students.” All students theoretically had access to these problems, but it was not expected that all students would actually work on them, much less that students who worked slowly or experienced obstacles would do so.

The exclusionary framing embedded in menus notwithstanding, teachers viewed menus as a mechanism for supporting all students, academically as well as emotionally. They talked about menus as providing students with opportunities to work on the mathematics that was appropriate for them, thereby promoting their content learning while also giving them a chance to feel successful—something that could not happen if “low” students were assigned problems that were too difficult or if “strong” students were assigned problems that were too easy. As one teacher said in a planning meeting, “Kids want to be pushed . . . so I think, that’s where differentiation comes in. Being able to push all students so that they all feel like they’re being pushed, but that they can meet those demands.” That teachers’ ideas for supporting diverse students were rooted in exclusionary frames of mathematical activity and ability is a reflection of the power of the culture of exclusion to shape teachers’ practice without their conscious awareness.

The Layering of Exclusionary Frames Over Inclusive Ones

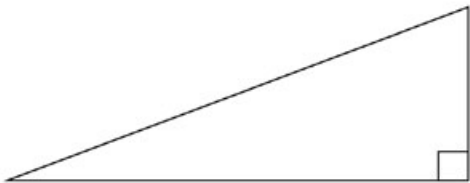
The preceding section focused on the exclusionary frames that the teachers in this study employed. In this section, I describe ways in which the teachers also engaged with inclusive alternatives, framing a wide variety of skills and practices

as central to mathematical activity (the sense-making and multidimensional math frames; see Table 1) and framing mathematical ability as something that all people possess in a multitude of forms (the multidimensional ability frame; see Table 1). I then show how teachers buried their own inclusive framing under exclusionary frames.

Inclusive framing of mathematical activity. In contrast to the rote practice frame, teachers sometimes framed mathematical activity as being less about the mastery of formulas and discrete skills than about sense making. Cyril made explicit statements to students about the necessity of developing conceptual understanding, such as, “It’s really important that you guys understand the relationship between the square and the square root.” In addition, all of the teachers occasionally assigned open-ended, nonroutine tasks that gave students opportunities to generate and connect multiple solution paths, multiple representations, and multiple perspectives (such as the flashlight activity).

The most consistent way that teachers invoked the sense-making frame, however, was not in their use of big, creative tasks (which were few and far between) but in the questions that they used to press for reasoning and justification in everyday classroom conversation. For instance, William asked students to estimate the value of the square root of 32, and when someone offered 5.5, William asked students to briefly discuss why that might be a sensible estimate. In another example, Ryan posed the problem in Figure 3 as a warm-up, and as he circulated around the classroom, he repeatedly pointed to students’ papers and asked, “What does that [quantity] mean in the picture?” and “Where did the 0.7536 come from?” In response, one student called 0.7536 “the slope of the angle,” developing a mathematically insightful analogy between slope ratios and tangent ratios, which she shared with the class at Ryan’s request.

Show what the 37, x , 5, and 0.7536 tell you about a right triangle. Where did the 0.7536 come from? Use complete sentences! Then show how you can solve for x .



$$\tan(37) = \frac{x}{5}$$

$$0.7536 = \frac{x}{5}$$

Figure 3. A warm-up problem from Ryan’s class.

Another inclusive alternative to the rote practice frame that appeared in the teachers' practice was the multidimensional math frame. Teachers occasionally asserted frames of mathematics as multidimensional by assigning group-worthy tasks (see E. G. Cohen & Lotan, 2014, pp. 85–97; Nasir et al., 2014, pp. 40–44)—open-ended, nonroutine tasks that required a variety of intellectual strengths and behaviors. For example, the flashlight activity appeared to be less about recall and computation than measuring distances, organizing data, making and testing predictions, generalizing, and sharing one's thinking with others. Ryan sometimes made such multidimensionality explicit by naming a wide variety of activities as mathematical or necessary for succeeding in mathematics. For example, he launched a group task one day by saying, "We're gonna do a task today where you're gonna need . . . people who are good at estimating, measuring, making conjectures, and seeing patterns."

