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Negotiating Perceptions of Tracked Students: Novice Teachers Facilitating High-Quality Mathematics Instruction

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In this article, the author reports on a participant-observation case study that explored how alternatively certified, middle school teachers' expectations of tracked students affect their ability to learn to teach in ways that promote students' mathematical struggle and participation in productive mathematical discussions. Two teachers—one teaching a "high-tracked" course and the other a "low-tracked" course—were participants. Both teachers initially held perceptions of their students that limited their efficacy and self-efficacy with respect to providing high-quality mathematics instruction. However, through program- and school-based mentoring, including participation in a modified reflective-teaching cycle, the teachers learned to learn from their teaching and modify their practice. Both teachers began to allow their students opportunities to struggle with rigorous mathematics and participate in student-centered discussion.

KEYWORDS: academic tracking, African American/Black students, high-quality mathematics instruction, reflective teaching

The National Council of Teachers of Mathematics (NCTM) states, "An excellent mathematics program requires that all students have access to a high-quality mathematics curriculum…[and] high expectations" (2014, p. 5). High-quality mathematics, according to the Common Core State Standards for Mathematical Practice (CCSSMP), provides students, among other things, opportunities to participate in mathematics instruction that asks them to "make sense of problems and persevere in solving them" (CCSSMP, 2016, ¶2) and to "construct viable arguments and critique the reasoning of others" (¶4). In the interest of justice, *all* students should have access to rigorous, high-quality instruction. Both the NCTM and the CCSSMP claim equity as a driving purpose for the importance of the implementation of standards of high-quality mathematics instruction. The development of both the NCTM and the CCSSMP was guided by the desire to make high-quality mathematics available to all students, regardless of race, SES, language, school placement, or course placement, so that all students become college and career ready and are internationally competitive. The language of *all* espoused throughout both the NCTM and the CCSSMP documents, however, may not be sufficient to

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ensure equity (Apple, 1992), but rather suggests what may be considered a necessary step in the road to equity: equality of opportunity. Martin (2015) contends that the documents perpetuate the goals and ideals of middle- and upper-class White privilege and decenter the needs of those children and youth who he calls "the collective Black" (p. 21). Therefore, we must first think about how the mathematics being taught in schools to students of non-dominant backgrounds mirrors (or not) what the NCTM and the CCSSMP consider high-quality mathematics instruction.

Historically, the perceived student responsibility for learning mathematics focused on following rules presented by the teacher or the textbook, memorizing and applying those rules, and verifying correctness through an authority such as the teacher or the textbook (Cobb & Yackel, 1996; Lampert, 1990; Schoenfeld, 1992). This type of instructional practice can be formal and restricting and, for many students, can limit opportunities to develop their mathematical reasoning (Brown, Collins, & Duguid, 1989; Stein, Grover, & Henningsen, 1996). In addition to the strong language around problem solving and mathematical discussion of the CCSSMP, the *Principles and Standards for School Mathematics* (NCTM, 2000) also states that students should be able to "make and investigate mathematical conjectures" and to "develop and evaluate mathematical arguments and proofs" (pp. 57–58). Furthermore, this type of reasoning should be augmented through communication as students—

> organize and consolidate their mathematical thinking through communication; communicate their mathematical thinking coherently and clearly to peers, teachers and others; analyze and evaluate the mathematical thinking and strategies of others; [and] use the language of mathematics to express mathematical ideas precisely. (p. 60)

If these understanding, communication, and reasoning goals and standards are to characterize norms of practice as evidenced in schools, there will need to be a fundamental adjustment in participation structures within the mathematics classroom (Foreman & Ansell, 2001; Herrenkohl & Guerra, 1998). Through mathematical communication, students and teachers may work and reason together as they "do mathematics" in a way that augments the mathematical knowledge that students are expected to know (Cobb & Yackel, 1996).

Therefore, it is important to investigate how new teachers learn to teach in ways that encourage students' perseverance in problem solving and participation in productive mathematical discussion with equitable practice and meaningful learning as the ultimate goal of these practices. In the study discussed here, I investigate two novice, alternatively certified, middle school teachers' perceptions of their tracked students and how those perceptions affected their efficacy and self-efficacy with regard to infusing their classrooms with perseverance in problem solving, mathematical sense making, and productive discussions. Two research questions guided the inquiry:

1. How might alternatively certified, middle school teachers' expectations of tracked students affect their ability to learn to teach in ways that promote students' mathematical struggle and participation in productive mathematical discussions?

2. How might these teachers negotiate their perceptions of students and learn to teach in ways that promote students' mathematical struggle and participation in productive mathematical discussions?

Review of Relevant Literature

This study integrates and is informed by two primary bodies of literature, tracking and alternative certification. Taken together, this literature shaped the rationale and purpose for this study.

Expectations in Schooling, Urban Schooling, and Tracking

Novice teachers from alternative certification programs are often used to fill vacancies in "hard-to-staff" districts or schools that are more times than not populated with underserved students (Darling-Hammond, 2000). Too often, both novice and experienced teachers in these hard-to-staff schools have deficit perspectives of low-income students of color (Delpit, 2012; Habermann, 1991). These deficit perspectives may be more prevalent for teachers prepared in alternative certification programs than for those prepared in traditional teacher education programs (Brantlinger & Smith, 2013).

Furthermore, academic tracking may further compound deficit perspectives that many teachers hold of low-income students, particularly, low-income students of color. Tracking is pervasive in education, and teachers of tracked students may have particular perceptions of these students' ability, negatively altering their instruction based on these perceptions (Futrell & Gomez, 2008; Oakes, 2005). Not only are low-income students of color often placed in "low-track" courses, denying them equal access to high quality curricula, but also they are less likely to have certified, high-quality teachers (Furtrell & Gomez, 2008; Oakes, 2005). This unequal access to both high-quality curricula and teachers is doubly detrimental in mathematics. Access to high-quality mathematics instruction can provide a gateway to future academic achievement, and can be considered a new civil right (Moses & Cobb, 2001; Oakes, 1990; Smith, 1996; Spielhagen, 2010).

Oakes and Lipton (1996) contend that students placed in high-track courses have access to richer mathematics instruction as well as more content. Access to cognitively demanding mathematics instruction and content provides students entrée to college preparatory high school courses and higher probability of engaging in mathematics related fields post-secondary school (Oakes, 1990; Oakes & Lipton, 1996; Smith, 1996; Spielhagen, 2010). When analyzing the Third International Mathematics and Science Study (TIMSS) data, Stigler and Hiebert (1997) found that education in the United States, in general, is often dominated by the teacher, following a pattern where teachers demonstrate a particular concept or skill, and then ask students to practice what they have "learned" by rote in an application phase. This prescription for instruction is reinforced over generations, regardless of reform efforts, because teachers often resort to providing their students the same instruction as they themselves experienced (Lortie, 1975). Furthermore, teachers in schools serving low-income students of color often are directed or feel the need to administer scripted curriculum that results in students participating in low-level tasks far more often than teachers placed in schools serving affluent, predominantly White populations (Delpit, 2003).

Student expectations. Teachers of low-income students of color often convey low expectations of the educational potential of their students (Delpit, 2012; Habermann, 1991; Oakes, 1992), regardless of the way students are sorted into tracks, which can bear little relation to the students' actual ability in mathematics (Oakes, 2005). These low-expectations cause many teachers to engage their students in educational experiences that require little higher-order thinking, discussion, or sense making through problem solving. Teachers of tracked courses often modify their instructional methods based on their perceptions of the educational potential of the students in those classes (Braun, Nielsen, & Dykstra, 1975; Eder, 1981; Oakes, 1992; Raudenbush, Rowan, & Cheong, 1993; Rosenbaum, 1980; Watanabe, 2008). Reciprocally, tracking, as well as race and SES, can be deterministic with regard to the teachers' and other stakeholders' expectations for their students' educational potential (Oakes, 1992, 2005).

