

ABSTRACT

Title of Dissertation: WIDGETS AND DIGITS: A STUDY OF NOVICE
MIDDLE SCHOOL TEACHERS ATTENDING
TO MATHEMATICS IDENTITY IN PRACTICE

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This is a study of novice middle-school mathematics teachers' attention to mathematics identity guided by three primary goals: (a) to understand how they were conceptualizing mathematics identity, (b) to investigate how they attended to mathematics identity in practice, and (c) to glean an understanding of the forces that they saw as influential in attending to mathematics identity.

I explored how these teachers conceptualized mathematics identity and attended to it across four dimensions: ability, importance, motivation, and the nature of mathematical tasks. I used a metaphor of interlocking gears to represent how these four dimensions were interrelated. While each practicing novice teacher (PNT) conceptualized mathematics identity differently, they all viewed it through an ability lens, meaning their attention to mathematics identity was predicated upon how they positioned students as mathematically competent or incompetent.

I used qualitative methods to highlight the perspectives and practices of three PNTs novice teachers who participated in an alternative certification program that prepared teachers to teach in a district with a long, documented history of low student achievement. I used Engeström's (1987, 1999, 2001) activity theory to explore how the elements of the teachers' activity systems promoted or impeded their attention to mathematics identity. I highlighted salient themes across all PNTs in a cross-case analysis.

The teachers in the study attended to mathematics identity in various ways. I categorized these tools in three ways: (a) attention to mathematics identity via instruction, (b) attention to mathematics identity via planning, and (c) an emergent sociopolitical stance. I used the cases to provide illustrative examples of what attending to mathematics identity in each category looked like in practice.

Across all of the PNTs, the rules at multiple levels (classroom, school, and district) that governed their activity systems were similar in nature. Their test-driven (Valli, Croninger, Chambliss, Graeber, & Buese, 2008) contexts shaped instructional decisions. At the classroom level, classroom management also proved to be a force that either supported or impeded the PNTs' attention to mathematics identity in practice. With the findings and analysis in mind, I present implications for teacher education, data collection, and theoretical considerations

WIDGETS AND DIGITS: A STUDY OF NOVICE MIDDLE SCHOOL TEACHERS
ATTENDING TO MATHEMATICS IDENTITY IN PRACTICE

by

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Dedication

I dedicate dissertation this to my father and mother, Patrick and Edith Jones.
Thank you for always reminding me that my possibilities are limitless.

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Graduate school and the dissertation process has been a test of faith, and I am so grateful first for the love and guidance of a wonderful Creator who has sustained me. I want to sincerely thank everybody who has cheered me on all the way to the end.

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Chapter 1: Introduction, Rationale and Theoretical Considerations

Introduction and Statement of the Problem

The first task that I assign to preservice mathematics and science teachers during methods or seminar courses is a mathematics or science autobiography. When analyzing the data for this study, I remembered writing the following essay to share with my class during a summer 2011 seminar course.

I began my journey as a mathematics teacher two weeks after my 22nd birthday. The school district that hired me gave me several options as to where I wanted to teach, and given my commitment to social justice, I decided to teach at the high school in my district that was characterized as “urban,” and “ghetto” by its stakeholders, including district officials, teachers, and students. Over time, I have had the opportunity to grapple and make sense of those terms and the deficit-laden rhetoric associated with them, but in that moment, being 22, middle class, and academically successful, I accepted the characterizations of this school and made it my responsibility to go there to help students who I believed were in need and, unconsciously, to “save” my students from themselves and their communities.

I had completed all of my program requirements in advanced mathematics, and as a mathematics education major, I had also taken three secondary mathematics methods courses. During my first year of teaching, I found myself panicking in front of a group of students in my remedial mathematics course. In that moment, I remember feeling terrified and woefully unprepared. I had always prided myself on succeeding in my mathematics courses. I falsely assumed that because I had a long history of success with mathematics, I was more than prepared to teach it at the high-school level. After

all, according to my flawed reasoning as a preservice teacher, teaching high-school mathematics was simply going to be an act of telling my students an easier version of the mathematics that I knew and then making sure that it “stuck” with them. I was prepared to transmit knowledge.

Standing in front of my students on the first day of class, I realized that knowing lots of mathematics content was not going to be sufficient to help my students be successful. Of course strong content knowledge was necessary to be an effective mathematics instructor, but I also needed some pedagogical tools. And, I would argue that beyond pedagogical tools, I needed skills for teaching mathematics that encompassed cultural understandings of my students, an understanding of the social and interactional nature of mathematics teaching and learning, and a critical consciousness of the political nature of teaching mathematics. In particular, I needed tools to make sense of what it meant to teach mathematics in schools serving predominately-underserved students.

Having been prepared to teach mathematics at a historically Black university, I thought that I brought a critical racial consciousness to my mathematics teaching and a respect of student difference, as my professors instilled a sense of racial pride and purpose in doing and learning mathematics. Further, I had personal knowledge of how race was salient to mathematics learning. I knew what it felt like to be the only Black person or only girl or only Black girl in advanced mathematics based on my K-12 experiences. However, teaching in Florida at the inception of FCAT testing and school sanctions, I was not prepared to handle the larger, tacit discourses of accountability, the achievement gap, and their influence on my perceptions of my students.

After teaching in Florida, I had the opportunity to move to the mid-Atlantic region to attend graduate school. I studied curriculum theory and was able to broaden my perspectives about teaching and curriculum through the works of scholars like Michael Apple, Jean Anyon, John Ogbu, and Pierre Bourdieu. Upon completing my Master's degree, I began teaching school in Griffin County Public Schools. This time around, I was teaching mathematics with not only a critical racial consciousness, but also with an awareness of how institutional structures contributed to the educational inequities I witnessed and experienced while teaching in Florida. I entered the mathematics classroom again, armed with the knowledge of structural and institutional inequality, yet sometimes I still found myself succumbing to the deficit-laden achievement gap and ability discourses regarding teaching mathematics in a high-stakes environment. This was especially true when I left Griffin County Public Schools and became a department chair in a neighboring district that was facing similar challenges with regard to addressing underserved students' testing disparities. In this role, I was forced to make incredibly tough decisions about tracking, course scheduling, and high-stakes testing that had major implications for students' mathematics education trajectories. And when looking back over my choices, I cannot say that I am proud of all of them; I was making decisions based on what I knew at the time. When I decided to leave the teaching profession to enter graduate school, I made a vow to myself to use my academic privilege to work toward educational equity for students like the ones that I had taught, advised, and grown to admire (Mathematics autobiography, June 2011).

I decided to begin the introduction to this dissertation study with a portion of my personal teaching narrative for several reasons. First, I want to establish that this work is

grounded in professional and personal commitments to equitable mathematical practice. As a former mathematics teacher and in my new role as a mathematics teacher educator, I am certain that if we as educators ever want to actualize the motto that most of us have stated at some point in our careers, “All children can learn,” we must be willing to think about the messages that our actions send to our students. Second, personal narratives and experiences were salient in this study; eventually, I realized how salient my experiences were to the research questions I posed and the methodological decisions I made. Third, I would contend that the type of additional knowledge I needed to meet my students’ needs while I was teaching (i.e., a cultural understanding of my students, a critical consciousness awareness of political influences, and an understanding of the interactional nature of mathematics teaching and learning) are encompassed in understanding mathematics identity and how one can attend to it in practice, which are the foci of this study.

Broadening the scope of study beyond my personal experiences, if one were to step into a mathematics department meeting at most secondary schools, one would more than likely hear statements of the following nature: “This is my *smart* group. They picked up on solving systems of equations quickly,” or “Well, you know, this class is primarily *basic*, so we just review mathematics skills important to the state test,” and maybe something to the effect of: “My Geometry kids are so *lazy*. They never finish their assignments, but my Geometry *TAG* (talented and gifted) students are always so prepared.”

During my years as a high school mathematics teacher and department chair, my colleagues and I often made comments such as the ones above with little to no

cognizance of their impact. While we took the labels of *smart*, *basic*, *lazy*, and *TAG* as commonly used and understood monikers our students' abilities, we were less aware of how our labeling and sorting of children based our perceptions of their ability were not only shaping their trajectories for future opportunities to learn, but also influencing how our students saw themselves as learners and doers of mathematics. Further, as teachers with limited knowledge of how prevalent, taken-for-granted discourses shape mathematics identity (Diversity in Mathematics Education [DiME], 2007; Ellis, 2008), we relied on the intellectual resources most often available to us. Often these resources were steeped in accountability mandates, which typically reinforced labeling students using classifications that signified quickness and correctness (or lack thereof).

My recalling of these events is not meant to be an indictment of teachers, but rather, it is an observation of how tacit assumptions, shaped by institutional forces, affect classroom participation and instruction. Beyond instruction, these forces affect student learning and participation at a higher level. Deficit-oriented perspectives about mathematical competency permeate the policy discourse regarding who receives access to rigorous mathematics (e.g., Diamond & Spillane, 2004; Lipman, 2003). Rather than indict teachers who, more and more, find themselves framed in deficit-oriented ways (Cuban, 2007), this study is meant to raise awareness about the complexities of teaching mathematics and attending to mathematics identity in an accountability era.

The title of this study comes from an interview with one of my participants, Chris, who became the teacher of record for several standardized mathematics test preparation classes. When asked if he could describe how high-stakes testing shaped his practice, he shared:

“ [We tell kids] ‘You got to get A's on the test.’ ‘You got to pass the [standardized assessment].’ ‘You got to find a job and make widgets.’ It’s all about the standardized tests.” His sentiments encapsulate the way standardized testing makes teachers feel forced to teach mathematics content in reductive ways, and this is especially true in schools with large populations of underserved¹ students (Schoenfeld, 2002). In this accountability era, high-stakes mathematics testing (i.e., digests) become a tool for reproducing inequality, the very thing accountability mandates were intended *not* to do. Chris asserted that students caught in the crosshairs of accountability are positioned to do mathematics for the purposes of being widget makers, meaning their career and educational opportunities are limited as a result of high-stakes testing policies and rhetoric. I would extend Chris’s assertion and contend that not only are their opportunities limited based on these forces, but these forces also shape their mathematics identities. As Gutierrez (2013a) explained, “the standardization of the curriculum and the focus on high stakes tests (at least in the United States) leave teachers with little room to reflect upon how such students are constructing themselves and being constructed with respect to mathematics” (p. 37).

While national, state, and local policies and deficit-laden public discourse play a role in shaping students’ mathematics identities, the agency of mathematics teachers cannot be ignored (Gutierrez, 2012; Martin, 2007). Mathematics teachers are identity workers (Gutierrez, 2013b), meaning that they play an important role in how students come to see themselves as mathematics learners. Because mathematics teachers are

¹ I use “underserved” to describe student populations that are often noted as having disparate achievement on high-stakes exams, most often including Black and Latino students, students with limited socioeconomic status, students who do not speak English as their first language, and those identified as needing special education services.

identity workers, by association, mathematics teacher educators are as well. As identity workers, mathematics teachers and teacher educators must consider facets of mathematics teaching that go “beyond the mathematics” as Jan, another participant in my study, would explain it (Interview, May 7, 2012). This study is my attempt to think about and beyond mathematics in underserved schools while simultaneously being situated within the content.

Operationalizing Mathematics Identity

Participatory Nature of Mathematics Identity

Research on mathematics identity is complex, as it addresses individual participation within social structures. In the body of literature regarding identity, all stakeholders in education (particularly teachers and students at the classroom level) interact across social spaces to construct what it means to be a learner and doer of mathematics. In addition, identity is inextricably linked to practice. It is “concerned with what is made available to individuals in the various social and cultural communities they inhabit and how they enact their participation across them” (DiME, 2007, p. 409). A working definition of identity refers to “the way we define ourselves and how others define us” (Anderson, 2007, p. 8). Thus, when students are learning mathematics, they are, in part, constructing mathematics identities (Nasir, 2007).