Inclusive framing of mathematical ability. Teachers sometimes framed mathematical ability as multidimensional rather than hierarchical—positioning all students as capable in different ways rather than positioning some students as smart and others as less than. A weak but common way for William, Cyril, and Luke to invoke the multidimensional ability frame was by directing students to "talk to your group," suggesting that the group would have something to offer regardless of who was in it. They did this when launching group work as well as in response to specific questions, positioning students as capable of supporting one another and succeeding without step-by-step guidance from the teacher.

Ryan similarly emphasized students' mutual dependence but in ways that reflected deeper connections to redefining mathematical activity. Consider a longer excerpt from the launch of the group task quoted above:

We're gonna do a task today where you're gonna need all the different smartnesses of your group. You need people who are good at estimating, measuring, making conjectures, and seeing patterns. I know every single one of you is good at at least one of these. So everyone has something to offer your group.

Ryan thus disrupted dominant frames of fast students as smart, naming instead a number of different ways "smartness" could look and asserting that "everyone has something to offer" (cf. the multiple-ability orientation, as it is called in CI parlance; Tsu et al., 2014). He also highlighted students' need for one another. Rather than attempting to give each student activities tailored to his or her unique learning style or "level," he positioned all students as capable of doing complex, challenging mathematics if and only if they pooled their many strengths and worked together. Instead of some students being positioned as experts and others as beneficiaries of their peers' expertise, all students were positioned as both learners and contributors who needed to share their resources and rely on their peers to do the same.

Ryan's repurposing of a menu that his colleagues had written, turning it into a group challenge, similarly reframed both mathematical activity and mathematical

ability. For students working on the problems as a self-paced menu, the primary task was to recall (or look up) the correct formulas to use and then apply those formulas accurately. In making the assignment a group challenge, Ryan instead highlighted communication and reasoning. Throughout the lesson, he reminded students that they would be graded on both the content of their mathematical thinking and “how you are working together as a team,” emphasizing the importance of sharing ideas and asking questions like “What should we do next?” and “Do we agree?” as well as “How did you get that?” (In their work together, students did in fact press one another to explain why a given number should be plugged into a formula while another number should be ignored, to justify why a particular formula works in the first place, and to articulate understanding that they had not previously put into words—deepening their engagement with and understanding of important mathematical ideas.) Ryan also linked these aspects of the task to students’ diverse—and complementary—strengths and areas for growth, telling the class that some students might need to work on understanding volume, whereas others might need to hone their communication skills. Ryan thus underscored social dimensions of mathematical competence (asking questions, giving explanations, and managing group dynamics) alongside content-focused ones and connected his multidimensional framing of mathematical activity to multidimensional framing of mathematical ability.

Another teacher move that signaled the multidimensional ability frame was naming specific students who were not widely perceived as smart as resources for their peers’ mathematics learning (cf. assigning competence; E. G. Cohen & Lotan, 2014, pp. 156–160). Although all four of the focal teachers in this study positioned students who were already relatively vocal and confident as capable (e.g., by suggesting that they help their peers, by calling on them to provide answers and explanations during class discussions, and by supporting them to work on challenging problems), Ryan also positioned students who were not widely seen as competent in this way. For example, during one lesson, he asked a timid, self-deprecating student named Alejandro to present his work on the warm-up to the class, and when Alejandro did, Ryan announced, “I really like your strategy, Alejandro, I think it’s really smart . . . [as a] way to do percents, even super-complicated ones.” Providing specific, public positive feedback such as this challenged exclusionary frames even more powerfully than general statements about students as one another’s resources, explicitly upending hierarchies that positioned students like Alejandro as anything but “really smart.”

Devolution of inclusive framing into exclusionary framing. In Luke, Cyril, and William’s classrooms, inclusive framing was rare (16%, 7%, and 10% of class time, respectively; see Table 2). When it did occur, it devolved into exclusionary framing if students did not quickly produce correct reasoning or results, the only outcomes that are typically valued in mathematics classrooms. The following episode, from William’s “newcomer” Geometry class (for recent immigrants whose native languages were not English), exemplifies this phenomenon.