Student testing used to evaluate both schools and teachers is prevalent in schools that serve low-income students of color. The emphasis on testing, in turn, too often results in teaching methods that are likened to "a thin gruel of test preparation … [t]he drill-and-kill practices that guarantee students will not be ready for college, skilled employment, lifelong learning, or effective citizenship" (Neill, 2012, p. 24). The tradition of administering low-level curriculum that is specifically focused on test-preparation may be pervasive in any track, regardless of the "objective" level of student ability (Bol & Berry, 2005; Bol & Nunnery, 2004; Delpit, 2003).

Student placement in tracks due to expectations and resultant treatment due to both expectations and subsequent placement is a reciprocal relationship (Braun et al., 1975). Teachers believe that students are placed appropriately, whether due to race, SES, or perceived ability level (Oakes, 2005), and therefore treat their students differently. Teachers expect more from those whom they perceive as highly motivated or high achieving, and therefore ask questions that are more rigorous and provide higher-level educational experiences (Braun et al., 1975; Brophy & Good, 1970; Cooper, 1979; Dusek, 1975; Oakes, 1992; Page, 1990; Watanabe, 2008). Track placements are often permanent, and those students in low tracks experience less rigorous instruction and lower-quality materials (Rosenbaum, 1980).

Tracking in mathematics. Tracking is pervasive in mathematics programs, and is used to sort students based on many different characteristics, including perceived ability, academic performance, test scores, or non-academic reasons (Bol & Berry, 2005; Oakes & Lipton, 1996). Although tracking in mathematics has been defended as a mechanism to ameliorate the "achievement gap" (Bol & Berry, 2005), there is *"no empirical evidence to justify unequal access to valued … mathematics curriculum, instruction, and teachers"* (Oakes, 1990, p. xi; emphasis in original). African American and Latin@ students are over-represented in low-track courses and often have less qualified teachers, and are subjected to low expectations. However, low expectations of low-tracked students often begin before placement in tracks. There are many instances where African American and Latin@ students are placed in remedial mathematics programs even when the measures of their academic ability are equal to or better than their White and Asian peers (Education Trust, as referenced in Love, 2002). These low expectations of students are reflected in instructional and assessment methods used in mathematics courses, which result in less emphasis on high-quality mathematics instruction (Flores, 2007; Irvine & York, 1993).

Tracking in mathematics has long-term effects on the trajectory of low-income students of color. For example, access to algebra in eighth grade influences students' mathematical knowledge, productive disposition, course taking patterns, and future mathematics achievement (Smith, 1996). Taking an Algebra I course in middle school offers students experience with demanding mathematics programs and allows them access to the mathematics pipeline, as Algebra I is often considered a "gatekeeping course" (Moses & Cobb, 2001; Oakes, 1990; Spielhagen, 2010). Enrollment in algebra in middle school also has a positive effect on students' access to a 4-year college (Spielhagen, 2010). Students of color, however, have less chance of being admitted to middle school Algebra I courses (Spielhagen, 2010).

Novice Alternatively Certified Teachers and Teacher Education

Novice mathematics teachers seem to be fighting an uphill battle. They are faced with providing instruction that is consistent with the new Common Core State Standards for Mathematical Practices (see CSSSMP, 2016). They are affected by the "apprenticeship of observation," which dictates that when they encounter a situation in which they are unsure, they revert all too often to the instructional methods of their own K–12 experience (Lortie, 1975). Furthermore, if they are placed in schools that serve low-income students of color which are historically low-performing, they may have expectations of their students that results in planning and enacting instructional routines which are low level in the intent to be test-preparatory (Delpit, 2003; Habermann, 1991).

Hiebert, Morris, and Glass (2003) suggest that it is unreasonable to expect that a teacher will learn everything they need to know to be an effective teacher during their teacher preparation program. This gap in knowledge is even more significant in the context of alternative certification, where the teacher education program is shorter in duration (Darling-Hammond, 2000). Such gaps may affect their efficacy in providing high-quality mathematics education as well. Hiebert and colleagues argue that in order for teachers to "learn to learn to teach" (p. 201), they must treat their teaching experience as an experiment, and be taught to learn from their own practice as a scientist would learn from an iteration of an experiment. With help, novice, alternatively certified teachers may be able to learn to learn to teach in ways that engage students in productive, high-level mathematics discussion regardless of their race, SES, or track placement.

The literature reviewed highlights the importance of investigating how new teachers' perceptions of tracked, low-income students of color affect their instruction, and how they may be supported to negotiate the challenges that the teachers' notions of student ability pose in order to provide high-quality mathematics instruction.

Conceptual Framework of Mathematics Instruction

An in-depth understanding of mathematics includes not only the knowledge of rules and procedures but also the ability to engage in mathematical sense making, participate in productive mathematical discussions, and have productive dispositions toward mathematics (National Research Council [NRC], 2001). For the purposes of this article, *mathematical sense making* is defined as valuing and applying abstraction and using those tools to understand mathematical structures (Schoenfeld, 1994). *Productive mathematical discussions* are those student-centered discussions where ideas are communicated mathematically so the shared ideas can be publicly understood, critiqued, and guided toward a learning goal (Smith & Stein, 2011). And *perseverance in problem solving* is describe as when students make conjectures about different solution paths and monitor and evaluate their progress, making changes whenever and wherever necessary (CCSSMP, 2016).

Mathematics classrooms that have students make sense of and persevere in mathematics problem solving through productive discussions and collaborations can be considered a more indirect form of instruction. Some researchers have argued that when instructional schemes in mathematics classrooms focus on problem solving, communication in groups, and more indirect pedagogy (i.e., student-centered and focused on student investigation and sense making), students from the dominant culture may be privileged (Apple, 1992; Delpit, 2006; Lubienski, 2000).

Other researchers have found that classrooms organized around these principles can be equitable and beneficial to low-income students of color if support systems are in place, and careful attention is given to assigning competence and developing norms for problem solving (see, e.g., Boaler & Staples, 2008; Gutiérrez, 2000; Kitchen, DePree, Celedón-Pattichis, & Brinkerhoff, 2007). This conditional clarification is consistent with the recommendations of researchers who suggest that students from outside the dominant culture must be given explicit access to the "culture of power" that will allow them to be successful (Bourdieu, Passeron, & de Saint Martin, 1994; Delpit, 2006).

In theorizing about how to dismantle the culture of power in mathematics education as a shift toward equity, Gutiérrez (2007) offers four dimensions to consider: access, achievement, identity, and power. *Access* relates to the tangible resources that students have available to them to participate in mathematics, including teachers, technology, curriculum, and classroom environments that foster participation. *Achievement* includes enrollment and participation in mathematics courses, standardized test scores, and persisting in the mathematics pipeline. *Identity* addresses students seeing themselves in the mathematics curriculum, as well as seeing themselves and mathematics in the world. *Power* refers to the presence or absence of student voice and decision-making abilities, ability to apply mathematics as a critical lens through which to see society, alternative forms of knowledge, and the representation of mathematics as a field that needs people.

Providing students with access to teachers who can provide a rigorous and affirming mathematical experience is beneficial to equity. Incorporating tasks of high-cognitive demand and opportunities to participate through student-centered, productive discussion allows students access to achieving a type of mathematical proficiency that allows them the ability to apply their knowledge outside of the mathematics classroom (see NRC, 2001; Smith & Stein, 2011; Stein, Smith, Henningsen, & Silver, 2000). Having student voices and decisions around mathematical problems with multiple possible solutions or solution strategies as a central feature of the mathematics classroom facilitates students' power in the classroom.