Additionally, a working definition of identity must account for how identity is negotiated across contexts and is multidimensional. It is shaped and reshaped through the “dialectic of between social structures and individual lived experiences” (DiME, 2007, p. 409). The mathematics classroom provides a space for students to position themselves and to be positioned by their teachers through instruction and the implicit messages that

accompany it (Anderson, 2007; Boaler & Greeno, 2000; Clark, 2009). As students develop their mathematics identities, their dispositions toward mathematics are also being shaped. According to Kilpatrick, Swafford, and Findell (2001) in their seminal work *Adding it Up*, the development of a productive disposition toward mathematics is an essential component to mathematics proficiency.

While being socially constructed and negotiated, it is important to note that mathematics identity in classrooms is in constant flux; it is not permanent and static (Gresalfi, Martin, Hand, & Greeno, 2009). Because mathematics identity is dynamic in nature, it holds promise for increasing participation for students who often find themselves at the margins of participation (Hand, 2010, 2012; Horn, 2008). In other words, attending to mathematics identity has implications for equity. Taking a critical approach, researchers have asserted that the achievement gap and data that support perceiving deficits in ability and competency have been sufficiently examined (Gutierrez, 2008; Hilliard, 2003). They argue that addressing educational disparities through drawing attention to them rather than being solution focused often stigmatizes students and perpetuates deficit-oriented discussions. In an effort to take a new approach to the disparities in achievement among disaggregated groups, scholars are calling for work that seeks to remedy the problem rather than reify it (Martin, 2009). Teaching mathematics with explicit attention to identity is, perhaps, an important component to the remedy. Attending to mathematics identity in the classroom includes teaching mathematics in a way that aligns with students' interests and aspirations (Ladson-Billings, 1997; Nasir & Saxe, 2003), thus giving access to students who may not be as apt to participate in the

mathematics classroom. With this in mind, it is important to examine the role that teachers have in impeding and supporting classroom participation structures.

Mathematics Identity and Teacher Practice

While being faced with overwhelming pressures to meet accountability demands, and more specifically, the demands of standardized testing, I would be remiss if I did not highlight the importance of teacher agency (Giroux, 1983), as teachers are brokers of policy, and teaching itself is a political act (Cuban, 1991). Teachers have agency and can influence their students' mathematical identity development (Clark, Badertscher, & Napp, 2013a; Zollman, Smith, & Reisdorf, 2011), even in accountability milieus that make the work seem daunting. Thus, in this exploratory study, I investigated how teachers attend to their students' mathematics identity through instructional moves, discourse, and the planning and enactment of tasks. Ultimately, I sought to identify instructional practices that mathematics teacher educators can highlight as features of a knowledge base often overlooked when identifying necessary knowledge bases for effective mathematics teaching.

While mathematics teachers tackle the day-to-day complexities of teaching, mathematics education researchers are making strides to re-conceptualize learning and participation and their relationship to how teachers frame students' mathematical abilities (e.g., Gresalfi, Martin, Hand & Greeno 2009). Additionally, researchers are adopting situative and sociocultural perspectives in mathematics education (Lave, 1991; Lave & Wenger, 1991; Lerman, 2000) to unpack issues of participation and practice in mathematics classrooms and have begun to focus their attention on how students are

positioned as learners and “doers” (Boaler, 2002) of mathematics in classrooms (e.g., Boaler & Greeno, 2000; Horn, 2008).

Researchers posit that students’ perceptions of their mathematical competency are shaped by self-perceptions as well as the perceptions of others (Boaler, 2000, 2002; Cobb, Gresalfi, & Hodge, 2009; DiME, 2007). Teachers, in collaboration with their students, socially negotiate what it means to *know* mathematics as well as what it means to do it. In this negotiation, students receive and construct messages regarding their mathematics identity. Further, through classroom interactions, students are constantly in the processes of shaping and reshaping their mathematics identities (Gresalfi & Cobb, 2006). Mathematics identities evolve and are constructed via student-to-teacher as well as student-to-student negotiation (Esmonde, 2009; Walker, 2006, 2012).

While acknowledging the socially negotiated nature of student and teacher interactions, the power differential between them must not be ignored. As teachers typically possess primary mathematical authority in most classrooms, they may enact practices that stigmatize students who are seen as mathematically incompetent, while positioning those who exhibit behaviors more socially and academically acceptable in mathematics classrooms as competent and “smart” (Gresalfi, Martin, Hand & Greeno, 2009; Horn, 2007). Thus, teachers have the ability to position students for access to particular pathways of participation in mathematics classes as well as future course taking in mathematics (Anderson, 2007; Horn, 2008).

Teachers, guided by their beliefs and personal experiences, also contribute to how they position their students as mathematics learners. Often, secondary teachers, preservice and novice, who had success learning mathematics in traditional ways struggle

to teach in ways that address the diverse needs of the learners in their classrooms (Nathan & Petrosino, 2003). Additionally, when secondary teachers teach in unfamiliar, high stakes contexts, they either neglect or adopt the prevalent deficit-laden messages that influence their instruction (deFreitas, 2004, 2008; Nasir & McKinney de Royston, 2013; Sloan, 2007).

Teachers' attention to mathematics identity is influenced in broader contexts beyond the classroom. In addition to the classroom-level messages students receive that influence their mathematical identities, broader social forces must not be ignored. Activities in traditional mathematics classrooms often produce tacit, yet palpable, intelligence hierarchies with regard to mathematics ability, particularly in classrooms of students with histories of low performance (Oakes, 2005). The instructional practices in these classrooms traditionally reinforce narrow understandings of the nature of mathematics, thus presenting mathematics in ways that do not align with the interests and aspirations of students (Ladson-Billings, 1997; Nasir & McKinney de Royston, 2013; Nasir & Saxe, 2003). Over time, a hierarchy of achievement has been established in the discipline, often limiting underrepresented groups such as African Americans (Martin, 2000, 2009a, 2009b; Steele, 2003), Latinos (Flores, 2006; Moschkovich, 2007) and women and girls (Boaler, 2008; Pringle, Brkich, Adams, West-Olatunji, & Archer-Banks, 2012;) in their participation in mathematics. A history of presenting Black, Latino, and female students as intellectually inferior to their White male counterparts, specifically in mathematics, plagues classrooms where misused data from standardized assessments further corroborate this broader narrative of the academic inferiority of underrepresented student populations in mathematics (Ellis, 2008; Sloan, 2007).

As researchers continue to theorize and expand upon the interrelated issues of mathematics identity, productive disposition, and equity, a question begs to be answered: How does one take theoretical work with regard to mathematics identity and learning and make it applicable to the day-to-day practice of teaching mathematics? Understanding how mathematics identity influences teacher practice implies that there is a distinct domain of mathematics teacher knowledge that must be considered as we prepare teachers for teaching mathematics, one that includes knowledge of the development of mathematical identities. If we only devote attention to understanding and developing teachers' mathematics content and pedagogical content knowledge from a cognitive perspective, we are "not acknowledging a stubborn reality; for more students to more fully engage in mathematical activity they must have some sense of themselves as mathematics learners" (Clark, 2009, para. 32).

Not discounting the importance of more prominent dimensions of mathematics teacher knowledge such as content knowledge and pedagogical content knowledge (PCK) (Shulman, 1986), the other intellectual resources teachers draw upon in practice (e.g., knowledge of students' mathematical identities and dispositions) may mediate the direct link that researchers tend to make between content knowledge or PCK and instructional practice (Clark, 2009; Hand 2012). Thus, in preparing mathematics teachers to work in schools with students from all walks of life and differing experiences with mathematics, this dimension of knowledge must be examined and taken up in teacher education. This knowledge base is especially important when teacher educators prepare preservice teachers to teach mathematics in schools with histories of low student mathematics performance and large populations of underserved students. Further, if researchers

collaborate with teachers around issues of mathematics identity and its relationship to instruction, a question arises: What would serve as evidence of this knowledge base when observing mathematics instruction?

Voices outside of mathematics education have called for all teacher educators, irrespective of their disciplines, to rethink and push the boundaries of what it means to prepare teachers for diverse schools. Ladson-Billings (1995) argued that teacher education has a responsibility to “re-educate [teacher] candidates . . . toward a more expansive view of pedagogy” (p. 483). Within mathematics education, in direct pushback to the “unambitious belief that not everyone can do serious mathematics” (Lampert et al, 2013, p. 227), Lampert and her colleagues call for ambitious mathematics instruction where issues of equity highly prioritized. With this in mind, they call for teacher educators to prepare preservice teachers to teach mathematics in ways “more socially and intellectually ambitious than the current norm” (p. 226).

Operationalizing Attention to Mathematics Identity

As an example of adopting more expansive views of pedagogy (Ladson-Billings, 1995), Clark (2009) synthesized across multiple identity frameworks (Anderson, 2007; Martin, 2000, 2007) and identified four dimensions of mathematics identity where teachers have influence with regard to their students’ mathematics identities:

- a) Ability: how students perceive their ability and how this influences their mathematical experiences,
- b) Importance: whether students perceive mathematics as important to their present and future endeavors,

- c) Nature of tasks: students' perceptions of their engagement and exposure to particular types of mathematics, and
- d) Motivation: sources of student motivation for productive mathematical activity (Clark, 2009).

In addition to thinking about the particular dimensions teachers can attend to, Clark et al. (2013a) also raise the issue of *how* teachers attend to those dimensions via Martin's (2000) socialization practices. Citing Martin and Lampert (2003), Clark and his colleagues described mathematics identity socialization practices as "processes and experiences by which individual and collective mathematical identities are shaped in sociohistorical, community, school, and intrapersonal contexts, and is an integral part of the work of the mathematics teacher" (p. 5). In this study, I examined identity through the four dimensions highlighted above and how the teachers in the study attend to them, via socialization practices, in four primary ways: (a) through teachers' instructional moves (both mathematical and non-mathematical in nature); (b) through teacher-student discourse; (c) through the planning of tasks; and (d) through non-mathematical classroom activities.

Clark (2009) explained that teachers influence any of or all four dimensions of mathematics identity at multiple levels. Further, he asserted that a teacher's influence could be occurring at three levels, individual, collective, and universal. The individual level comprises teachers' awareness of each student's disposition towards mathematics. Clark described the collective level as a teachers' understanding of a particular group of students' experiences in mathematics (e.g., English language learners or students receiving special education services) as well as an awareness of critical turning points in

students' mathematics trajectories (e.g., transition from arithmetic to algebra). The third level, universal, involves a teacher's understanding of broader and more theoretical notions of mathematics ability and identity. While all three levels are important, given the nature of this study, I have elected to primarily address each teacher's attention to mathematics identity at the collective level.

In addition to the dimensions and socialization practices highlighted above, I draw on the body of literature regarding mathematics identity to operationalize what is meant by "attending to" mathematics identity in this study. For, as Hand (2012) posited, "It is only when teachers . . . attend differently to classroom mathematical activity that the field of mathematics education will provide a more even playing field for non-dominant learners" (p. 235). For the purposes of this study, when I highlight a teacher-initiated socialization practice that attended to one or more dimensions of mathematics identity, I contend that one or more of the following conditions were evident in the interaction:

- a) *Teachers expressed warmth or mutual respect* in teacher-student interactions.