In the episode, four boys—Assad, Efrain, Juan, and Hakim—were seated together. Assad and Hakim spoke Arabic as their first language; Efrain and Juan were both native Spanish speakers. Hakim and Efrain spoke English hesitantly but proficiently. The episode began with William’s arrival at the boys’ table. He looked at their work and noticed that Juan and Hakim had made similar sketches (see Figure 4) but arrived at different answers.

In the first part of the episode, William made an extended effort to help students explain their thinking to each other. Nine times in just over 4 minutes—nearly every time he spoke—he prompted students to share and explain their methods. For example, when Hakim reported that “when I do minus, 100—100 minus 9, 100 minus 9 is 91,” William solicited his reasoning, giving Hakim time to formulate his ideas into words and offering an alternative way of explaining when Hakim still struggled:²

William: Why, Hakim? [2 sec] I agree that 100 minus 9 is 91. Why do you think this is going to give you the right answer? [4 sec]

Hakim: I don’t know how to say it really.

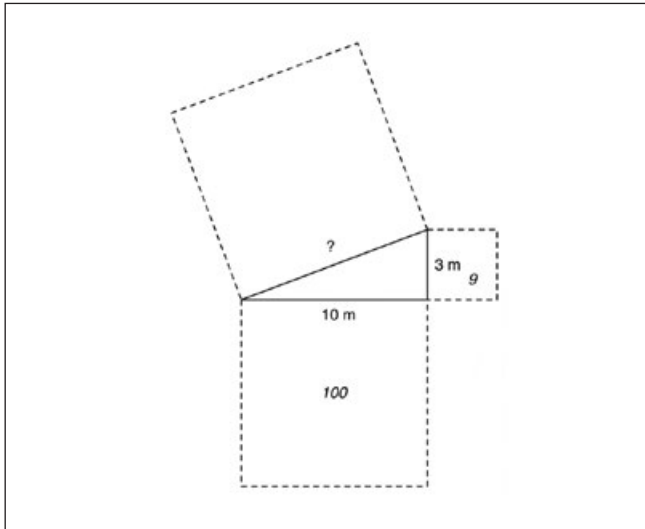


Figure 4. The task on which William’s students were working. Juan and Hakim’s common inscriptions are shown with dotted lines and italicized font; all other markings were given (figure not to scale).

² Numbers in brackets indicate pause length in seconds.

William: Can you write it down? Show me what you're thinking, using the numbers?

William similarly asked Juan to share his reasoning, saying, "And, okay. Juan, why did you put 109? [2 sec] I want you to explain, to everyone." Thus, William framed the thinking Hakim and Juan had done as significant and worth sharing. He directed his attention to all four students and not only to Hakim, whose solution was incorrect, and he explicitly told Efrain and Assad to "sit up" and "look here for a minute" because "this is an important thing that they both are—they're solving in different ways." William thus moved toward a multidimensional framing of mathematical activity, valorizing not only correct computation and application of formulas but also communication and explanation. He also disrupted exclusionary, hierarchical framings of students, positioning both Hakim and Juan as mathematical thinkers with valuable ideas that deserved their peers' attention, even though Hakim had made a mistake and Juan had not.

However, as Hakim and Juan struggled to articulate their thinking, William began to layer exclusionary frames over the inclusive ones that he had asserted. After trying to elicit explanations from Hakim and Juan for 4 minutes, he stepped in with more directed questions and his own reasoning. (The // symbol indicates the start of overlapping speech.)

William: So Juan added, and Hakim subtracted. Okay. Which is correct? [6 sec] Let's think. Which, which one is the biggest area? Which one is the biggest area, the legs or the hypotenuse?

Hakim: The hypotenuse.

William: The hypotenuse is the biggest. So is this okay?

Juan: No.

William: Is this the hypotenuse, // squared?

Juan: // Yeah.

William: Yes, this is the hypotenuse squared, because here is the right angle, right, so that's okay. What about—Hakim, where is your hypotenuse?