To facilitate student sense making and productive discussion, teachers may structure lessons around problematic or investigative tasks, set up these tasks to aid student access, and require students to complete the tasks collaboratively in small groups (Boaler, 2002a, 2002b, 2006). Teachers may assert and maintain expectations, and develop norms for students' production of explanations of mathematical solutions strategies in small- and whole-group discussions, as well as require students' active engagement with making sense of, responding to, and attempting to understand student explanations and justifications (Wood, 1999; Yackel, 2001; Yackel & Cobb, 1996). Such instructional strategies mean that students must be able to answer questions such as "how" and "why," and that teachers may ask probing, leading, or advancing questions to encourage students to develop these answers

(Bowers, Cobb, & McClain, 1999; McClain & Cobb, 2001; Yackel, 2001; Yackel & Cobb, 1996). Having students pose questions to others is another important component of sense making through discussion (Borasi, 1992; Ciardello, 1998; Zack & Graves, 2001).

To promote this exchange between students, teachers may direct student questions to other students, asking students to revoice a students' explanation or to pose a question if they cannot revoice. To structure discussions that promote sense making, teachers may also carefully choose solutions to be presented so that a discussion of reasonableness or correctness of those solutions may result (Smith & Stein, 2011). Teachers may use instructional strategies of their own design, or use strategies that are presented to them during teacher preparation courses or through teacher-support systems, such as teacher mentoring.

Integrating these facets of equitable instruction is challenging work for any mathematics teacher; it is especially challenging for new teachers (Achinstein & Athanases, 2005). In particular, it is important to attend to the expectations that new teachers have of students. Teachers' expectations of students may affect teachers' ability to provide students access to high-quality mathematics instruction (Oakes, 2005). Teacher's expectations of students may be influenced by race, SES, and perceived ability level (Delpit, 2012; Habermann, 1991; Oakes, 2005). In particularly, there is a dangerous and harmful essentialism present in the discourse around low-income students of color and education: that most members of this collective subpopulation are inherently low performing, specifically so in mathematics (Faulkner, Stiff, Marshall, Nietfeld, & Crossland, 2014; Martin, 2012; Stinson, 2006).

Methods

Design

This study used participant observation within a case study (Yin, 2009). Yin defines case study as "an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between the phenomenon and the context are not clearly evident" (p. 18) The methodology employed allowed me to describe in depth the instructional strategies considered and co-constructed by the novice teachers and me within the context of mentoring sessions and a teacher seminar (subsequently described). Due to the nature of the study, and my relationship with the teachers, I learned much about them, both professionally and personally. The collected data provided firsthand notations and records describing their experiences and professional change evidenced through the talk and action of the teachers within the context of their mentoring and seminar support as well as their actions within their classrooms and schools.

Program Context

The context of this study was first-year teachers who were enrolled in an alternative certification program. Alternatively certified teachers were chosen for two reasons. First, alternatively certified teachers are often less prepared to teach in ways that result in high levels of student mathematics achievement due to the truncated nature of their teacher preparation (Brantlinger, Cooley, & Brantlinger, 2010). Second, as previously noted, alternatively certified teachers may hold lower expectations for low-income students of color than traditionally certified teachers in the same context (Brantlinger & Smith, 2013; Delpit, 2012; Habermann, 1991). It is imperative, in the interests of equity, to investigate these teachers' expectations of their tracked students, as well as how they may be taught to negotiate these expectations.

The program for which I served as a mentor and in which the participants were enrolled was a collaborative effort affiliated with a large mid-Atlantic university and a large local school district. Locally, it was not unusual for schools in this district to be described as hard to staff; in that, many of the schools had a history of low student performance on the state's high-stakes standardized assessments, had a high rate of teacher turnover, and had a predominant population of students who were low-income children of color. By design, this alternative certification program recruited prospective teachers who were committed to the community and/or the population of the student body. Those who enrolled in and successfully completed the requirements of the program were certified as teachers of middle school mathematics or science and one other core middle school subject. While it encompassed some of the features of alternative resident-teacher certification programs, the program was designed so that prospective teachers were slowly introduced to teaching. During the summer, they were enrolled in a short field experience. When they entered teaching in the fall, they were partnered with a cooperating teacher for a month-long internship, and then subsequently assumed a half-time (rather than a full-time) teaching load while partnered with another novice teacher from the cohort. In this way, a pair of novice teachers filled a full-time teaching vacancy. Through pairing, teachers were able to gain experience with the work of teaching and to observe other teachers during their non-teaching time.

Participants

The participants in this study were two novice teachers enrolled in the alternative certification program described. During the year in which I collected data, there were 13 teachers enrolled in the program. Eleven of those teachers' primary certification was in mathematics. Of those 11 teachers, nine agreed to participate in the study. After conducting preliminary observations of these nine teachers in their summer methods course, I selected two based on my perception of their initial predispositions for and conceptions of teaching and placement to solicit data from two contrasting cases (Yin, 2009). The first, Jack Davis (all proper names are pseudonyms), was selected due to his unabashed commitments to student-centered instruction. The second, Michelle Miller, was selected because of my perception of her reticence to teaching in a conceptual, student-centered manner. These teachers were my mentees in the alternative certification program and participated in a teacher seminar while simultaneously participating in the requirements of the teacher preparation program. Although both teachers are African American, it was not intentional; the alternative certification program attracted a high number of teachers of color as the program was focused on recruiting candidates that had an investment and commitment to the urban community in which they were going to teach.

Michelle and Jack shared a vacancy in a K–8 public school academy. The students in the middle school program were tracked in all of their classes based on their reading scores. That is, the students' scores on a reading assessment determined whether they were placed in the honors track for all of their classes or the comprehensive track (i.e., the low track) for all of their classes. Michelle was assigned to teach the low-track courses; Jack was assigned to teach the high-track courses.

Michelle Miller. Michelle Miller is an African American woman. She had earned both a bachelor's degree in physics and a master's degree in mechanical engineering and previously worked as an automotive engineer before deciding to become a teacher. Her experiences in school and in her subsequent profession were characterized by sexism. During her undergraduate education, all of her mathematics and science professors were men who rarely provided her with the substantive feedback necessary to achieve. As an engineer, she felt isolated and excluded from any employee bonding activities. She had no prior teaching experience before entering the program. The licensures that she subsequently earned through enrollment in the program were in middle grades mathematics and science. Michelle's initial one-month internship was in the same school where she was subsequently assigned as a paired, half-time teacher. This school was a public K–8 academy. Michelle's permanent placement assigned her to teach the low-tracked seventh-grade mathematics and science courses; she taught one section of each subject.

Jack Davis. Jack Davis is an African American man. He entered the program immediately after receiving his undergraduate degree in economics. His K–12 experiences with mathematics were racialized; even though he was high-achieving he and his family still had to fight for his placement in the high-track mathematics courses. He also received his education in the same school district in which he was teaching. His previous instructional experience encompassed mentoring and providing tutoring for middle school students. The licensures that he earned through enrollment in the program were in middle grades mathematics and social studies. Jack interned and was permanently placed in the same K–8 school as Michelle. He taught one section of seventh-grade honors mathematics and one section of seventh-grade social studies.