This encompassed teachers' attention to relationship building or attention to affect during planning or instruction (Clark et al., 2013a; Zollman, 2011)

- b) Students had an opportunity to exercise *mathematical agency*, meaning that students felt empowered to make decisions while participating in mathematical tasks and to make choices that determined how they would approach mathematics problems (Hand, 2010; Zollman, 2011).
- c) Students had an opportunity to exercise *mathematical authority*. This means that teachers positioned them to or that they saw themselves as being a legitimate

source of mathematical knowledge in a mathematical interaction (Gresalfi et al., 2009).

Mathematics Identity Framework: The Metaphor of a Gear System

The title of this study is derived from the gear metaphor that I used to conceptualize the interrelated nature of the dimensions of mathematics identity. Expanding on Clark's (2009) assertions, I used the metaphor of a system of gears as an explanatory tool to demonstrate how these dimensions of mathematics identity work together in an integrated fashion. A gear is a simple machine, a modification of a wheel and axle with teeth. Two or more gears work together in an interlocking fashion, forming a system of gears, also referred to as gear train. As one gear, i.e., the driving gear, exerts force, the other(s) move in response to the initial force. In turn, all gears in the gear train begin to move. If one gear does not move, then the others do not either, as they have an interdependent relationship. In a gear train, a gear's size determines its speed and force. In any group of gears, the largest one will rotate with greatest force (Retrieved from: <http://users.tellurian.com/teach/machines/>).

Relating the basic properties of gears to mathematics identity, I liken each component of identity as an individual gear, and in totality, the four dimensions that comprise the mathematics identity framework represent a gear train. Just as the gears in a real-life gear train work together, the dimensions of mathematics identity work in concert and are influenced by the force of each other. It is important to note that using individual gears to represent the components of mathematics identity is not meant to treat the dimensions as stagnant, stand alone, and interchangeable. Instead, putting these gears into an interconnected gear train is intended to highlight the interlocking nature of these

dimensions. Representing them as an interdependent system highlights the difficulty of trying to pull them apart and to attend to them individually as well as the futility of attempting to make them work without each other (Clark, Badertscher, & Napp, 2013). Figure 1 is a schematic that visually represents the interconnected nature of each dimension via the gear metaphor.

Just as size of gears can vary in a real-life gear train, metaphorically, I posit that the priority placed on the various dimensions of identity can vary as well. In other words, when teachers conceptualize and attend to mathematics identity, they may emphasize certain dimensions over others. Using the gear metaphor, I would describe the dimension of emphasis in a teachers' understanding of and attention to mathematics identity as the largest gear of their gear train. Referring back to my original explanation of gears, this means that this dimension is the largest and exerts the most force over the system of gears. In Figure 1, all four gears are of equal size, which means they are exerting equal force. However, given the findings of this study, I will argue that this depiction of the gear system, depending upon the teacher and his or her experiences, may vary and some attention dimensions of mathematics identity are given precedence over others.

This study was exploratory in nature and was grounded in the abovementioned work regarding mathematics identity and situative and sociocultural perspectives of mathematics teaching and learning. During the course of this study, I had the opportunity to teach, mentor, and collaborate with three novice teachers during their first and second years of teaching and observe how they attended to particular dimensions of mathematics identity. In collaboration with these practicing novice teachers (PNTs), I sought to co-

construct what it meant to attend to these dimension in practice, thus shifting from theorizing about mathematics identity to contributing to a framework of enactment.

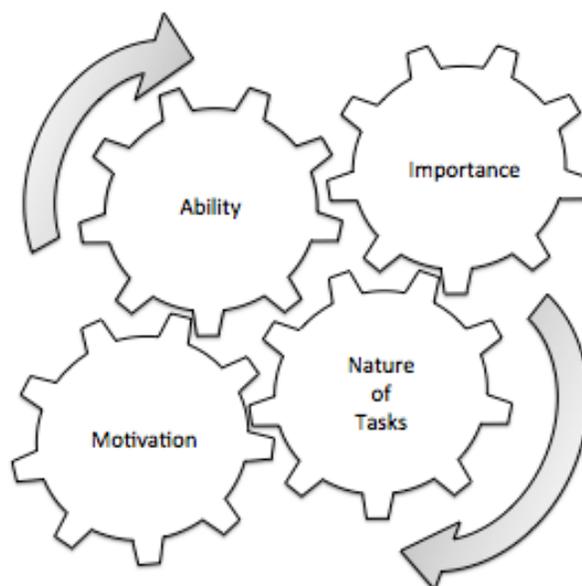


Figure 1. Dimensions of mathematics identity represented via a gear system

Theoretical Considerations

While I used activity theory to capture the culturally and historically situated nature of classroom activity, I approached this work informed by theories that were influential to what particular elements I emphasized in the activity systems that follow in Chapters 4 through 7. First, I will first discuss the importance of thinking about mathematical classroom activity from multiple, yet related, theoretical perspective. Then, I will present a detailed explanation of activity theory, as it serves as the primary theoretical framework that drove my analysis and data interpretation.

Mathematics Classroom Activity via Multiple Theoretical Perspectives

I observed the PNTs in their classroom contexts guided by situative, sociocultural, and cultural-historical perspectives of teaching and learning mathematics (Cobb &

Yackel, 1996; Lave, 1991; Lave & Wenger, 1991; Lerman, 2000). Hand (2010) captured the importance of integrating theoretical perspectives to understand classroom participation as follows:

Accounts of social activity that stem from situative, sociocultural, and cultural-historical perspectives have been particularly illustrative in highlighting the joint interactional accomplishments of individuals in relation to broader communities, processes, and structures. . . . Examining complex social phenomena . . . through this lens has the potential to situate individual acts . . . within the various levels of social activities in which they are embedded, providing impetus, constraints, and rationale to these behaviors. (p. 98)

From this integrated perspective, classrooms are communities of practice that are comprised of systems of activity where students and teachers negotiate the classroom structure and students' mathematics identities are shaped and reshaped in this process (Cobb & Yackel, 1996; Lave, 1991; Lave & Wenger, 1991). Proponents of situative perspectives espouse that learning in mathematics classrooms or any context does not happen through the acquisition of bits of knowledge, but rather through social engagement. In other words, learning is mediated by co-participation of community members. From a sociocultural perspective, this has major implications as to who can learn to do mathematics or see themselves as mathematicians, thus serving to support or dismantle mathematical hierarchies (Martin, 2000; 2009b; Gutierrez, 2013a, 2012; Hand, 2012). Additionally, thinking about how activity is culturally and historically situated gives us a broader understanding of teaching and learning mathematics, as it is not happening absent of context, but rather, it is grounded in larger cultural, social, and

historical contexts (Engeström, 1987). Approaching research in mathematics classrooms from this perspective helps to redefine who can legitimately participate in mathematics classrooms. Employing this perspective means that *how* students participate in the classrooms will be given just as much attention as *who* participates. With respect to this integrated understanding of teaching and learning, I chose to represent each teacher's attention to mathematics identity via activity theory.

Activity Theory

I interpreted the interactional practices of each PNT via the theoretical frame of activity theory (Engeström, 1987, 1999, 2001). This theoretical frame allowed me to highlight the interactional nature of teaching and learning as well as the importance of considering an individual's meaning making and understanding of self in the context in which they participate. This framework originated from the earlier work of Russian theorists Vygotsky, Leont'ev, and Luria. In his expansion of their work, Engeström (1987), created a visual representation of a system of activity (see Figure 2) and expanded how the theoretical frame could be used to study change and development.

Activity theory is a flexible and evolving theoretical framework (Engeström, 1999). Further, it looks at artifacts and people as embedded in dynamic activity systems (Engeström, 2001). Contemporarily, researchers in mathematics education have utilized activity theory to examine complexities of mathematics teaching and learning in several ways, including dilemmas in integrating technology in urban mathematics classrooms (Anthony & Clark, 2011), the role of visual representations in geometry classes (David & Tomaz, 2012), and the relationship between conducting research and leading professional development in mathematics education (Potari, 2012).

Activity theory has evolved in three distinct phases (Anthony & Clark, 2011; Engeström, 2001; Feldmen & Weiss, 2010). I used the third generation of activity theory in this study. Drawing on Vygotsky's (1978, as cited in Arnseth, 2008) first-generation, triangular model that sought to understand the relationship between subject, object, and artifact, Engeström (1987) extended this framework to include rules, divisions of labor, and community. In other words, subjects, objects, and artifacts do not just exist in a vacuum; other elements influence the relationships among the three components highlighted by Vygotsky, which comprise the top sub-triangle of Figure 2. Thus, Engeström called for *activity systems*, minimally consisting of subject, object, mediating tools, rules, community, and a division of labor. As the analysis and interpretation of the data in this study rely on an understanding of activity systems, I will highlight each element of the activity system.

In an activity system, the subject is an individual or individuals who are participating in the activity. The subject consists of an individual or group of individuals engaged in a purpose whose agency is the focus (David & Tomaz, 2011). In an activity system, the subject is not a static component of the system. Rather, the subject or subjects of the system are reshaped through participation. Roth et al., (2004) explained:

That is, through their agency, the people in an activity not only produce material outcomes, but also, in the process, produce and reproduce themselves and others *qua* participants in the relevant community. Therefore, the identity of an individual is not something that can be taken for granted as an a priori constituent of activity, but it is something that is made and remade as activity is enacted and when individuals participate in multiple activity systems (p. 51).

The subject(s) and the activity share a reflexive relationship; meaning individual goals are coordinated and reshaped by the activity while the individual also reshapes the activity. Within the system of activity, the subjects are part of a community in which

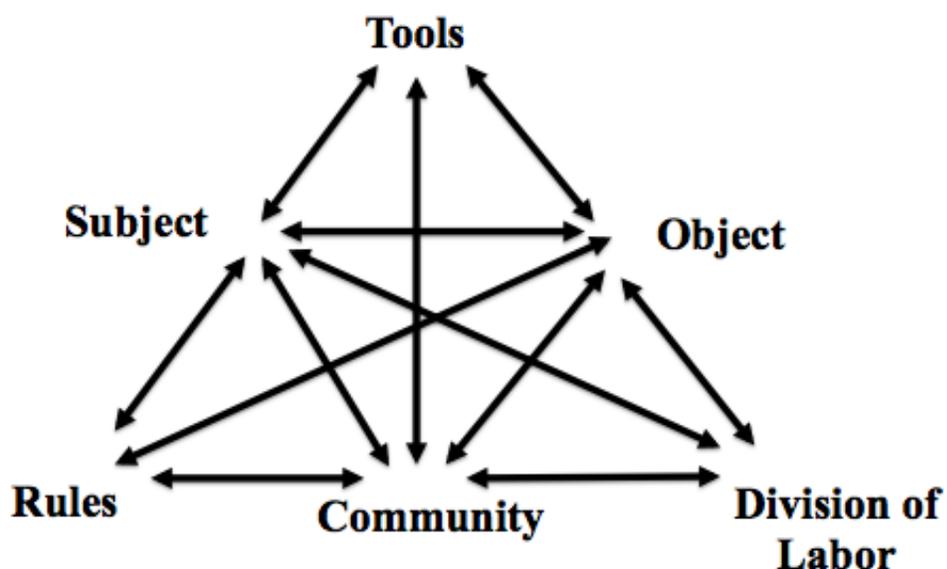


Figure 2. Elements of Engeström's (1987, 1999, 2001) activity system

rules for participation evolve. The object is the purpose and motivation for which the subject(s) is participating within the activity system. It serves as a bridge between the individual and the collective activity (Anthony & Clark, 2011).