Hakim: It's right here. [He points to the hypotenuse.]

William: Here. So is this the biggest area? [Indicating 91, Hakim's answer.]

Hakim: [1 sec] Yeah.

William: It's, it's bigger than 100?

Hakim: No.

William: No. So is this possible? [5 sec] It's not, right, because this is the hypotenuse, right? So this must be the biggest side and the biggest area, right? So you do add, you add—these are the two leg areas, right, so you do add. So Juan—

Hakim: Juan is good?

William: Juan is correct. Because you add the two leg areas to get the hypotenuse area.

In the last minute and 42 seconds of his interaction with this group, William engaged students in a series of initiation-reply-evaluation (IRE) sequences (Mehan, 1978). He initiated by asking closed-ended questions to which Juan and Hakim gave one- to three-word answers. He then evaluated their responses, repeating the answer if it was correct or his question if it was not. He ended his interaction with the group by giving his own explanation of how to solve the problem at hand and making the correct solution explicit. When he left, just under 6 minutes after arriving, Juan and Hakim had hardly explained their work, and the expectation that either of them do so had been buried under the teacher's explanation. Opportunities to position Assad or Efrain as resources for the group's learning had similarly been lost.

William's help in this episode layered hierarchical frames over multidimensional ones, reasserting the culture of exclusion after his tentative proposal of an inclusive alternative. By the episode's conclusion, what had surfaced as mathematically important was knowing how to apply the Pythagorean theorem (more specifically, when to add and when to subtract) to solve for a missing length, in line with the rote practice frame. Students themselves, initially positioned as owners of important ideas worth sharing with others, ended up positioned as dependent on the teacher to provide reasoning and to evaluate answers.

Sustained Inclusive Framing

The devolution of inclusive framing into exclusionary framing, in particular from open-ended tasks and questions to formulaic exercises and IRE sequences, was not uncommon in Luke, Cyril, and William's classrooms. Ryan more often sustained inclusive frames by bolstering inclusive framing of mathematical activity with inclusive framing of mathematical ability. His case illustrates both that it is possible to maintain inclusive framing when students are struggling and how teachers can go about such maintenance.

Like William, Ryan taught Geometry classes for newcomers, and students struggled somewhat to express themselves in English. Ryan nonetheless left significant mathematical work to students. Instead of offering his own reasoning or standard procedures, he often encouraged them to develop their own mathematical understanding (the sense-making frame) and guided them to notice and use their various strengths to help one another in this endeavor (the multidimensional ability frame), as in the following episode.

The episode began with Ryan's arrival at Ana, Carmen, and Dashiin's table. Ana and Carmen were native Spanish speakers; Dashiin had immigrated from Mongolia less than 2 months prior to the episode (and he was the only Mongolian speaker in the room). The class had been practicing finding missing angle measures and side lengths of right triangles using tangent ratios. They had just begun to consider other trigonometric ratios (i.e., sine and cosine). They were working to find the lengths of the legs in right triangles where the length of the hypotenuse and the measure of one acute angle are labeled. Ana called the teacher

over because she and Carmen were unsure which side of a particular triangle was opposite the reference angle.

Ryan responded by positioning the students as sense makers with important resources to offer one another. Instead of answering the question, he drew Dashiin, who had not been involved in Ana and Carmen's conversation, into the discussion. Dashiin indicated the side opposite the reference angle, and Ryan asked him to explain how he knew that side was opposite. Ryan then engaged the students in making their own sense of the word *opposite*:

Dashiin: This opposite, like this. Like this. [He points at one side of the triangle with his pencil.]

Ryan: Why?

Dashiin: [He smiles.] [6 sec] Reference angle, this is.

Ryan: Hm?

Dashiin: This is the reference angle.

Ryan: That's the reference angle, good. [2 sec] What does it mean if the side is opposite?

Dashiin: Um. [4 sec]

Ryan: You guys can help, you can help Dashiin, cuz I know it's hard,

Ana: // I don't know!