Setting

The school in which Jack and Michelle were placed enrolled nearly 700 elementary and middle school students in 2011. Ninety-five percent of the students enrolled at the school were African American and 2% were Hispanic or Latin@. Sixty-nine percent of the middle school students were considered low income, according to the data on students receiving free or reduced-price meals. Fourteen percent of the middle school students were receiving special education services. Both Jack and Michelle taught tracked mathematics courses, where the students were placed into all their courses based on a standardized reading inventory. Although mathematics and reading scores may be correlated, this placement is significant because Oakes (2005) suggests that often teachers tacitly accept the placement procedures as objective and appropriate regardless of the methodology and appropriateness of placement. This setting is also of particular importance because studies of the differential expectations and educational experiences of students in tracked courses are often studied in more diverse settings (e.g., Oakes, 2005). There is a need to investigate the implications of tracking on the expectations of teachers in tracked settings where the majority of the population is low-income students of color, where expectations are already low, and the cognitive demand of the curriculum is often lowered across all tracks (Delpit, 2012, 2013).

Researcher Positionality

As a researcher, I worked closely with the participants in this study. I was their program provided mentor and supported them during their first year of teaching. Furthermore, I was an active participant in a seminar during their field placement. That is to say, during their initial year as a teacher, I influenced what instructional strategies were considered and potentially discussed as mechanisms for supporting and maintaining high cognitive demand during instruction (Stein & Smith, 1998).

I am a white, middle-class woman. I had a middle-class upbringing, and attended majority-minority schools in my K–12 education. I benefitted from a type of tracking discussed here, specifically, a gifted program that was originally created as a way to desegregate schools by incentivizing White student attendance. I recall being offended as a young person by the comments my parents' friends would make about their decision to send me to school with "those kids." After undergraduate education in computer science and mathematics, I came into teaching through a grant-funded alternative certification program. This program was a partnership between the same university and school district that partnered together for Jack and

Michelle's teacher education. I taught high school for 8 years in that same district before attending the university as a full-time doctoral student to conduct this study.

While I was teaching high school, I was also continuously enrolled in graduate coursework. The school in which I taught served a population of about 75% African and African American and 25% Latin@ students. I once again noticed, and was offended by, the reactions and negative comments about my students that I received when I would tell people where I worked. I increasingly began to recognize how important it was for me to educate myself on critical perspectives in education, culturally relevant pedagogy, issues of inequity and racism in education, and the cultures and lived experiences of my students if I was going to effectively conduct my duties as an educator. I enrolled in as many courses at the university that addressed issues of equity, power, race, and class in education as I could, and I made a concerted effort to engage in conversations about equity and diversity with my colleagues of color, both in the school and at the university. When I enrolled as a full-time student to complete my dissertation, my fellowship provided me the opportunity to work with an alternative certification program and mentor new teachers. I felt connected to this work because I had also been alternatively certified, I had taught in the same district, and the alternative certification program was attempting to bring in teachers who had a dedication or a connection to the district community. My experiences drove my dedication to mentor teachers to provide high-quality mathematics education for the low-income students of color whom my district served.

Mentoring

Features. The focus of the mentoring was on two interconnected features of instruction. First, I encouraged the teachers to find or develop tasks that provided students opportunities to perseverance with and make sense of mathematics to uncover relevant mathematics on their own through application of their prior knowledge to an accessible problem. Second, I encouraged the teachers to provide students opportunity to have productive small-group and whole-class discussions (Smith & Stein, 2011) about the relevant mathematics and to develop strategies of effectively facilitating that discussion without taking ownership of the discussion from the students. Because these teachers were novice teachers, many of the instructional strategies that I proposed arose either in discussion with them during individual mentoring sessions or group seminars. I served as a researcher collecting data and as mentor of these individuals operating with the intent of supporting each of them throughout their first year of teaching.

This mentoring is important because several researchers argue that mentoring should be integrated into transformation of the teaching profession as well as an inquiry-based approach to incorporating all the features of education reform, including standards-based practices (Feiman-Nemser & Parker, 1993; Hargreaves & Fullan, 2000; Stanulis & Floden, 2009). Research suggests that focusing on "balanced" approaches to instruction would improve the actual practice of teaching, rather than simply focusing on emotional support of new teachers (Stanulis & Floden, 2009). Furthermore, there is a call for more research on how to support novices in their development of reform-based teaching by incorporating the standards into the base conception of induction mentoring practice (Wang & Odell, 2002). This mentoring treatment foregrounded two of the Standards of Mathematical Practice (CCSSM, 2016), "make sense of problems and persevere in solving them" (¶ 2), and "construct viable arguments and critique the reasoning of others" (¶ 4), while simultaneously incorporating content standards, mathematics teaching practices (NCTM, 2014), other standards of mathematical practice (CCSSM, 2016), and the NCTM *Principals and Standards for School Mathematics* (2000).

During this mentoring process, I provided time and guidance during collaborative sessions for the teachers to reflect on videos of instruction as well as their own teaching by focusing on teacher moves that promoted or did not promote students' sense making and productive discussion (Smith & Stein, 2011). During the planning sessions, Michelle, Jack, and I met as a group to either plan individual lessons or whole units. I shared information about tasks that, I believed, would promote student discovery of mathematics; the ordering of topics in a way that made mathematical sense; the different topics that would need to be incorporated; how to promote discussion; and what manipulatives would be appropriate for hands-on, concrete learning opportunities. During observations, I usually simply took notes, but there was one occasion that I co-taught with Michelle while Jack observed as a response to a request from Michelle. During reflection sessions, I would focus on giving feedback on specific teacher moves or plans that, from my perspective, supported or inhibited student sense making and productive discussion. We would also collaboratively review student data and make decisions on next steps for student learning. The content of each mentoring cycle is summarized in Table 1. The first cycle is disaggregated between Jack (J) and Michelle (M), as that planning session was conducted individually, while all the others were conducted in a group of three (Jack, Michelle, and me).

Differences in mentoring of Michelle and Jack. When specifically focusing mentoring resources on Michelle, the work of mentoring became focused on lesson and unit planning. Together, we worked on planning lessons that included tasks that were of a high level of cognitive demand, and included opportunities for student talk. When specifically focusing mentoring resources on Jack, I attuned Jack to the on-task discussions that the students had without his direct intervention, as well as mentored him to reduce the amount of scaffolding (e.g., leading questions) that he provided to small groups during their time working on problems that had high cognitive demand. Also, because Michelle and Jack observed each other due to their half-time teaching arrangement, they were each able to participate in the other's reflection conversation with me and support the positive strides that both students and they were making with respect to having students persevere with, make sense of, and discuss mathematics.

Table 1
Mentoring Cycle Content

Cycle	Content
1 (J)	• Task with high cognitive demand (Stein & Smith, 1998) • Individual work, small-group work, and whole-class discussion (Lampert, 2003) • Calling on students randomly during whole-class discussions • Moving toward questions that elicit mathematical thinking rather than leading questions (Driscoll, 1999) • Using talk moves to engage more students in whole-class discussion (Chapin, O'Connor, & Anderson, 2009)
1 (M)	• Task with high cognitive demand (Stein & Smith, 1998) • Individual work, small-group work, and whole-class discussion (Lampert, 2003) • (*teacher suggested*) Student roles in groups (Johnson & Johnson, 1999) • Feedback on student investigation implemented as direct instruction • Feedback on Initiation-Response-Evaluation model of student talk • Using talk moves to give students agency in their learning (Chapin, O'Connor, & Anderson, 2009) • Allotting enough time for student sense making
2	• Co-planning open-ended task with high cognitive demand (Stein & Smith, 1998) • Co-teaching and facilitating student whole-class discussion with Michelle as Jack observed • Feedback on pacing of lesson; do not have to wait until all students have the right answer to have a summary discussion • Feedback on focusing on mathematical goals • Analyzing student work • (*Jack*) Feedback on effective use of talk moves (Chapin, O'Connor, & Anderson, 2009)
3	• Teacher reported that administration wanted more use of hands-on activities and manipulatives • Task with high cognitive demand (Stein & Smith, 1998) • Unit planning – Expressions and Equations • Guess-Test-Generalize (CME Project, Algebra I) and Polya's Problem-Solving Techniques (Polya, 1945) • Guidance to avoid using keywords to decode word problems (NRC, 2001) • Concrete-Representational-Abstract sequence of instruction (Witzel, Mercer, & Miller, 2003) and the National Library of Virtual Manipulatives • Activating prior knowledge (Hollingsworth & Ybarra, 2009) • Facilitating teachers doing the math
4	• Having students construct their own mathematics definitions based on examples • Using multiple different representations of figures • Unit planning – Geometry • Task with high cognitive demand (Stein & Smith, 1998) • Heterogeneous grouping • Small-group stations • Using rubrics to hold students accountable for participation in small-group instruction • Asking a random student to explain to the teacher to encourage students collaborating to develop an explanation (Boaler & Staples, 2008) • (*Michelle*) Feedback on slow pacing and lowering of cognitive demand