Tools mediate between the subject and the object of an activity system. They can be either psychological (e.g., language, gestures) or material (e.g., instructional tools, classroom tasks, etc.), and help to produce meaning within an activity system. In an activity system, the rules refer to the explicit or implicit norms and conventions that regulate actions and interactions within the activity system. For example, letters grades have historically and culturally come to take on meaning within the system of schooling.

Thus, letters grades have become tools that produce meaning about academic performance. Further, within the activity system, the participants negotiate the division of labor, meaning the negotiated roles and responsibilities of the group members. Further, activity systems are multi-voiced (Potari, 2012). In activity systems, there are multiple points of view, traditions, and interests among the members of the community, and the division of labor creates different positions for the participants.

Activity Theory in the Context of This Study

Using activity theory as a theoretical framework requires that activity serve as the unit of analysis, particularly an activity as a goal-directed or purposeful interaction of a subject with an object through use of a tool (Arnseth, 2008). Potari (2012) noted, “Engestrom considers teaching as a work activity undergoing historical transformation that is also transforming through new forms of organizing teaching work” (p. 510). In this study, the PNTs’ practice (the activity) was the unit of analysis by which attending to student mathematics identity in practice was studied (the object). How these teachers (the subjects) enacted practices that affirmed or disaffirmed students’ mathematical identities, whether through language or instructional tasks or some other medium, were the tools that mediated the activity and impacted the object. As noted earlier, activity theory plays particular attention to the historically and culturally situated nature of activity. As Arnseth (2008) explained:

The historical dimension of practice becomes crucial in [activity theory]. The experiences of other people using a tool are, so to speak, accumulated in the structural properties of the tool as well as in knowledge about how the tool should be used. (p. 292)

The teachers in this study are entering classrooms in schools that have unique and challenging histories. The teachers are working in schools that some would characterize as “test-driven” (Valli, Chambliss, Croninger, Graeber, & Buese, 2008), in which authentic learning is often usurped by overemphasis on standardized test preparation. Thus, these schools highly emphasize instruction that closely aligns with the statewide examinations. Further, the norms and expectations established by virtue of teaching in a system facing accountability pressures established rules that governed how teachers taught mathematics and attended to mathematics identity. How teachers attend to mathematics identity and ability within the confines of school- and district-wide histories of test-driven instruction highlight the usefulness of activity theory to better understand classroom interaction from a cultural-historical perspective.

The structure of activity systems allowed for each PNT’s experiences and perceptions to be prominent within the activity system. When mathematics teachers enter their classrooms, they bring prior experiences including engagement with mathematics content, prior schooling, home and family life influences, issues of race, class, gender, language, and ability, and a multitude of other factors. Because the subject of the activity system provides the purview by which the activity will be considered, the perspectives and experiences of the PNTs in this study were salient elements of the system.

One of the contributions of Engeström’s development of activity theory is the notion that tensions may exist between systems that hinder the achievement of shared goals in an activity system. Engeström (2001) coined these tensions *contradictions*, and defines them as “historically accumulating structural tensions within and between activity systems” (p. 137). While contradictions cause tensions within the activity system, they

are sources of change and development. Contradictions are historically accumulated structural tensions within and between activity systems. These tensions lead to changes in the activity, and in particular they emerge when a new element comes. As Engeström explained, these contradictions generate “disturbances and conflicts, but also innovative attempts to change the activity” (p. 134).

Figure 3 represents a general activity system that is specific to this study. It served as a tool for organizing the findings in Chapters 4-7. This framework aided in understanding the relationships between the individual (the subject of the system) and the elements of his or her system of activity.

Research Questions

Students in schools with histories of low performance and under pressures of sanctions based on standardized test performance are often framed in ways that limit their participation as competent learners and doers of mathematics. Further, teachers’ perceptions are knowingly and unknowingly shaped by accountability rhetoric and deficit-oriented discourse regarding the mathematical competencies of their students.

However, as gatekeepers (Moses & Cobb, 2001), teachers can exercise their agency to help students develop positive mathematics identities in these contexts. Additional research is needed to investigate how teachers in these contexts can attend to mathematics identity in ways that positively influence their students’ mathematics identities and, in turn, increase participation and achievement in mathematics. I designed a qualitative study to investigate how PNTs attend to mathematics identity in practice. mathematics identity at the time of this study. Knowing that teachers’ experiences and school contexts also influence how they approach mathematics instruction, this study also

sought to understand the forces the PNTs cited as influential to their practice, with particular attention to forces salient to their attention to mathematics identity. This study focused on investigating these issues through case study and cross-case analysis design.

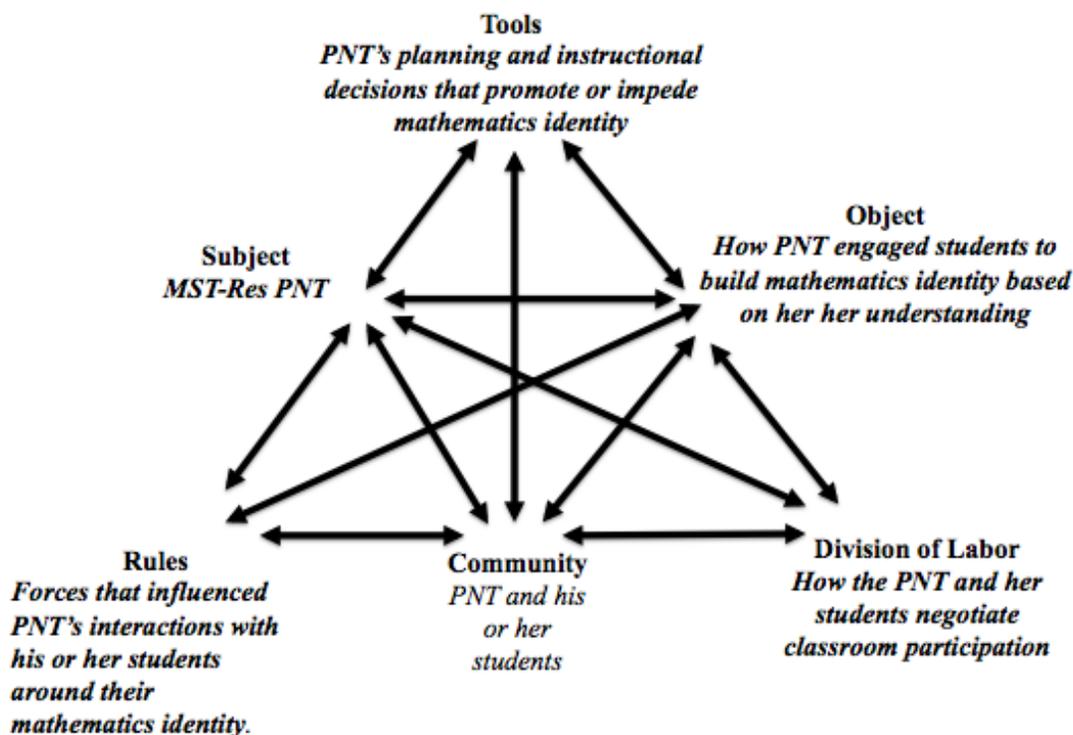


Figure 3. Activity theory framework in relation to this study

Additionally, I was interested in understanding how they conceptualized

The study was guided by the following questions:

- How do novice middle-school mathematics teachers conceptualize mathematics identity?
- In what ways do the teachers in this study attend to the dimensions of mathematics identity in their planning and practice?
- What forces appear to influence these teachers' attention to these dimensions of mathematics identity in their practice?

Significance and Contributions

As federal and state policies call for evidence of student learning via standardized testing, and STEM initiatives seek to diversify those who participate, *how* one teaches

students who have had limited success in mathematics should be considered just as important as *what* they are taught. More rigorous mathematical standards or new, innovative curricular materials remain null and void when their enactment is not considered, and how curriculum and tasks are enacted is influenced by how teachers understand the nature of mathematics, mathematics teaching and learning and social context (Ernest, 1989), and how they perceive their students (Horn, 2008). Research regarding mathematics knowledge for teaching and pedagogical knowledge, while extremely important, does not adequately attend to facets of instruction such as teacher beliefs and equitable practice (Gutierrez, 2012) or teachers' perceptions of their students' mathematical abilities and awareness of their students' dispositions (Clark et al., in press), factors which are all salient to mathematics identity. These facets of mathematical instruction may also mediate instruction (Clark, 2009). This study sought to explore a facet of mathematics teaching that encompasses these domains, how teachers enact practices that attend to mathematics identity.

While mathematics identity has been theorized in the mathematics education literature, few studies exist that explicitly address what this work means for teachers beyond stating implications for the classroom. This study builds off the few studies that explore how the theoretical underpinnings of mathematics identity can be addressed pragmatically via teaching practice, including Gresalfi et al.'s (2009) study that examined how teachers co-constructed competency (noted as the ability dimension in this study) and Clark et al.'s (2013a) work that studied the pedagogies, beliefs, and perspectives of two highly-respected African-American teachers who attended to mathematics identity in

practice. This study aimed to contribute to this body of literature that is still ripe for exploration.

In addition to contributing to the growing body of literature concerning mathematics identity, this study also contributes to literature that informs mathematics teacher education and addresses the knowledge base for mathematics teaching. With the great strides being made in mathematics teacher education with regard to ambitious mathematics teaching (Lampert et al., 2013), high leverage mathematical practices (Ball & Forzani 2005) and mathematics content and pedagogical knowledge (e.g., Ball, Thames, & Phelps, 2008; Hill & Ball, 2004; Hill, Schilling, & Ball, 2004), research that addresses the ideological assumptions that mathematics teachers bring to the classroom is warranted (Crockett, 2002; Crockett & Buckley, Weisglass, 2000). These ideological assumptions influence the ways in which teachers attend to mathematics identity in practice (Gutierrez, 2009, 2012; Hand, 2012; Martin, 2007).

Overview of the Study

In this study, I collaborated with three participating novice teachers (PNTs) during their first two years of teaching in the quest to better understand how teachers attend to mathematics identity in practice. Each PNT was participating in a university-based alternative certification program, the Mathematics and Science Teaching Residency program, MST-Res², of which I was a course instructor and mentor teacher. I aimed to explore how these PNTs understood mathematics identity as they were teaching under the pressures of teachers in Griffin County Public Schools, a school district with a

² All names of school and university programs, participants, teachers, instructors, schools, and school districts are pseudonyms.

long history of low student performance and sanctions based on standardized test performance. I also wanted understand the forces that these PNTs, as subjects of their classroom activity systems, cited as influential to their ability to promote mathematics identity development with their students.

To investigate these questions, I employed case study methodology as well as cross-case analysis (Yin, 2008). Following a review of pertinent literature in Chapter 2, I will detail the methodological decisions, data sources, data collection process, and limitations in Chapter 3. I then present each teacher as an individual case in Chapters 4 through 6 via Engeström's (1987, 1999, 2001) activity theory framework. In Chapter 7 is a cross-case analysis, in which I use a broad activity system to consider salient themes across the cases. In Chapter 8, I suggest implications and areas for further research as a result of my findings and analysis.

Chapter 2: Literature Review

The literature that is relevant to this study crosses several fields of study. An initial overview of mathematics identity literature is central to understanding what it is that teachers are attempting to attend to in their practice. I provide a brief overview of the literature regarding mathematics identity and how it has been conceptualized through sociocultural and sociopolitical lenses. I also highlight pertinent studies with regard to mathematics identity in instruction, both in teacher-student interactions and peer interactions among students. Because the teachers in this study were all first or second-year teachers at the time of this study, the literature base regarding new teachers' perceptions of students in schools considered to be "urban," also informs this study; thus I highlight research related to this issue. I also review studies that highlight teacher and student experiences while teaching and learning mathematics in contexts that are test-driven (Valli et al., 2008) Additionally, given the research regarding knowledge for teaching mathematics and the claim that knowledge of mathematics identity is distinct yet related, a brief overview of this literature is also provided with an argument for why more work with respect to teachers' knowledge of the more affective domains of teaching mathematics is needed.