Ryan: // with the English. [1 sec] What does opposite mean, just in general? Not in this context, but.

Ana: Opposite.

[Ana and the teacher both laugh]

Ryan: Opposite means opposite?

Ana: I don't, like—

Carmen: I have an // idea. Opposite here, and opposite here. [She makes some inscriptions on the triangle on her paper.]

Ana: // The other, like, I'm opposite of you. [She gestures at herself and Dashiin, who is sitting across from her.]

Ryan: Yeah, like you and I are on opposite sides of the table, right? We're across from each other.

Ana: Uh huh.

Ryan: Dashiin and I are adjacent. We are on the same side of the table, right. Dashiin is next to me.

Carmen: So—

Ana: Uh huh.

Ryan: So, if opposite means across from, which side is across from 76 degrees?

Carmen: [Points at something on Ana's paper with her pencil.]

Ana: B.

Ryan: Yeah. Exactly, yeah. But good. I really like the way that you're trying hard to like think about what makes sense.

Ryan invoked inclusive frames through what he did as well as what he did not do in this exchange. He could have ended the entire interaction with a single syllable at the start: “B.” Doing so would have freed him to move on to another group. It also would have positioned the students as dependent on his mathematical authority, albeit subtly. Instead, Ryan elicited what they knew, asking Dashiin to answer Ana’s question. When Dashiin gave the correct answer, Ryan again could have stepped away. Instead, he pressed Dashiin for a justification, and when Dashiin struggled to give one, Ryan recruited Ana and Carmen to help their groupmate—positioning all of the students as resources for their peers. None were singled out as smarter or more knowledgeable, or dumber or less knowledgeable, than any of the others.

Ryan’s inclusive framing of mathematical ability was interwoven with and bolstered by his framing of mathematical activity as multidimensional, in particular as having space for (and indeed requiring) students’ own sense making and interpretations. In getting the group to explain why side B was opposite the reference angle, he did not direct their attention to formal definitions in their textbook or in their notes. Rather, he asked the students to draw on their own everyday meanings for “opposite.” He joked with Ana about her difficulty in putting her understanding into words, but he responded seriously to her gestured explanation, revoicing and extending it. When she came to the correct answer, he acknowledged her correctness but focused his praise on how she was “trying hard to like think about what makes sense.” Thus, he simultaneously framed mathematics as a sense-making activity (thereby creating opportunities for sense making and conceptual understanding) and positioned Ana as a valuable contributor to the work her group was doing, irrespective of the fact that she did not know which side was opposite the reference angle at the start of the episode.

Ryan continued to sustain inclusive frames of mathematical activity and ability as Ana asked another question. He again drew the whole group’s attention to their groupmate’s question, recruiting Ana’s peers as resources not just for her but also for each other in the collective project of making sense of mathematics. He then restated the given information without suggesting what they should do with it. Of his own accord, Dashiin offered a way to set up an equation using the sine ratio. Ryan responded by encouraging the students to “keep going” as a team, again asserting the multidimensional ability frame by giving the students specific information about what each of them had to offer the others. He thus positioned the students as equally important contributors to their group’s work despite apparent asymmetries in what they knew and could do with trigonometric ratios:

I think you’re on the right track Dashiin. I want you to think—I want you to make sure that that makes sense to everyone at your table. Because you’ve got an idea. And one thing, Dashiin, that I want you to practice: Ana and Carmen are excellent at showing their work, they’re showing it really clearly, and right now, some of the work that I see on here? [Pointing at Dashiin’s paper.] Is missing some steps. So I want you to think, how could you show your work, really, really clearly. And part of that? Is if you do a good job of explaining, your idea that you just said, then Ana will be able to help you, figure out how to show the work. A little better. Okay? So keep going. I think

you guys are on the right track. I'm going to step away though, and check in with the other teams. [Walking away.]