5	• Unit planning – Data Analysis • Tasks with high cognitive demand (Smith & Stein, 1998) • Developing a project for Project-Based Learning (Krajcik & Blumenfeld, 2006) • Working through why constructions "work" based on properties of circles with the teachers
6	• Review of project for Project-Based Learning (Krajcik & Blumenfeld, 2006) • (*Jack*) Review of the mathematics behind misleading graphs • (*Michelle*) Reflection on successful whole-class discussion on which data displays are appropriate for which situations
7	• Reflection on the project • Discussion of the upcoming unit • Discussion of upcoming testing and field trips • Benefits of including tasks with high cognitive demand and small-group discussion • Closing out coaching

Data Collection and Analysis

I collected data from seven teacher-support reflection cycles. Each support cycle took place over approximately two weeks. These sources allowed me access to teacher expectations of students as well as their instruction trajectory (see Table 2).

Table 2
Description of Data Sources

Data Collected	Description
Collaboration: Teacher Seminar	All mentees (four mentees and I) met to review teaching videos and their own teaching with an eye to student sense making and discussion. Sessions were videotaped.
Planning: Mentoring Session	Jack, Michelle, and I met bi-weekly to plan lessons and units.
Observations	Lessons were observed bi-weekly. There was one instance of co-teaching with Michelle while Jack observed.
Reflection: Mentoring Session	After the observations, the mentor and the participants met one-on-one to debrief the lesson.
Baseline	Baseline data was collected through observations of participants' summer coursework, reading of their submissions in summer coursework, and interviews about how to teach with a task.
Follow-up Interview	Participants were interviewed after the original treatment in order to reflect on questions on what transformed their teaching.

Within the teacher-support reflection cycle, all of the planning and reflection mentoring sessions were audio recorded and transcribed. Each teacher seminar, as conducted between November 2011 and March 2012, was also video recorded and transcribed. Although seven classroom observations of each participant were conducted, only three of these were sources for data collection. The teaching observations that served as sources for data collection were conducted in November 2011, during Cycle 1 of the teacher-support reflection cycle; in January 2012, during Cycle 4 of the teacher-support reflection cycle; and in March 2012, during Cycle 7 of the teacher-support reflection cycle. I identified these particular classroom observations as sources for data collection to establish whether instructional change had transpired as documented by the beginning, middle, and end of the study. I took field notes during each of these three observations and made notations that indicated particular features of the lesson that were relevant to analysis pursuant to answering the research questions. These notations consisted of codes that I hypothesized before conducting the study. Each teacher also carried an audio-recorder to document their verbal teacher moves as well as responses from students with whom they were interacting. These audio-recordings were transcribed. My observational data consisted of field notes and audio transcripts; however, my audio transcripts are limited to statements of teachers and the responses of students in interaction with their teachers.

The codes for this corpus of data were centered on strategies and challenges. I looked for instances of strategies that the teachers were using to incorporate mathematical sense making and productive discussion, both those that the teacher used independently and those that we developed together. I also looked for the teacher using language that suggested they were struggling to implement high-cognitive-demand tasks that allowed students room for discussion, and what they expressed as their challenge. Working with other colleagues in the doctoral program, we coded pieces of data independently to ensure the coding method was reliable. A subcode that arose during analysis in the "challenge" codes was student ability. Teacher talk that referenced their notions of their students' ability to participate in the mathematics arose regularly.

Findings

During their interactions with me in the mentoring sessions, both Michelle and Jack expressed their expectations of their students' ability due to their track and their experiences interacting with their students. They also, through mentoring and reflecting on their experiences with their students, began to develop the ability to provide high-quality mathematical experiences that allowed their students to engage in mathematical sense making through participation in productive mathematical discussion.

Michelle: Low-Tracked Course

Initially, Michelle had low expectations for her students in the low-tracked course. Through mentoring and experience with her students, however, she began to teach in a way that provided opportunities for students to engage with high-quality mathematics tasks and participate in mathematical sense making through productive discussion.

Michelle's perception. As we discussed mathematical content in a manner that focused more on overarching mathematical ideas and topics rather than presentation of single, isolated skills, Michelle's perception of her students' ability and the successes they would be able to experience when approaching mathematics through both concepts and skills often troubled her. In one mentoring session, I suggested that a teacher could teach equation writing and solving from a conceptual perspective based on generalization from arithmetic and working backwards to undo arithmetic procedures. I posited that then it would be unnecessary to teach solving one-step equations using addition, subtraction, multiplication, and division, and then two-step equations with combinations of those as individual elements. I suggested that initially thinking about an equation as a procedure with a result would allow students to think about what was done to the variable and then what would have to be undone to return back to the value of that variable. Michelle responded by stating that she would separate one-step and two-step equations and then further break down one-step equations to focus on those that involved addition and subtraction as a single skill, and then subsequently address those one-step equations that involved multiplication and division:

> **Michelle:** Well, I don't know, I probably would for [my class]. Maybe I wouldn't take 2 days for each [operation]…. I can combine addition, subtraction and then multiplication, division.
> **Jack:** I can see that.
> **Michelle:** I would put those together but I would do step-by-step. I wouldn't combine them all at once and do several different operations with [my students]. So, okay, well I'm happy that it gives us a time to teach conceptually in step-by-step with the operations. Okay.

In this explanation, Michelle immediately followed her statement of preference for isolating addition and subtraction one-step equations from one-step equations involving multiplication and division with the statement that she was happy to have the time to teach conceptually. This response suggests that although she wanted to use manipulatives to have the students visualize the individual operations, she still felt the need to isolate a single skill into a lesson. When I suggested that she could address solving equations as one concept, she resisted. She stated, "Yeah, you probably could do it in your class" (Michelle, Mentoring Session, December 9, 2012), referring to Jack's class. This highlights her concern about her students' ability level, because the school labeled Jack's class as an honors class and labeled Michelle's class as comprehensive, ostensibly populated by students with a lower level of ability.

Michelle's change in perception through experience. It may be that Michelle was experiencing some dissonance between her perception of what she felt her students were able to accomplish successfully and what they actually were able to do. She had been seeing her students have successes in the classroom on problems that she felt might have been too difficult for her students to approach. She had stated previously: "Sometimes you're kind of leery in giving them stuff and then run off on their own. But sometimes they surprise you" (Michelle, Seminar, November, 21, 2012). The successes that she was seeing her students experience in the classroom from more discourse-based, conceptually focused instruction challenged her previous ideas regarding the limitations associated with perceptions of her students' limited ability and allowed her to try more difficult mathematics problems with her students.