Sociocultural and Sociopolitical Perspectives On Mathematics Identity

As stated in Chapter 1, a recent wave of research highlights the sociocultural nature of developing mathematics identities. In this section, I highlight what the literature says with regard to adopting a sociocultural approach on mathematics identity and also present studies that are exemplars of this. I then turn my attention to the recent

calls for mathematics identity to be considered from a sociopolitical perspective. I highlight salient research from this perspective as well.

Researchers in mathematics education are exploring how students' identities are both personally constructed and imposed by others. From a sociocultural lens, cultural tools mediate identity development. Studying identity from this perspective focuses on how activity is socially and culturally organized (Nasir, & McKinney de Royce). Franke, Kazemi, and Battey (2007) posited that cultural practices are central to a student's identity, and they advocate for utilizing cultural knowledge to support authentic mathematical activity. In particular, they argued for the use of a "cultural difference" perspective as opposed to a "cultural deficit" perspective. Students' competencies outside of the classroom are therefore recognized as a resource and should be validated in the classroom. The notion of identity is concerned with both what is made available to individuals in the various social and cultural communities they inhabit and how they enact their participation across them. Identities are constantly in transition, and students learn to manage multiple identities based on the contextual situation (Esmonde, 2009).

A number of researchers have examined identity negotiation and development related to mathematics learning from a sociocultural lens, with a particular focus on non-dominant groups. Nasir (2000, 2007) attended to the complex relationship between identity, goals, and learning in her study of African-American middle and high school basketball players. Her research illuminated how identities necessarily involve aspects of both community and learning and how players' identities emerged as a product of their participation in basketball and the particular goals they set. This indicates that the formation of goals and identities in practice are related processes that are central to

learning. More specifically, Nasir's (2007) findings pointed to the salience of considering "the extent to which students' activities are aligned with a broader community of practice and the extent to which students imagine themselves as being committed to that community" (p. 145) as important factors in learning.

Given the "social turn" in mathematics (Lerman, 2000), researchers are not only using sociocultural perspectives to explore mathematics teaching and learning; but they also have turned their attention to issues of race, class, power, and issues of identity. A view of learning that challenges views of deficit thinking and negative narratives about low performing students lends credence to a focus on students' identities as a central component of participation in mathematics. Researchers in mathematics education have called for research in this domain and have asserted that for teachers to effectively teach mathematics, they must be aware of the sociopolitical forces at play (deFreitas, 2004, 2008; Gutierrez, 2012; Martin, 2007). Nasir and McKinney de Royce (2013) noted that while mathematics learning and the development of mathematics identity is sociocultural, it is also sociopolitical.

While noting that sociocultural perspectives highlight the role of culture and tools in mediating practice and developing identity, Nasir and McKinney de Royce (2013) distinguished sociopolitical perspectives from sociocultural ones as "how race and power operate in learning settings, especially as they may related to privilege and marginalization" (p. 266). Nasir distinguishes between sociocultural perspectives as those that bring to light how dominant cultural and social capital privilege particular ways of knowing, while sociopolitical perspectives, drawing from critical race theory (e.g., Ladson-Billings & Tate, 1995) bring to light non-dominant forms of capital as viable

ways of being and knowing. Further, sociopolitical attention to identity addresses not just how activity is organized, but how issues of power attempt to understand race and power in these same learning contexts.

While Nasir & McKinney de Royce (2013) and Gutierrez (2013) have recently brought to the fore a sociopolitical approach to conducting research on mathematics identity, research from this perspective is present in mathematics identity scholarship. Martin (2000) situated the learning and mathematics identities of African-American learners in a master narrative about the limited mathematical achievement of African-Americans. In his groundbreaking work, Martin focused on the notion of multiple identities, in particular, the construction of individuals at the intersection of being African-American and being a doer of mathematics. Using counternarratives as a means of giving voice to his participants, Martin interviewed African Americans³ from diverse walks of life to capture their challenges in maintaining and merging racial and mathematics identities. These counternarratives were intended to reframe the limited mathematics success of African American students as individuals and solely an issue of cognition, rather than issues of stereotyping and marginalization. He documented episodes of mathematics participation and experiences in which an individual's racial identity assumed salience and found that teachers played a significant role in the formation of student attitudes, dispositions, and beliefs about mathematics. With this understanding, he called for researchers and teacher educators to reconsider characteristics that are most important for teaching mathematics to African-American students. In particular, he asserted that to effectively teach African-American students,

³ African American and Black will be used interchangeably throughout this document.

teachers must be aware of how sociopolitical forces influence mathematics teaching and learning (Martin, 2007).

Drawing sociopolitical understandings of mathematics identity, deFreitas (2008) argued that secondary mathematics teachers are gatekeepers (Moses & Cobb, 2001), in that they teach a “high-status discipline” (Alquist, 2001). She posited that success or failure in mathematics has major implications for secondary students’ career and economic trajectories. Under this premise, she stressed the importance of bringing the sociopolitical nature of teaching mathematics to the attention of preservice secondary mathematics teachers. Grounded in her commitment to social justice in mathematics, she required her students to observe secondary mathematics classrooms “attending to the social structuring of the classroom culture along lines such as gender and race” (deFreitas, 2008, p. 44) and to reflect on their own mathematics histories, identifying instances of privilege or oppression to highlight the sociopolitical influences on mathematics instruction.

Integrating sociocultural and sociopolitical perspectives on mathematics identity has promise for teacher education and for teacher practice. Attending to identity from a sociocultural perspective highlights the situated nature of learning mathematics and frames learning as a cultural practice. A sociopolitical perspective informs the sociocultural perspective, as it raises issues of power exerted by societal and institutional forces on non-dominant groups. What these perspectives offer new approaches for thinking about mathematics identity, studies with regard to the practices that teachers enact with respect to these perspectives remains sparse.

Secondary Students and Mathematics Identity Development

Mathematics instruction consists of both socializing students into the norms of the classroom (Cobb & Yackel, 1996) as well as influencing students' perceptions of themselves as members of a community of mathematics learners or doers of mathematics (Boaler, 1999, 2000, 2002). Identity work is an essential variable for many students' achievement. Mathematics teachers have to create classroom conditions for identity work to flourish (Zollman et al., 2011). This is particularly true in secondary classrooms with adolescent students. Self-understanding is central to identity, and identity development is a fundamental task of psychological maturity during the adolescent years (Graham, Taylor, & Hudley, 1990; Walker, 2012). Adolescence is a period when students begin to define themselves as distinct from their parents and families, and schools and peers afford important social contexts where much identity work occurs (Walker, 2006, 2012). In the context of mathematics learning, this means that students develop a view of themselves as capable doers of mathematics (Zollman, et al., 2011). Given the salience of mathematics identity development in secondary students, I briefly outline salient and influential research on mathematics identity with secondary students.

Drawing from the notion of figured worlds (Holland, Lachicotte, & Skinner, 1998) and adopting a sociocultural perspective, Boaler and Greeno, in their study of secondary students (2000) argued that mathematics classrooms can be considered "narrow and ritualistic" (p. 171) figured worlds that are often rejected by students who find it incongruent with their developing identity as thinking agents. They investigated two different Advanced Placement Calculus classroom ecologies. One classroom represented a didactic teaching environment in which mathematics teaching afforded the

traditional view of received knowing, while the other represented a discussion-based environment where classroom practices supported students as active agents in the development of mathematical sense making. Students who learned mathematics in the former classroom ecology reported more negative views of mathematics due to their positioning as “passive receivers of knowledge” (p. 181). Despite making good grades in this context, these students were less apt to continue taking mathematics courses upon their completion of Calculus, as they saw mathematics as not aligning with their self-conceptions. Conversely, students in discussion-based classrooms made positive identifications with mathematics because of their opportunities to develop connected and meaningful understandings.

In another study of secondary students’ mathematics identity development, Horn (2008) conceptualized ninth-grade students’ sense of mathematical competency as emerging through the interactions with the mathematical world in which they exist. Defining a mathematical identity to be the self-understandings students develop about themselves in relation to mathematics which are co-constructed through their experiences in the social world, Horn’s research focused on seven students and their success in mathematics within two different mathematics departments. She followed the students as they matriculated through high school and found that day-to-day classroom interactions played a role in the development of students’ mathematics identities, specifically in relation to the different norms and expectations students encountered as a result of different teachers and classroom environments. More specifically, Horn found that individual teachers made positive contributions to students’ sense of mathematical

competence, which played a large role in the way students defined aspects of their mathematical identity.

Angier and Povey (1999) posited that the mathematics instruction is mediated not just by the curricular materials but also by the “relationships lived out in the mathematics classroom on the other are fundamentally intertwined in forming and framing that cultural space” (p. 148). The researchers followed a group of students from Grade 9 to Grade 11, conducting focus groups and individual interviews. Their interviews with students revealed that how students felt about themselves as a result of their interactions with their teacher affected their performance in their mathematics classes. In their multi-year study of the dynamics of a secondary mathematics cohort, they found that when the teacher allowed for more *spacious* mathematics, i.e., mathematics that allowed room for creativity and inquiry, students built peer networks within that classroom that aided in their learning of mathematics as supported by other researchers (Hiebert, Carpenter, Fennema, Fuson, Wearne, & Murray, 1997).

In a study of middle school classrooms, Gresalfi et al. (2009) contrasted how competency was constructed in middle school mathematics classrooms. They observed teacher and student participation on tasks created by the Algebra Project (Moses & Cobb, 2001) in two classrooms, one sixth grade and one eighth grade. In the sixth-grade classroom, the teacher and students constructed competency that defined doing mathematics as “a process of production, reevaluation, and revision” (p. 58). The students in this classroom came to understand that mathematics was sometimes difficult and that competency was more about negotiating the sensibility of solutions than finding correct solutions quickly. As a result, these students participated in activities that offered

a more expansive view of mathematical competency. This more expansive view offered students mathematical agency and authority, two indices that I have highlighted as positively contributing to mathematics identity. In contrast to the norms established in this classroom, the eighth-grade teacher and students constructed mathematical competency as correctly solving problems in the way that the teacher had modeled them, thus limiting students mathematical agency and authority. True to their sociocultural perspective, the researchers noted that when constructing a student as competent or proficient “it is essential to characterize not just individual students' accomplishments, but their accomplishments in the context of the opportunities they have had to develop that proficiency,” (p. 67) and those opportunities are most often created by mathematics teachers during instruction. Gresalfi et al. point to each teacher’s role in constructing competency in their classroom.

While teachers play an important role in shaping mathematics identities in secondary classrooms, peer interactions are equally as important. Walker (2006), studied peer networks and their effect on African-American and Latino students’ mathematical success. She concluded that peer interactions, both within and outside of mathematics classrooms, have the potential to positively influence participation in mathematics. Walker also asserted that while students may have peer groups that encourage academic success, school structures and policies may, in some cases, “perpetuate peer groups’ negative social consequences in terms of student achievement” (p. 48). For instance, students sorted into low-tracked mathematics courses based on their standardized test performance may struggle with reconciling a positive academic identity with the implicit messages of mediocrity (intentionally or unintentionally) communicated in low-level

mathematics courses. In her conclusion, Walker noted that despite earlier literature regarding minority students' disinterest in academic success (e.g., Ogbu, 1986), her findings ran counter to the claims made in such studies. Instead, she found students who used each other as motivators for academic success. Some of the peer relationships established during working on mathematics assignments were purely academic, while others were both academic and social. Regardless of the nature of the relationships, the African-American and Latino students in her study found strength in each other to persist and be successful in mathematics.