In this statement, Ryan emphasized that mathematics should “make sense to everyone.” He also emphasized showing work clearly, highlighting this as a specific strength that Ana and Carmen had to offer Dashiin. That is, he reframed the kinds of skills that counted as mathematical, invoking the multidimensional math frame, and reoriented students to each other as capable in different ways, all of which are necessary for successful mathematics learning, asserting the multidimensional ability frame. Explicitly deciding to step away from the group reinforced the latter frame, positioning the students as capable mathematical thinkers who could solve problems by working together (whereas in his work with Hakim, Juan, Assad, and Efrain, William initially positioned students this way but stayed at their table to monitor and direct their interaction, suggesting that the students could not actually succeed in the task he had set without his presence). All of this was somewhat routine for Ryan. He regularly pressed students for sense making and reasoning, gave them specific feedback about their varied strengths, provided scaffolding for their interactions with one another (rather than scaffolding that reduced cognitive demand around the mathematics at hand), and left them to resolve their own questions, even in situations in which they were not obviously “on the right track.” In spite of the influence of the culture of exclusion at his school and at times in his own classroom, he frequently and meaningfully reframed mathematical activity and ability in inclusive terms.

Discussion

All of the teachers in this study expressed a commitment to empowering students who had not been well-served by their previous mathematics learning experiences. They all chose to work at a school attended by many such students. They talked frequently and explicitly about how to support each and every student to learn. They were active participants in an intensive PD program aimed at disrupting hierarchies and expanding what it means to do mathematics. Furthermore, many educators in the region considered them to be leaders of equity-oriented reforms. (Indeed, the study was initially designed to investigate their resistance to and transformation of inequities in mathematics education.) However, much of the teachers' classroom practice remained enmeshed in and reproductive of exclusionary frames.

Even as they aimed to move toward more equitable and inclusive forms of instruction, the teachers in this study created and enacted instructional strategies that were rooted in exclusionary framings of mathematical activity and ability. Menus, for example, were an attempt to differentiate instruction to meet diverse students' needs. However, the hierarchical ability frame made interpretations of diversity as ordered from “low” to “high,” along a narrow path from incompetence to mastery, sensible and automatic. Teachers did not invent this frame. Nonetheless, they built it (however unintentionally) into the menu structure and into their

interactions with students as they worked, supporting students on the “high end” to work on the challenging “dessert” problems while “low” students worked on repetitive skills practice. Similarly, teachers talked about their desire to teach for understanding, but closed-ended, fill-in-the-blank questions seemed to come to them naturally. Steering students toward correct procedures and answers may have been motivated by the best of intentions—for instance, from concern that without such steering, students might be stuck with incorrect thinking or become frustrated and give up, or from concern about pacing and the amount of material that had to be covered in time for standardized testing (especially urgent because Union stood to lose significant funding if mathematics scores did not improve). In addition, within hierarchical and exclusionary frames of reference—within a culture that views mathematics as a collection of discrete skills and students as recipients rather than producers of knowledge—the practices that they employed appeared to be sensible and effective not only in a general way but also for the specific purpose of inclusion and meeting the needs of every student. In other words, without consistent, deliberate attention to reframing, much of their instruction had the unintended effect of reinscribing the culture of exclusion.

Possible Interpretations of the Persistence of Exclusionary Framing

One way to interpret the exclusionary manner in which the teachers in this study framed mathematical activity and ability would be to look for their deficiencies as individuals, examining such characteristics as their beliefs about mathematics and intelligence, their personal histories and identities, and their mathematical or pedagogical knowledge. It is no doubt possible to identify differences in these areas and use them to explain Ryan’s relatively inclusive framing and his colleagues’ relatively exclusionary framing. However, such an approach limits the range of solutions that the field is able to imagine to those that target individual teachers. It also ignores the substantial similarities between the teachers’ practice, in particular the presence of exclusionary framing in Ryan’s instruction (in episodes coded as mixed and as exclusionary, which together made up more than half of the coded time in Ryan’s class), and seriously underestimates the challenges that all teachers face in attempting to transform their practice to disrupt rather than reproduce inequities.