Not only did Michelle begin to incorporate richer mathematics problems into her teaching but also she began to include more small-group work. She had students work together on real-world problems and allowed students to reason through the problems concretely before she asked questions that would help them think about the mathematical ideas behind them. She found that her students were successful in translating their thinking into mathematical terminology:

> So, for example, a lot of them, they started off with 30 and then $10 was for food, so they took out $10 out of the total 30 and I said, "What are you doing? What are you actually doing when you're doing that?" And they get it! They say, "Oh, I'm taking away. Oh, what's the mathematical term [for that]? Oh, subtracting." (Michelle, Mentoring Session, December 30, 2011)

Michelle was happy to see that her students were "getting it" when they were approaching word problems, as Michelle had initially considered word problems to be too difficult for her students. She saw her students have success working on a problem in their small groups without her intervention and without her leading the students through the whole process of problem solving. These instances of students working together to solve difficult mathematics problems allowed her to feel that she could take more risks in her mathematics classroom. She began to change her perception of scaffolding. Originally, she thought of scaffolding as the practice of offering leading questions that directed students through the intended individual procedures and skills in the classroom. Now she was scaffolding by asking guiding questions that facilitated students' mathematical thinking while they investigated problems using concepts and ideas.

Michelle seemed to use what she knew or learned about student difficulties in a lesson as an insight for influencing her future instructional decisions, instead of abandoning her plans entirely. Michelle taught a mathematics course and a science course to the same students. To engage her students in a conceptual discussion about different systems within the body, she had given her science class a homework assignment that required them to read about a certain system in the human body and then come prepared to discuss their knowledge with the class in small groups. However, she was disappointed that her students did not come to class prepared. She assigned blame to the students for not doing the homework assignment and therefore for sabotaging a lesson that would have focused on discussion. She noted, because of their lack of preparation, the students simply did not have anything to add to the discussion:

> I don't know. I had this nice thing planned, and it's one thing too when you're trying to have group work and facilitate discussion, you have to have something to add. I had a homework assignment, they were supposed to investigate things that they identified that they were going to do. If half the class doesn't do that, it's like I wanted to rotate them so that they would [teach] each other and provide information for one another. It's like, when they don't do the task; it just shuts the discussion down. Okay, you've got nothing to add. You know, they'll just be sitting there. (Michelle, Seminar, February 1, 2012)

Michelle expressed frustration with her students for their inability to participate in the discussion. In this case, it seemed that the students were not able to participate in the discussion because of the individual, at-home nature of the preparatory assignment. Michelle seemed to recognize this limitation, as she did not give up on having conceptual-themed discussions with this group of students. Instead, she modified her instructional strategies to allow time in class for students to formulate their responses in their small groups before engaging in the discussion. Subsequently, she tried again to organize a class based on the assumption that students would prepare for class in advance. But this time, Michelle did so with her mathematics class. In a unit on data analysis, she provided her students with a list of scenarios and asked the students to decide which data display would be the most appropriate in the given scenario. She also provided them with a reference sheet of key terms, definitions of those terms, and their exemplar applications, to allow students access to a discussion where there could be multiple correct responses to a single question. Instead of Michelle's initial scaffolding design, which was to assume control of the conversation and carefully guide the trajectory of student talk in the classroom, she positioned the students centrally in the discussion. She provided the students with a means of facilitating their discussion through their reference sheet and then allowed them to express their thinking to each other, only providing direction and comments when necessary to continue the flow of discussion. She began to place herself in a position of facilitator rather than director of classroom talk. After Michelle made these different instructional adjustments, she saw that her students could successfully participate in a conceptual discussion:

> And we're at the point [where] we're talking about which data display to choose and why, depending on the circumstance. So I had two scenarios, and I asked each group to talk amongst themselves to determine which data display they'll choose for [each of] the scenario[s]. And so, once they did that I opened it up to the floor. … and I called a group, a table, and they shared their response, and I said, "Okay, who agreed or disagreed and want[s] to add to it?" So, that spawned a lot of discussion. "Oh, look, I disagree because this, this, and this." And they were able to use the terminology of why… and recommend something else. And so, that kind of went on back and forth for a good

> 10 minutes, and it was a really good discussion. So I got to hear what they were thinking. So it was really good. Positive. (Michelle, Seminar, March 7, 2012)

Although Michelle had experienced earlier failures when expecting the students to prepare for and participate in whole-class discussions that focused on mathematical concepts and had multiple solutions, she had tried again and found success. She negotiated this challenge by providing not only class time to prepare in their small groups but also a reference sheet to remind students of the mathematical tools that they could use to respond to the tasks and to explain and justify their reasoning and solutions. This experience provided her with another example of student success in her classroom.

Summary of Michelle. Michelle taught 70-minute class periods throughout the year. In November, Michelle incorporated 5 minutes of small-group work, some guided presentation, and individual work. In the January observation, she attempted to allow students to collaborate in small groups for 5 minutes, then co-opted their discussion when she felt the student were struggling. By March, she spent 34 minutes of her 70-minute class period facilitating students' discussion in small groups, followed by student presentations and discussions of findings in the whole group. This transition can be attributed, in part, to the consistent mentoring that resulted in her having successful experiences with her students working on rigorous mathematics and having productive discussions.

Throughout the year, Michelle saw more successes in terms of her students' ability to access different mathematical problems in her classroom as she changed the types of scaffolds she provided. Instead of leading students through systematic procedures that she considered difficult for her students, she began to facilitate their interaction with mathematical concepts and their constituent skills. Where earlier in the year she would stop small-group time to demonstrate solutions to the exercises that the students were working on, later in the year she provided more indirect scaffolding and allowed the students to work together to solve problems. She discovered that her students were capable of working with other students on difficult mathematics with less teacher direction. She reflected on her surprise and happiness about her students' successes: "They do it and then you're shocked…. It went very, very well" (Michelle, Seminar, March 14, 2012). She seemed to continue allowing students more autonomy in their small groups as a result of her negotiation of this challenge, in addition to allowing her students more opportunities for working together. Furthermore, instead of removing instances in which she thought her students would struggle, she made different instructional decisions to support her students' efforts to working through not only mathematical skill but also the meaning of concepts.

Jack: High-Tracked Class

Although Jack initially believed that his honors tracked students would easily participate in sense making through productive discussion, his initial experience in the classroom gave him a different perception. Due to that experience, he became unsure and reticent about implementing instruction that promoted problem solving and discussion.

Jack's perception. Jack perceived that there were differences in his students' and Michelle's students' willingness to participate in student-centered instruction that included discussion. He stated:

> When I sit at my desk and watch [Michelle] teach and I see her students doing…it's easier for them to work off script…. I think my kids were technically supposed to be in honors classes, they like much more direct instruction and they don't like to be asked to do something first. They're a lot more resistant to it…. I think, like maybe, if you were in an honors class, you probably would be good at "doing school" and you'll be good at "doing school" if you were good at just listening and taking notes. (Jack, Seminar, November 21, 2011).

Jack felt that his students were acclimated to instructional techniques that directed them as to what to do and what to recall. Furthermore, he felt that his "honors" students were familiar with "doing school" in a particular way, a way that required them simply to sit quietly, listen, and take notes. He felt that Michelle's students might not have been as completely acculturated to direct instruction in the way that the honors students were, given that they were not considered to be "good at doing school." Therefore, he felt "being good at school" caused his students to be more resistant to participation in student-centered lessons and mathematical discussion, as compared to Michelle's students.

Jack also believed that his students' familiarity with particular norms of schooling prevented them from productively collaborating; in that, instead of explaining and justifying solution strategies, asking clarifying questions, making sense of different solution strategies, and sharing the work, they were used to simply providing and sharing answers. He felt that his students were more comfortable with working individually rather than in small groups:

> I hope they drag [the students who do not understand] with them and not just leave them alone…. It's hard to make them cooperate you know…. Sometimes they just like to do it on their own. (Jack, Mentoring Session, January 18, 2012)

Jack wanted his students to work together so that a student who had a greater understanding of a particular topic could assist the other students who were not as secure. However, the students' comfort with working individually, rather than collaboratively, made it difficult for Jack to get them to assist each other when addressing a mathematics problem in small groups.