Test-Driven Contexts and Their Relation to Mathematics Identity

While highlighting the importance of teacher and peer interactions in mathematics classrooms, the classroom context is also important to better understanding the ways that students develop mathematics identity. As noted earlier, all of the data collected for this study was from classrooms with test-driven cultures (Valli & Chambliss, 2007; Valli et al., 2008). Valli and her colleagues chronicled the instructional shifts that occurred at four elementary schools based on the demands of standardized testing. Some school leaders, threatened by the impending sanctions for low test performance, opted to structure school days in ways that overemphasized teaching to the test and promote instruction that “frequently ignored children’s English proficiency, prior knowledge, and cultural experience” (Valli & Chambliss, 2007, p. 64).

While Valli and her colleagues examined the phenomenon of test-driven cultures at the elementary school level, examining the mathematical experiences of secondary students in accountability contexts remains ripe to be explored. Two studies, Lamb (2007) and Lattimore (2005), explored students’ perceptions of themselves and their

mathematical experiences as a result of accountability mandates. In a third study, Clark et al. (2013a) examined how secondary teachers used socialization practices to attend to their students' mathematics identities in a district facing high-stakes sanctions.

Lamb (2007), as both researcher and teacher of record, recounted his and his students' experiences of preparing for a high-stakes algebra exam in a low-income, rural Mississippi high school. He described the shift in his instruction as the standardized test drew near, and unique to studies of this nature, he interviewed his students to explore how they were making sense of high-stakes testing and how it shaped their self-perceptions. Lamb's work illuminated the diversity of student experiences within the same classroom. His students' responses to their feelings about high-stakes mathematics exams ranged from pride in being successful on them to shame and embarrassment due to poor performance.

Lattimore (2005) interviewed 6 African-American students in an inner-city high school known for its poor test performance about their experiences of preparing for a high-stakes mathematics exam. Students stressed the importance of memorization and cramming for success on these exams, but what was most troubling was how students had internalized their failure as something that they could "fix" about themselves and how they did not recognize what Lattimore called the "pedagogy of mediocrity" that pervaded their mathematical experiences.

As part of a larger study of highly respected African-American Algebra 1 teachers, Clark et al. (2013a), addressed the issue of high-stakes testing pressures and how two teachers, Floyd and Madison, addressed these pressures while attending to their students' collective mathematics identities. Floyd, in particular, had a unique perspective

regarding mathematics and its relationship to standardized testing. He believed that one of the primary purposes for learning mathematics was to pass the high-stakes standardized assessment at the end of Algebra 1, as it determined whether his students would graduate. He likened passing the Algebra 1 assessment to boxing, and it was his students' responsibility to "beat" the test. Because he privileged the role of high-stakes assessment in his teaching, he tended to closely adhere to his school district's pacing guide, which was closely aligned to the assessment and offered limited opportunities for conceptual understanding.

Low-Tracked Classrooms and the Development of Mathematics Identity

From the responses of student participants in Lamb's (2007) and Lattimore's (2005) studies, the influence of implicit messages to lower-tracked students from schools, teachers, and other stakeholders are evident. Oakes (2005) and others (Ellis, 2008; Watababe, 2008; Zohar, Degani, & Vaaknin, 2001) discussed the taken-for-granted nature of tracking students into low-tracked courses such as the ones discussed in this paper. Teachers, often so immersed in accountability systems, teach influenced by the constraints imposed upon them without ever questioning the structures in place (Sloan, 2007). They, like their students, are negotiating accountability structures. Understanding this, it is likely that implicit messages about mathematics ability are passed along from teachers to students during instruction.

Oakes (2005) revisited her seminal work on the detriments of tracking in the 1980s noting that much of what was true at the initial time of the research still rang true. She argued that certain types of attitudes were clustered at various academic tracks. Unsurprisingly, higher-tracked students expressed more positive attitudes toward

academics (e.g., The author reported a high positive response to statements such as “I like math.”) and self-concepts. They also tended to have higher educational aspirations. In complete contrast, students in lower academic tracks tended to have lower educational aspirations and scored lower on the self-concept and academic questions as well.

In the same study (Oakes, 2005), when students were questioned about what they were learning in their classes, their answers further substantiated the claim that students in different academic tracks receive very different messages. When asked what they learned in their mathematics courses, students in lower tracked courses reported learning things such as “coming into class and getting our folders and going to work,” and “How to go through a cart and find a folder by myself.” (p. 89). Students who were in high tracked-classes respond with answers like, “[I]n this class you learn from your mistakes...you should keep trying and striving,” “How to think and reason logically and scientifically,” and “I have the discipline to take a difficult class just for the knowledge.” (pp. 87-88). The stark contrasts in these responses was also triangulated by teachers who gave similar responses in regard to what they were teaching in their high- and low-tracked mathematics classrooms.

Similar to Oakes’ results, Zohar et al. (2001) found that teachers of lower performing students resorted to instruction with less cognitive demand for several reasons. Based on their findings from a mixed-method study of 40 secondary teachers, some teachers felt like students could not handle more cognitively demanding tasks without mastering the basics, while others saw structured, low-level instruction as a means of classroom management. Still, others saw exposing their lower-tracked students to high-level instruction and activities as harmful because their students became

frustrated. They report a two standard deviation gap between the emphasis on higher order thinking in high- versus low-tracked mathematics classes. Based on the findings of their study, they conclude that teachers' attitudes regarding student ability and tracking could ultimately result in self-fulfilling prophecies, i.e., developing their expectations of their students based on "subjectively interpreted attributes and characteristics of that student" (Rist, 2000, p. 268). The authors conclude that their findings suggest "a comprehensive and time-consuming change in teachers' beliefs is indispensable if the goal is to seriously convince teachers that higher order thinking is a suitable goal for all students" (p. 484).

Specific to identity development in a standardized test-driven culture, Lipman (2003) argued that low-tracked courses such as test preparation courses in struggling schools are comprised of social practices that "teach" students particular identities. Contrasting the environment and instructional practices of Chicago's elite educational institutions with those of more impoverished and high-minority populations, Lipman concluded that while schools draw on social-cultural resources, the resources at struggling schools are disparate, and thus disparate school experiences influence how students come to perceive themselves. She highlighted how the open and intellectually demanding curricula of more privileged schools implicitly taught students societal roles different from the roles being taught at struggling schools that overemphasize deference to authority and basic skills. Lipman spoke to the taken-for-granted nature of the distinct messages of ability being sent to the students in her research. She acknowledged the well-meant intentions of instructional leaders at schools that emphasize low-level instruction behavior management, however, she is quick to point out that the concern

with these instructional methods has more to do with the pervading ideologies of these institutions rather than their intentions.

The implicit messages of low-tracked courses and schools are shape students' perceptions with regard to their identities as doers of mathematics. How these (sometimes) unintentional messages affect mathematics classroom participation and peer interactions from a student perspective remains a space open for further examination. As highlighted in these studies, authentic learning in lower-tracked, test-driven classes is often overshadowed by deficit-oriented teacher perceptions, resulting in watered-down instruction with an overemphasis on basic skills, test-taking strategy (Apple, 1995; Sloan 2007, Watanabe, 2008, Valli & Chambliss, 2007), and behavior management (Hand 2010). As a result, students' opportunities to build positive mathematics identities through tasks that offer opportunities for agency and authority are limited.

Deficit Perspectives of High-Stakes, Urban Schools and Mathematics Identity

As highlighted in the previous section, the daily realities of teaching under the pressures of accountability mandates complicate teachers' abilities to positively influence mathematics identity. The demands of teaching in these contexts limit teachers' ability to provide meaningful instruction, let alone deal with the more affective domains of mathematics instruction. As deFreitas (2004) explained: "The emphasis on structural institutional forces as they impinge on [the] daily choices [of practice] reveal the complexity and inevitable dissonance that the novice math teacher will experience within schools" (p. 263). As noted in the study overview in Chapter 1, at the time of this study, the PNTs were participating in an alternative certification program in schools described as "high needs." Additionally, these schools would be characterized as being "urban," a

moniker that is troubling, as it is laden with deficit perceptions (Chazan, Brantlinger, Clark, & Edwards, 2013).

Tatto (1996) referred to underlying societal deficit perspectives that pervade teacher education and, ultimately, novice teachers' practice as "lay culture norms" that are generally accepted as common knowledge. Addressing the cultural mismatch and taken-for-granted assumptions of novice teachers in diverse, urban classrooms is essential to effective instruction. Mathematics classroom in high stakes, urban settings is a space ripe for exploring taken-for-granted behaviors. Teachers, often so immersed in accountability systems, teach within the constraints imposed upon them without ever questioning the structures in place. They are negotiating accountability structures just as their students are. Thus, tacit assumptions about mathematics ability and competency that accompany accountability mandates are highly influential to how students come to see themselves as doers and learners of mathematics.

While lay culture norms pervade educational rhetoric as the district and school level, even at the classroom level, implicit assumptions about certain students are a commonplace practice that often goes unnoticed (Horn, 2007). In her research on teacher discourse and its influence on how students are perceived by teachers, Horn studied two high school mathematics departments as they restructured their course offerings as a result of district-level reform. Using discourse analysis to analyze one instance from a department meeting of each group, she unpacked how teachers are often hindered by the "mismatch problem" when trying to provide more equitable practice. Horn describes the mismatch problem as disconnect, whether founded or unfounded, that teachers sense between their students' perceived abilities and the school mathematics curriculum. She

noted vast differences between the ways in which teachers discussed students in relation to the mismatch problem in each of the departments. Further, she noted that the way students were framed in department discussions had major implications for the opportunities afforded to them in their mathematics course taking and classroom participation. For instance, in one of the participating departments, the majority of the teachers questioned the “regular” students’ ability to handle two-column proofs in a geometry course. The teachers in this group had separated students into college-bound and non-college bound groups and mapped out their course taking trajectories as such. In the other department, a teacher tried to draw a distinction between “fast” and “slow” students, deeming the faster students as “smarter.” Because there were other teachers in the group who rejected the labels as indicators of their students’ abilities, the teacher was supported in her effort to deconstruct and rethink notions of “fast” and “slow” as labels of mathematics ability. Horn argued that teachers must be challenged to think of students in more complex ways than the traditional sense of labeling them as “smart” or “lazy” or “fast.” Further, she espouses that student categorizations are not static. A conception of students’ identities as flexible and evolving opens new spaces for classroom participation.

Given the tremendous task placed upon teachers in the current age of accountability, it is understandable that fixed notions of student ability such as “below basic” and “proficient” remain unchallenged. Further, it is common for teachers to allow these ability labels to profoundly affect their teaching (Watanabe, 2008; Zohar, Degani, & Vaaknin, 2001). Labeling and tracking students, according to some researchers, is core to our schooling system, particularly to the subject area of mathematics, as it helps to reproduce social stratification (Ellis, 2008; Skovsmose & Valero, 2001).

Expanding the Knowledge Base of Mathematics Teaching

Literature in the field of mathematics education often cites the need for preservice teachers to be both competent in content and pedagogical knowledge (Hill & Ball, 2004; 2005; Philip, et al., 2007). With respect to content knowledge and PCK, researchers contend that there is another dimension with respect to mathematics teacher knowledge – this dimension of understanding the complexities of mathematics identity development and its implications for positive disposition and motivation in the mathematics classroom (Anderson, 2007; Boaler & Greeno, 2000; Clark, 2009, 2011; Gresalfi & Cobb, 2006; Martin, 2000). In a recent study, Campbell et al. (manuscript) discovered an interaction effect between teachers who claimed to have an awareness of their students’ mathematical dispositions and their students’ performance on high-stakes mathematics exams. Thus, understanding more about this dimension of teacher knowledge has implications for student achievement.