Another way to interpret the teachers’ persistently exclusionary framing of mathematical activity and ability is to contextualize it within the dominant culture of mathematics education. Previous studies have explained the tenacity of traditional mathematics instruction in similarly cultural terms (McCloskey, 2014; Stigler & Hiebert, 1998, 2009; Webel & Platt, 2015). For example, Webel and Platt (2015) analyzed the persistence of procedural, teacher-centered methods in terms of a battle between teachers’ student-centered goals and their enculturated sense of obligations to their profession and to students (e.g., obligations to ensure that students knew standard mathematical vocabulary or that students could use standard, “efficient” solution methods) in which the latter won out. Other studies have found that the culture of the teaching profession in general—with its norms of privacy and autonomy (Little, 1990; Louie, 2016) and emphasis on doing rather

than thinking (Earl & Timperley, 2008; Horn & Little, 2010)—interferes with teacher learning and change and thereby facilitates the maintenance of the status quo.

I argue here that an additional, central facet of the dominant culture of mathematics education is exclusion. Ways of learning mathematics that do not align with the procedural focus of most classrooms are excluded, and students who do not conform to stereotypes about what people who are “good at math” are like—geniuses who know a lot of formulas, always answer questions quickly and correctly, and are White or Asian males from economically privileged backgrounds—are excluded from developing positive disciplinary identities. My findings demonstrate that this culture permeates even the instruction of teachers who express firm commitment to equity and who receive substantial support from equity-oriented PD.

Possible Interpretations of Ryan’s Inclusive Reframing

Ryan’s example shows that it is possible for teachers to meaningfully subvert the culture of exclusion despite its dominance (and the images of his use of inclusive framing shared in this article may be useful for those struggling to envision alternatives to the culture of exclusion). Some might take his inclusive reframing of mathematical activity and ability as evidence that differences between individual teachers are more important than cultural forces, but as I have described elsewhere (Louie, 2015, 2017), Ryan was not a superhero who transcended the culture of exclusion through sheer force of will. Rather, he embedded himself in an alternative culture, participating in multiple communities that motivated and sustained his engagement with inclusive frames. For example, he maintained relationships with teachers from Railside, where as a student teacher he had been immersed in a department that viewed students as mathematically brilliant in diverse ways. His network also included a group of CI teacher leaders from his district who met monthly and members of a district-sponsored video club that brought teachers together to practice noticing and naming students’ mathematical strengths (modeled on the video clubs described by Jilk, 2016).

Ryan’s network supported his inclusive reframing in several ways. It provided him with resources for developing and sustaining a vision of an inclusive alternative to the culture of exclusion, technical support around curriculum and instruction, a sense of solidarity around a shared mission and vision, and affirmation of his worth as a teacher even when he struggled (and struggle he did). Some of these communities were theoretically open to Cyril, Luke, and William. However, as an athletics coach, Cyril often had scheduling conflicts; Luke was already overwhelmed by the demands of being a new teacher; and William described a need for “boundaries” to protect his family and keep himself from burning out (Louie, 2017). For reasons that made sense in the contexts of their lives, these teachers opted out of many of the activities that Ryan spent evenings and weekends attending. However, as a result, they had fewer resources for grounding themselves in inclusive cultural frames. Thus, understanding why exclusionary

framing was more prevalent in their instruction than in Ryan's requires understanding the intimate links between individual differences and fundamentally social and cultural opportunities for teachers to make sense of their work.

Implications

The approach that I have taken here foregrounds culture, taking a "collective view" that interrogates culture as a social and historical phenomenon (McCloskey, 2014, p. 22). This contrasts with approaches that treat culture as an explanatory variable while maintaining analytic focus on individual teachers' knowledge, beliefs, or behavior. It also contrasts with approaches that treat culture primarily as a local construction, emergent through interactions in individual classrooms or schools. In centering my analysis on cultural frames, I have located the problem of realizing rich, rigorous, and equitable mathematics instruction in a macroculture that comprises a complete system of conceptual and material tools (e.g., curricular forms, instructional strategies, and hierarchical systems for categorizing students). These tools are constantly at teachers' fingertips, readily supporting them to interpret mathematical activity and ability through exclusionary frames and to reproduce and reenact these frames in their work with students. Inclusive framing competes not as an equal option that teachers are more or less free to choose but as a relatively abstract set of ideas about equity, diversity, and inclusion versus a familiar, even automatic, toolkit for making sense of and enacting classroom practice. This perspective challenges the idea that equity in mathematics education might be achieved if only the beliefs, knowledge, or skills of individual teachers could be improved without broader attention to the systems in which teachers are embedded.