Jack attributed his students' resistance to student-centered mathematics and participation in discussion to the type of instruction with which his honors students were familiar. This resistance was not what he had expected as he entered into teaching believing that students who were labeled honors would find it easier, as compared to the "comprehensive" students, to participate in discussion and student-centered instruction. His students' resistance to collaborative problem solving and discussion, however, led him to believe that his students had repeatedly experienced instruction in their years of honors course placement which were organized around lecture, note taking, and independent seatwork. He reflected during a follow-up interview during the following school year:

> If anyone, I would expect them to be able to handle it more…like I said…it was harder for them to make the jump to doing something extra. I guess what they saw as something extra. As long as they could write it down, I think they thought that was sufficient. Um, but I guess I had to spend time explaining like, "You learn more, you learn more by teaching." (Jack, Follow-Up Interview, May 7, 2013)

Because Jack believed that his students previously had solely been required to complete problems individually and to record their answers in written form, they were resistant to doing something they felt was unnecessary, or "extra." Therefore, Jack had to reinforce his expectations consistently and to provide a rationale as to why students would benefit from discussing mathematics to entice his students into participating fully.

Jack's change in perception through experience. Initially, Jack attempted to implement a procedure whereby those students who finished a particular problem first would serve as experts and assist other students in completing that problem. During an early seminar, Jack explained the problem with this particular strategy:

> So, one thing I tried…in terms of getting students to appreciate each other, [or] what each other has to…say…when they work on something,…. Whoever finishes first and gets it correct, they get to go around and explain it to the rest of the class and like check off the papers and stuff. But what I noticed was that…they weren't explaining. (Jack, Seminar, November 7, 2011)

Jack wanted his students to discuss and explain their solution strategies to others in order for each of the students to develop an appreciation of other students' thinking. The students who were serving as experts, however, were simply telling the others the answer and having them change their approaches to earn a check on their work. This telling was not the desired outcome; Jack wanted students to learn to collaborate and explain their thinking to others. Jack realized that the strategy of using student experts was not yielding the result of collaboration.

In November, Jack taught a lesson where students investigated patterns to discover how to calculate numbers raised to the zero power and negative exponents. To investigate negative exponents, Jack had the students complete a table of positive exponents and extend the pattern backwards to a zero exponent. Jack circulated around the classroom and encouraged students to explain their thinking about why the result of raising a number to a zero exponent would be 1.

> **Jack:** Can you explain why you think it may be 1? Do think it may be 1? Can you explain, [student name]?
> **Student 1:** No.
> **Jack:** So you just think it'll be 1 but don't know why.
> **Student 1:** Oh, I used the calculator (laughing).
> **Jack:** (To another student) OK, you think you can [explain it]?
> **Student 2:** Yeah.
> **Jack:** Go ahead and explain it.
> **Student 2:** I think it would be 1 because yeah I would say 3 [to the] 1. Three [to the] 1s gonna equal 3 but as you have 9 over 9 that's gonna be 1 whole. (Jack, Classroom Observation, November 17, 2011)

When one student said that she used the calculator to find her answer and could not explain her thinking further, another student in that group suggested that she could explain it and then proceeded to explain her thinking. Jack persisted in pressing students to explain their thinking rather than just finding a solution. He asked for explanations from individual students as well as encouraged them to speak to each other, saying, "I need you to make sure that everybody at this table [understands]" (Jack, Classroom Observation, November 17, 2011). Jack was not only eliciting explanations from students so that they could relay their ideas to him, but also encouraging them to explain to each other when he was not present.

Later in January, Jack began to incorporate center rotations with his students. In this particular lesson, half of the class was completing a review "scavenger hunt," where folded papers were arranged around the classroom with a multiple-choice problem on the inside, and the answer to a different problem on the outside. Students would move about the classroom searching for the answers to their problems, and, in this way, complete each of the problems. The other half of the class was split into two groups, one that was directed by Jack to take notes on the definitions related to congruence, and the other was attempting to discover the surface area of a rectangular prism through the use of nets. Most of Jack's focus was on the group to which he was providing direct instruction, so the students in the other group had to work collaboratively and mostly autonomously, as Jack would check back with them only intermittently. Jack previously challenged a small group of students to refine their formula by double-checking if the area of each face of the rectangular prism was the same. While Jack worked with the other group, the following conversation transpired:

> **Student:** Mr. Davis, we got it.
> **Jack:** Do [all the sides] go together?
> **Student:** No, because [different side lengths of the different pieces].
> **Jack:** Check each other, [student name] and [different student name] check each other's. (Jack, Classroom Observation, January 27, 2012)

Two things are salient about this conversation. It shows that Jack was still, consistently, not only requiring students to work together, but also asking them to collaborate through validating their answers with other students. Also, there is a shift in the language that the students were using. In the initial observation, the students used the work "I" when explaining their thinking. Here, the student used the word "we." Jack's consistent, high-level expectations were changing the norms of student discussion in the classroom.

In March, Jack reflected in seminar about a lesson in which he engaged students in error correction of a past assessment. By then, Jack was aware of students engaging autonomously in their small groups in discussions that included both procedural and conceptual talk. I also affirmed, through observation, that his students were making sense of problems, procedurally and conceptually, in small groups, through discussion. Jack was also aware of occasional incidents when students would give answers to each other and then would quickly redirect their conversation to explanation. He reflected:

> I think there was a mix [of procedural and conceptual conversation among students]. Of course, there's going to be some people just saying, "Oh, the answer was 'a'," and so I did hear that. And so for those people I had to say, "But why is it 'a'?" (Jack, Seminar, March 7, 2012)

Summary of Jack. Jack negotiated the challenge of his students' receptiveness and ability to persevere, make sense of, and have productive discussions about mathematics. In November, Jack's students spent 50 minutes of his 70-minute class period working individually, while the rest of the time was spent participating in teacher-led talk. By the time I observed in January, Jack had his whole class working in centers for the duration of the period, where they worked in small groups either autonomously, in student-centered investigations, or teacher-led notes. During the observation in March, Jack spent 45 of 70 minutes in whole-class discussion where students presented their findings, challenged each other, and justified their arguments. Although there had been a marked shift in both the occurrence and the manner through which students were discussing in the classroom, there still was an occasional deviation from that pattern. While Jack was cognizant of these deviations, he persisted in enforcing his high expectations for these students by reminding them quickly to explain their thinking to each other. Jack's commitment to excellence in teaching and education motivated him to work diligently to change the culture of discussion in the class through teacher moves that reminded students of his persistent expectation of explanation and discussion.

Discussion

For Michelle and Jack, the fact that their students were tracked had at least an initial effect on their instructional decision-making. Research indicates that tracking has an influence on teachers' perceptions of students, especially their assumptions about their lower-tracked students (Oakes, 2005). In this case, tracking affected the perceptions that these teachers had with respect to their students both in the courses labeled comprehensive and in those labeled honors.

Michelle taught a course that was labeled as comprehensive, although this tracking was based on her students' prior reading scores and not on any prior assessments of their mathematics proficiency. Nevertheless, Michelle often used her preconceived notions of her students' low ability as an excuse for not engaging them in challenging, student-centered mathematics lessons that would require problem solving and provide the students with opportunities for sense-making discussions. In addition, Michelle did not recognize the differing strengths or needs of her students. She spoke of her students as an aggregate, as a whole class only composed of students with low levels of ability. Although she made attempts at incorporating opportunities for discussion in her class, her perception of her students' ability caused her to fear student struggle, to provide direct instruction of procedures, and to focus much of her attention on rote memorization of vocabulary terms. Nonetheless, although Jack and Michelle's students took the exact same district-prescribed unit assessments, she never indicated that she had any evidence that her students were performing any differently that Jack's honors students were. Her instructional decision making, particularly her decision to slow down her pacing and to include more direct instruction, seemed to be based solely on her preconceived notion of what the "limited" ability level of students placed in a lower-tracked course meant to her. However, she was able to negotiate this challenge and engage her students in productive mathematics learning in whole- and small-groups discussions that allowed students opportunities to make sense of mathematics.