Clark (2009) addressed this issue by arguing that in addition to the more widely acknowledged forms of mathematics teacher knowledge (content knowledge and PCK), there exists another domain of knowledge that mathematics teachers should possess to effectively teach mathematics. This domain includes supporting students, and in particular marginalized students, in seeing themselves as members of mathematics learning communities. Additionally, he posited that this domain of mathematics teacher knowledge includes understanding how and why some students participate in mathematical activity and are successful in mathematical contexts, while others are not. Further, he argued that drawing on the body of literature regarding students’ mathematics

identities may be one avenue to better understanding and developing this knowledge domain.

Mathematics Identity and Equity Implications

Attending to students' mathematics identities in practice also shows promise for rethinking and addressing issues of equity and diversity that have been raised by researchers in the field (e.g., Cobb & Hodge, 2006; Gutierrez, 2007; Gutstein, 2007; Lubienski, 2007; Sleeter 1997; Tate, 1994, 1995). Researchers acknowledge that the ways mathematics is taught and how underserved students are negatively perceived as learners of mathematics must be reexamined if equity and accessibility to meaningful mathematics is to ever be achieved (Gutierrez, 2008; Leonard, 2006; Sleeter, 1997; Stinson, 2006). In Sowder's (2007) review of effective mathematics professional development, she highlighted the importance of not only assisting new teachers in developing their own identities as mathematics teachers, but also of the importance of helping preservice and novice mathematics teachers prepare for the demands of the urban classroom. She noted, "Teachers of the future are unlikely to be capable of...practice [in urban schools] without major changes in our teacher preparation and professional development programs" (p. 167).

Leonard (2006) described her efforts to integrate activities in her mathematics methods courses that focus on the importance of culture. She required students to write cultural autobiographies and bring multicultural literature to class. She also used video of diverse learners in mathematical learning contexts. One semester, she utilized online discussion boards to have her students reflect on the importance of integrating issues of culture in mathematics instruction. Some of her students resisted the notion of

connecting the two, as they did not see the purpose of or the value in doing such work. Leonard issued the caveat: “Convincing some prospective and beginning teachers about the importance of connecting culture to mathematics instruction is a challenging task” (p. 15). In a more recent attempt to integrate issues of equity in mathematics instruction, Gutierrez (2012) shared similar sentiments.

Looking outside of mathematics education, teacher educators and researchers share similar sentiments with regard to preparing novice teachers for urban classrooms (Sleeter & Grant, 1994; Sleeter, 1996, 1997). Sleeter (2008) recommended that teacher education programs revisit their commitments to equity and democracy in education, as many programs are falling victim to “neoliberal” ideas of “[lessening] explicit equity-oriented teacher preparation...toward preparing teachers as technicians” (p. 1947). While not discounting the importance of content knowledge, she calls for democratic education that rests on three pillars: (a) preparation for the complexities of urban classrooms, (b) content and pedagogical knowledge, and (c) dialog with the communities where urban schools are situated.

Mathematics education researchers have pushed the field to consider and value mathematics instruction that integrates students’ ethnic and cultural identities and home experiences (Gonzales, Andrade, Civil, & Moll, 2001; Civil, 2002). Additionally, mathematics programs such as the Algebra Project encourage students to use their lived experiences and the social capital valued in their communities to better understand mathematical concepts (Davis, West, Greeno, Gresalfi, & Martin, 2006; Moses & Cobb 2001).

Further relating mathematics identity to issues of equity, as some researchers investigate what should be incorporated within mathematics curricula, other researchers are pursuing research that examines how teachers should approach teaching mathematics in ways that are more inclusive. Drawing on Ladson-Billing's (1994, 1995) groundbreaking work about culturally relevant pedagogy, some researchers have taken up how to implement it in mathematics classrooms (e.g., Bonner, 2009). Building from culturally relevant pedagogy, others have begun using theories of care to understand student-teacher relationships in the mathematics classroom and how caring relationships may enhance students' opportunities to learn rich, engaging mathematics (Bartell, 2011).

Summary of the Literature

While these studies are distinct in nature, they all encompass some element of teaching and learning mathematics that is central to students' mathematical identity development. Further, I drew on some of this literature during the participating teachers' summer course as we explored what it means and what it looks like to attend to student identity in practice. Also, as these teachers' mentor, I will reference some of the aforementioned research as the teacher they work in their own classrooms. In the next chapter, I will outline the research design for conducting the proposed study with the participating teachers.

Research on mathematics identity continues to grow in the body of mathematics education literature, yet ways to meaningfully infuse this research within classroom practices remain understudied. Several of the studies cited above highlighted the important role that teachers play in helping students construct positive mathematics identities (Boaler & Greeno, 2000; Horn, 2008; Martin, 2000, 2007), yet few discuss *how*

teachers should explicitly address building positive mathematics identities through their teaching practice.

Chapter 3: Research Design and Methodology

Chapter Overview

This is a study of how three novice middle-school teachers understood mathematics identity and enacted practices that attended to it. The study was guided by the following questions:

- How do novice middle-school mathematics teachers conceptualize mathematics identity?
- In what ways do the teachers in this study attend to the dimensions of mathematics identity in their planning and practice?
- What forces appear to influence these teachers' attention to these dimensions of mathematics identity in their practice?

I explored these questions with three first-year middle school teachers over the spring and fall 2012 semesters. The PNTs allowed me to observe their teaching, dialogue with them, and collect artifacts from their coursework as prospective teachers as well as from their classrooms. I organized each PNT's experiences into individual cases, then employed cross-case analysis to better understand how the novice teachers were conceptualizing mathematics identity, the ways their enactment of practices impeded or supported positive mathematics identity negotiation, and how high-stakes contexts shaped their conceptualizations and enactments.

I carefully selected the methodology, settings, and participants to answer the research questions. In this chapter, I provide a detailed description of the data collection process and analytic tools and also discuss how the research questions align to the data sources. I have arranged this chapter into five primary sections. In the first section, I describe the program from which this study originates, MST-Res, along with the participants and their teaching contexts. I also address my researcher positionality, as I

served as the PNTs instructor in the summer of 2011 and eventually became their mentor teacher while collecting data for this study during the 2011-2012 school year. In the second section, I highlight the data sources and how they aligned to the research questions I sought to answer. Then, in the third section, I present my rationale for case study and cross-case analysis in and describe the data collection and analysis procedures. Specifically, I highlight the complexity of analyzing data from multiple sources that served as evidence of supporting or impeding mathematics identity as well as how the mathematics identity framework presented in Chapter 1 supported the analysis. That section is followed by methodological limitations and considerations. I close this chapter with a brief outline of the organizational structure of the cases that will follow this chapter.

Participants, Settings, and Researcher Positionality

MST-Res Program. The PNTs in this study belong to the second cohort of teachers who were participating in a university-based alternative certification program for middle school mathematics and science teachers, MST-Res. Cognizant of the research regarding teacher recruitment and retention of teachers for hard-to-staff schools, alternative certification, and mathematics and science teaching in urban contexts, MST-Res purposely selected this cohort of teachers based on their expressed commitment to equitable practice, strong mathematics or science content knowledge, or some combination of the two criteria.

MST-Res provided its prospective teachers with a summer preservice experience prior to entering the classroom. This summer experience included a mathematics or science methods course, a course about reading strategies across content areas, and a

summer seminar. I was the instructor of record for the seminar in the summers of 2011 and 2012. The PNTs in this study enrolled in the summer seminar during the summer of 2011.

The summer seminar, while addressing more traditional indices of teacher preparation, also addressed the complexities of teaching mathematics beyond issues of content and pedagogical knowledge. The MST-Res program vision for preservice education, in part, derived referenced Ladson Billings' (1999) framework regarding preparing teachers for diverse settings and McDermott and Varenne's (1995) theory regarding explanations for academic success and failure as related to culture. In an effort to be reflective of the stance and vision of MST-Res, I designed the coursework for the summer seminar with this literature base in mind. The summer course addressed general education topics including lesson planning, relationship building, and working with parents, while also addressing mathematics and science teaching with respect to culture, race, class, ability, language, and gender from a difference- rather than deprivation- (or deficit-) oriented perspective (McDermott & Varrenne, 1995). I developed the summer seminar with the ultimate goal of assisting teachers develop equitable approaches to teaching mathematics and science.

During the first week of the seminar, the prospective teachers and I discussed differing definitions for equity, established a working definition of equity for the duration of the course, and thought about what equity meant in the context of teaching mathematics and science. In the summer of 2011, I expanded on the notion of equity in mathematics and science and facilitated a unit on mathematics and science identity and its implications for equity, the unit that is the origin from which this study arose. It was

my hope that at the end of the summer seminar, the MST-Res prospective teachers would enter their mathematics and science classrooms with a sense of agency and a better understanding of how they could help their students co-construct positive mathematics identities.

I recruited the PNTs for this study from the teachers in the second MST-Res cohort. The teachers in the second cohort represented a wide variety of ethnicities, ages, and professional experiences. The diversity of the cohort was intentional, as the MST-Res had a commitment to diversifying the mathematics and science teaching profession in Griffin County Public Schools. This type of diversity was unlike many preservice teacher programs, as research on recruitment and retention of secondary mathematics teachers highlights the homogeneity (with respect to race, ethnicity, class, and language) of the candidates (Liu, Rosenstein, Swan & Khail, 2008). Their diverse perspectives and walks of life proved to be a tremendous resource during the facilitation of the summer course.

I selected readings for the identity unit based on contemporary research in mathematics education regarding the development of students' mathematics identities. In addition to course readings, the teachers also participated in activities that encouraged them to think deeply and pragmatically about these issues. These activities included teaching mathematics at a local community center, completing a life history interview with a student at the community center, and writing their autobiographies while analyzing them for issues of power, privilege, and discrimination. Some of these documents served as data that I collected and analyzed as a part of this study.

Participants and settings. Each of the participating teachers is unique from one another in ethnicity, educational attainment, prior professional experience, and mathematics background. Additionally, their experiences as people of color, mathematics learners, and novice teachers in test-driven classrooms informed their classroom practices and the ways in which they attended to mathematics identity. At the close of the summer 2011 seminar, I announced that I would be recruiting teacher participants for my dissertation study that was related to our course content. I was particularly interested in working with students from the summer seminar, as they had some knowledge of mathematics identity based on our work together over the summer. While several students inquired about participating, I ultimately collaborated with Jan, Carmen, and Chris based on our mutual interests in mathematics identity and their willingness to dedicate extra time to the study, including completing writing tasks and participating in follow-up interviews.

During the Spring 2012 and Fall 2012⁴ semesters, I collaborated with the PNTs. Their classrooms were the primary site for observations and interviews. According to the MST-Res program requirements, they taught in schools that were designated as “high-needs” middle schools, meaning that the schools that had histories of limited success on standardized assessments. Additionally some of these schools were in the process of being restructured by the State Department of Education, both in terms of academics and social norms. These schools were located in a predominately Black, urban-fringe school district in the mid-Atlantic, Griffin County Public Schools.

⁴ Carmen and Jan participated in the Fall 2012 data collection process. Chris was no longer teaching at that time; thus he was ineligible to participate.