Calling out the culture of exclusion and its power to thwart teachers' efforts to teach for equity is an important step toward changing it. This article also contributes a framework for analyzing the culture of exclusion in mathematics classrooms, highlighting two aspects of framing—mathematical activity and mathematical ability—that are crucial in these settings. I have also presented a list of practices that correspond to exclusion and inclusivity for each aspect (Table 1). This list may support researchers and practitioners in reconsidering common instructional practices that they currently take for granted as normal or acceptable, and future research might fruitfully work to expand it by linking additional practices to exclusionary or inclusive frames. However, the presence or absence of any particular practice is less important than how the practice functions in a cultural context in which hierarchy and exclusion are dominant. The culture of exclusion has a tendency to assimilate practices labeled inclusive such that apparently inclusive practices (such as differentiation and cooperative learning) may come to serve exclusionary ends. Nevertheless, it may sometimes be appropriate for teachers to engage in practices that I have labeled exclusionary (such as presenting standard formulas and algorithms) without worrying that they are destroying an inclusive classroom culture. The point is not to train teachers to follow a recipe of best practices (nor to train students to react to isolated practices; e.g., responding to

open-ended questioning with answers that are longer than 10 words and include the word *because*). It is important to communicate to students that what is “going on” (Goffman, 1974) in their math classrooms is not business as usual. They need to be supported to understand that what is valued is more inclusive than the narrow forms of competence to which they are accustomed. However, this goal must be coordinated with a multitude of other goals and concerns in the daily work of teaching, requiring “sensitivity, flexibility and judgement” (Lefstein & Snell, 2014, p. 5). Evidence suggests that the complexity of this task is too great for any one teacher to take on alone.

Advancing equity in mathematics education may depend on the field’s ability to recognize and respond to exclusion as a cultural and not solely an individual phenomenon. Rather than addressing exclusionary frames of mathematical activity and ability by attempting to change individual teachers, including those who hold firm commitment to equity as well as those who do not, understanding these frames in terms of the culture of exclusion suggests that those who wish to advance equity should attempt to change the contexts of teaching to make inclusive framing more visible, more sensible, and more practical than exclusionary framing. For example, the cases of the four teachers in this study suggest that more should be done to connect teachers to colleagues who are more practiced at inclusive framing than they are and to immerse them in communities where inclusive framing is (becoming) normal. Although it would require some restructuring of the school day, building these connections into teachers’ schedules on a routine basis (e.g., through facilitated video clubs like the one that Ryan attended) would give all teachers access to the supports that these communities can provide, whereas present arrangements often limit such access to those teachers who are willing and able to volunteer their evenings and weekends (above and beyond the hours many teachers already volunteer for planning, grading, attending school events, and so on).

More research is also needed to better understand how teachers who resist the dominant culture learn how to sustain themselves through the challenges that doing so presents. Studying a variety of trajectories and strategies would allow the field not only to better support teachers to work toward richer and more equitable mathematics instruction but also to develop more nuanced theories of how teachers engage with practices that they never experienced as K–12 students. Ryan’s example suggests that one direction for such study may be to investigate the kinds of communities that support teachers to transform the culture of exclusion through their classroom practice. Better understanding how these communities function, and how they themselves can be built and sustained, may prove critical for reculturing mathematics education.

Future research should also examine how inclusive framing affects students’ behavior, mathematical thinking and learning, and identities. What ratio of inclusive to exclusionary framing is necessary for achieving particular changes? Over what time scale? In addition, more research is needed to investigate how students themselves participate in framing (or reframing) mathematical activity and ability.

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Submitted September 29, 2016

Accepted January 6, 2017