Michelle used strategies to mitigate her students' perceived struggle to encourage their participation in class discussions. She gave students both individual and small-group thinking time before requiring them to share their thinking to the class. She also provided reference sheets with mathematical terminology so that students could use the "correct" mathematical vocabulary in their discussions. She required them to verify individually calculated solutions with other small-group members. Also, Michelle began to appreciate using small-group work because it provided her with more contact time with individual students. During this time, she could correct any misconceptions held by individuals. She may not have changed her mind about her students' initial ability, but she was able to see her students' successes in mathematical sense making as the year progressed.

Jack, on the other hand, taught the class that was labeled honors; students were placed in this course by the same prior reading assessment that determined the placement of Michelle's students. Although Jack stated that he had automatically assumed that his honors students would be more capable of engaging in student-centered mathematics investigations and discussions, he found his students resistant to this type of instruction. He attributed their resistance to the students' assignment to high-tracked courses. He felt that because his students had been tracked into honors courses, a feature of scheduling that had been in place for more than one year, his students had become acclimated to learning in a particular manner: through listening, note taking during directed instruction, and completion of written solutions to mathematics problems reflecting their individual and independent efforts. He felt that his students' prior experiences with tracked courses, and their prior teachers' mode of instruction in these tracked courses, made his students appreciate and expect specific types of instruction over others. They were not only familiar with these instructional routines; they had learned how to be "good at school" in environments marked by these practices. Jack felt that he had to struggle harder than Michelle to teach students how to participate in student-centered learning environments where the expectation was for students to explain their thinking to others, and he attributed that struggle to the fact that his students were tracked into the honors section.

Jack, however, used his experience with building relationships with middle school students to establish a safe environment in his classroom. He built a rapport with his students that caused them to trust that he would not embarrass them publicly. Furthermore, he established norms in his classroom whereby students would be respectful of others during small- and whole-group discussions and would not devalue the thinking of others. Through these techniques, he began to develop a culture of participation in small- and whole-group discussion in his classrooms. His students became familiar with the practices of struggling with, and making sense of, mathematics collaboratively.

Implications

Tracking has long been targeted for discussion in the mathematics education community. Many mathematics researchers have advocated for heterogeneous classrooms, claiming that they are better sites to support all students' learning across and within all achievement levels, advancing both equity and mathematics achievement (e.g., Boaler & Staples, 2008; Burris, Hubert, & Levin, 2006). Tracking not only affects teachers' preconceptions of students' potential to achieve, but also it might affect students' development of a productive disposition about mathematics (e.g., Oakes, 2005). Nevertheless, there has been much resistance to grouping students' heterogeneously both in public discourse and in policy documents (e.g., Loveless, 1998). Education policy is not likely to eliminate tracking. Thus, it is important to prepare teachers for the possibility of teaching in a tracked course.

The study reported here highlights two points. First, teacher education courses must include an opportunity for both prospective and practicing teachers to think about and discuss tracking critically. Teacher educators must provide counter-narratives to the pre-conceptions that tracked former students bring to their classrooms as teachers. The teachers' perceptions of tracked students influenced their desire and ability to engage their students in sense making and productive discussion. Furthermore, it has been stated that teachers in alternative certification programs may be more likely to harbor low-expectations of tracked students than traditionally certified teachers (Brantlinger & Smith, 2013; Delpit, 2012; Habermann, 1991). Therefore, it follows that critical discussion about tracking, the perceptions of students who are tracked, and how to actively work against tracking are arguably even more important in alternative certification programs than in traditional teacher education programs. It often is assumed that tracking is necessary to provide appropriate instruction for homogeneous groups of students. Research has shown that de-tracking and heterogeneous instruction is powerful and equitable (Boaler & Staples, 2008; Burris et al., 2006).

Moreover, Oakes (2005) finds that the methodology of tracking is often tacitly accepted as appropriate, and therefore teachers believe that instruction with different levels of rigor is appropriate for their tracked population. As teacher educators, we need to problematize tracking and its implications. In addition, teachers need to be pushed to continue to try to engage their students in sense making through participation in productive discussion so they can gain the *experience* through *experimentation* that can further challenge their pre-conceptions of their students' ability. Through literature, hands-on experiences, and classroom discussions, we may be able to disrupt the misconceptions that new teachers might have about students who have been tracked. This disruption will help to address situations similar to that evidenced by Michelle and Jack, as their assumptions about their students' abilities contributed to the challenges that they faced when developing student-centered instruction, instruction that included opportunities for students to discuss and make sense of mathematics collaboratively.

Furthermore, teacher educators need to prepare teachers to have discussions with their students that include counter-narratives to ability grouping. Teachers must be equipped with ways to talk to students about their ability so that students placed in low-track courses are able to build the same types of productive dispositions that students in high-track mathematics courses might develop. Additionally, high-tracked teachers need to be equipped with ways to challenge the norms of schooling that may be prevalent in courses that are labeled honors. Often teacher educators focus solely on the low teacher perceptions of low-tracked students; however, student resistance to a "new way" of participating in mathematics courses also needs to be a focus, considering that schools that serve low-income students of color often heavily stress low-level direct instruction for test-preparation purposes even in those courses noted as honors (Delpit, 2003). In this way, teacher educators can help to reduce the challenges that novice teachers face. Teacher educators, however, cannot expect that teachers learn everything they need to know about teaching during their teacher preparation program (Hiebert et al., 2003). Therefore, it is important that teacher education programs prepare teachers to analyze their students' abilities in ways that enable the teachers to recognize student strengths as well as weaknesses and to learn for themselves that students of any track are capable of being successful.

Additionally, it is important for teacher education programs to help novice teachers develop ways to de-track mathematics within their classrooms and at their schools. In this instance, Jack and Michelle were encouraged to group students heterogeneously in their classrooms. Furthermore, because Jack and Michelle were planning together, the level and type of education that the students in the two different tracks were receiving were more similar than they were different. Therefore, as Jack and Michelle learned how to implement lessons that included tasks with high levels of cognitive demand (Stein & Smith, 1998) and productive discussion (Smith & Stein, 2011), they were effectively de-tracking the seventh grade at their school. It should be encouraged in teacher preparation programs that teachers, no matter the level of the track of their placement, consistently hold students to high expectations, allow them opportunities to make sense of the mathematics, and allow them to work in heterogeneous groups (Boaler & Staples, 2008).

Concluding Thoughts

The participants were intentionally placed in hard-to-staff schools where the population was high-minority and low-income. In addition, students in these schools are tracked, which is pervasive in education. Teachers who work in schools that serve a population that is high-minority and low-SES may have, or have to challenge, low expectations of the children in their classrooms (Delpit, 2006; Haberman, 1991). Tracking may further the low expectations of this population of children. Research indicates that tracking has an influence on teachers' perceptions of students, especially their assumptions about their lower-tracked students (Oakes, 2005). Both the NCTM and the CCSSM, however, have goals for every student to experience an education that provides opportunity for mathematical success for each student at a high level. What this study elucidates is that tracking may negatively affect teachers' perceptions on their ability to engage both low-tracked *and* high-tracked students in persevering in, making sense of, and productively discussing mathematics.

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