Participants. Jan Dan was recent college graduate with a degree in biochemistry who decided to leave behind her aspirations of being a pharmacist to follow her “calling,” as she would describe it, to teach middle school mathematics. She identified as an Asian-American woman of Korean descent who was in her early twenties at the time of this study. Jan became the teacher of record for several test preparation courses in the spring of 2012. While the courses were intended to focus primarily on test preparation, Jan expressed a personal goal of having her students not only improve their mathematics skills, but also leave the class feeling better about themselves as mathematics learners. Jan desired to deemphasize ability, though this proved to be challenging. Jan’s case is illustrative of how teachers’ personal academic narratives as well as the nature of the courses they are assigned influence how they attend to mathematics identity. Jan’s case is one of negotiating tensions and trying to balance the competing goals of accountability mandates and building positive mathematics identity.

Chris Andrews was a former financial analyst who decided to teach middle school mathematics after being laid off from his job in finance. He had enjoyed his experiences as a substitute teacher while being laid off and saw MST-Res as a path to fulfilling his commitment to helping Black students. He self-identified as Black and was in his late forties at the time of the study. During the summer seminar, Chris often wrestled with issues of ability, particularly with regard to whether some people were simply predisposed to be “math people.” As an Ivy League graduate with a long legacy of educational achievement in his family, his notions of ability and mathematical competency proved to be highly influential to his instructional practices, especially with regard to how he attended to his students’ mathematical identities. Unique from the other

teachers in this study, Chris often found himself grappling with what it meant to be a Black man teaching mathematics to classrooms of predominately Black students and how he had a responsibility to counter the deficit-laden messages about the identities and academic achievement of Black children. Chris's case is illustrative of how sociopolitical forces shape teachers' attention to mathematics identity.

Carmen Laureta, a former culinary instructor and recent communications major, identified as an Filipina woman in her late twenties at the time of this study. During the summer of 2011, after the summer seminar ended, Carmen expressed considerable interest in learning more about promoting positive mathematics identity development in her classroom. Once Carmen transferred to Washington Middle School upon completion of her student teaching, she continued to express a desire to know more about the school's surrounding community and her students' out-of-school experiences, interests, and motivations. Carmen taught lower-tracked mathematics courses during the Spring 2012 semester, but was scheduled to teach the honors sections of Mathematics 7 during the Fall 2012 semester. Watching her attend to mathematics identity in the same school but within different classroom contexts was illuminating with regard to how she selected tasks and attended to her students' mathematics identity.

Setting: Test-driven middle school classrooms as spaces for inquiry. While attending to mathematics identity across all mathematics classroom contexts is important, I chose to explore my research questions within the context of classrooms in schools struggling to meet high-stakes accountability mandates. After mentoring, collaborating with, and observing the PNTs, I contend that each of them taught in what Valli et al. (2008) would consider *test-driven* cultures, wherein "learning is supplanted rather than

supported by assessments. Schools participate in gaming strategies to avoid adverse consequences, and teachers reshape instructional activities to mirror standardized tests. As a result students often learn less than when learning, not testing, is the explicit goal” (p. 25). Further, Oakes (2008) argued that NCLB mandates at the state and local levels are creating a new system of tracking, dubbed *neotracking*, a combination of older versions of rigid, comprehensive tracking with newer forms of within-subject area curricular differentiation. Neotracking within mathematics as a result of standardized testing is prevalent. It occurs both at the district and school level. Each of the teachers in this study were experiencing some form of neotracking in test-driven classroom climates, as each of them either taught test preparation courses or some iteration of Mathematics 7 or 8 under the guise of meeting the testing needs of their students. Examining how sorting practices as a result of high-stakes accountability influence teachers’ understandings and practices with regard to mathematics identity is both timely and important. I would surmise that the classrooms I observed in this study mirror the complexities of assessment, instruction, and affect playing out in low-performing districts nationally.

Though labeling and sorting practices in public schooling are not new, contemporary issues in mathematics education, like attending to mathematics identity, benefit from being examined in these particular contexts. As accountability mandates call for the disaggregation of assessment data by subgroups, school systems are literally labeling students with monikers such as *advanced*, *proficient*, and *basic* or other comparable labels (Ellis, 2008). The pervasive discourse of ability as measured by test performance permeates curricula, course scheduling, and ultimately instructional

decisions at the classroom level (Diamond & Spillane, 2004; Oakes, 2005; Watanabe, 2008). How teachers negotiate these stratified classroom spaces through instruction in conjunction with attending to issues of mathematics identity is warranted and the rationale for using these spaces as locations for inquiry.

At the time of the study, both Jan and Chris taught at Albert Einstein Middle School, a predominately African-American (65%) population with an increasing population of Latino students (approximately 20%). Einstein, like most of the middle schools in this urban-fringe district, had faced its challenges in the past with regard to making the annual measurable targets on the statewide mathematics standardized exam. Having Jan and Chris at Einstein allowed the school administration to rework the spring schedule of classes so the mathematics department they could offer additional remediation courses.

Carmen taught at Booker T. Washington Middle School, a school that served a predominately African-American student population (almost 90%) from grades 6 through 8. At the time of this study, the State Department of Education was reconstituting Washington Middle School based on its test performance in recent years. Reconstitution by the State Department of Education included the requirement that all mathematics teacher, including Carmen, participate in activities such as state-run professional development courses, collaborative lesson planning, and data chats in the hopes of improving Washington's standardized assessment scores.

Researcher Positionality. Having served as both investigator of this study and MST-Res mentor teacher, I am cognizant of my influential role in this work. My responsibilities as the PNTs' mentor teacher included reviewing mathematics content

with them, co-planning lessons, assisting with pedagogical strategies, encouraging them to become reflective practitioners, supporting them in making sense of their teaching dilemmas, and supporting their development across other dimensions of practice.

Because of the nature of this study, my role as a researcher overlapped with my responsibilities as a mentor teacher. I viewed my role as an influential participant and, in some ways, a part of the context of the research, in that I was helping to facilitate their understanding of mathematics identity while also using their interview responses, observations, and written feedback to support their practice.

My commitment to MST-Res and its philosophies about teacher recruitment and preparation were not just professional, they were personal as well. In addition to serving as an MST-Res mentor teacher and instructor, I also brought other unique experiences to this study, some of which I highlighted in Chapter 1. I was a resident and former teacher in the school district where this study took place. In fact, my home was within 5 miles of one of the research sites, and I used to teach mathematics at the high school that enrolled students once they matriculated through Washington Middle School. This work was especially important to me because it could shed light on the nature of mathematics education and schooling in my community as well as equip teachers in local schools with new ways to build positive academic and social relationships with their students, an element of instruction I believed was sorely missing from many of the teacher-student interactions I witnessed as a former mathematics teacher in Griffin County Public Schools.

In addition to being a community member at the time of this study, upon analysis of the data for this study, I am cognizant that my identity as a Black woman also

influenced my participants' responses during our interviews, particularly in Chris's case. Race became a salient issue in this study in ways that I had not anticipated before conducting interviews. After interviewing Chris and reviewing the transcripts from our meetings, I started to notice his liberal use of phrases like "You know how *we* are" "and "*Our* children" during our interviews. I interpreted these statements as an acknowledgement of our shared cultural experiences. There was a level of trust and warmth in our interactions that reminded me of the way that Foster (1997) recalled her experiences as a Black woman interviewing Black teachers in her seminal work *Black Teachers on Teaching*. Chris openly discussed topics in his interviews that were hard for me to write about, as they are conversations that are often spoken behind closed doors. However, Chris's interpretations of mathematics identity, and particularly motivation, shed new light on elements of mathematics identity rarely captured in the literature.

Being cognizant of how my identity shaped the nature of my data, I was both honored by the level of trust and candidness that all three of my participants afforded me. I aimed to interpret their words and actions with fidelity and in methodologically sound ways.

Data Collection

The data for this study were collected from multiple sources in four phases. The multiple sources served as a means of data triangulation (Cresswell, 2007; Miles & Huberman, 1994), meaning that that my multiple my sources provided corroborating evidence to support my findings. Table 1 outlines the data collection phases, time periods, and data sources. I will describe each data source in detail below.

Table 1
Data Collection Timeline

Program Phase	Date	Data collected
Phase 1: Preservice Education and Field Experience	Summer 2011	<ul style="list-style-type: none"> • Mathematics autobiographies • Online message board responses
Phase 2: Pilot Interview Questions Pilot Coding Scheme	Winter 2011	<ul style="list-style-type: none"> • Piloted interview questions • Analyzed data from pilot interviews and observations to refine coding scheme
Phase 3: Student Teaching Classroom Teaching	Spring 2012	<ul style="list-style-type: none"> • Biographical/background interviews. • Interviews • Observations • Mathematics identity lesson planning prompts
Phase 4: Classroom Teaching Follow-up Interviews Member checking	Fall 2012	<ul style="list-style-type: none"> • Interviews • Observations • Mathematics identity lesson planning prompts

Interviews. I conducted the majority of the interviews with the PNTs while also serving as their mentor teacher. My responsibilities as a mentor teacher required me to meet weekly or bi-weekly with the PNTs during the spring of 2012. Thus, our interviews served several purposes, which will be outlined below. These interviews were in-depth (Yin, 2009), in that I interviewed my participants about their opinions and perspectives over a period of time; they were also semi-structured, meaning that I prepared a written sequence of interviews questions whereby I asked all of the PNTs the same core questions, but maintained the “freedom to ask follow-up questions that buil[t] on the responses that I received” (Brenner, 2006, p. 362). Each interview protocol was divided into subtopics. I allowed the PNTs to review the protocols prior to recording the interviews to ensure that they were comfortable with the nature of questions.

The first round of interviews aimed to do the following: (a) introduce the teachers to the study and provide information regarding their consent, (b) open up discussion about each PNT's salient personal and academic experiences, (c) make connections between their experiences and their teaching practices when possible, and (d) shed light on how the PNTs were thinking about mathematics identity and the dimension that they thought was most pressing to attend to in their practice. I refined the interview questions for the first round of interviews based on interview questions I piloted in December of 2011 with an MST-Res PNT who did not participate in this dissertation study. The first set of interviews proved to be fundamental to completing the study, as they determined the trajectory for each teacher's subsequent interviews.

During the second round of interviews, the PNTs provided their rationale as to why they desired to prioritize a particular dimension during the course of the study. Additionally, they reflected on several of their artifacts from the summer 2011 seminar, including excerpts of their autobiographies and postings from the course message board. The third through sixth interviews⁵, also semi structured, differed in their nature depending on the PNT with whom I was collaborating, their needs as a novice teacher, and their preceding interviews (see appendices A-C for sample interview protocols). Some of the interviews ended up being instructive and supportive, as I had a responsibility to support their practice. Some interviews were more collaborative in nature. Other interviews were simultaneously instructive, supportive, and collaborative. During these interviews, we discussed the tasks that planned and how they saw these tasks attending to their students' collective mathematics identities across any of the four

⁵ The number of interviews varied among the teachers.

dimensions presented in this study. Other times, we strategized ways to meaningfully integrate activities and instructional practices that attended to particular dimensions of their students' collective mathematics identities. In some instances we debriefed lessons using the mathematics identity lesson planning prompts. In the fall of 2012, I had the opportunity to do some member checking with Jan and Carmen. I shared some of my interpretations of the Spring 2012 data.

Interviews took place at each teacher's school site, either in their classrooms or in the teachers' lounge. We ensured that the interview spaces allowed for privacy. I interviewed each teacher, in total, four to six times, based on his or her availability. Interviews ranged from 15 to 95-minutes each. I audio recorded all of our interactions using a digital recorder. A professional transcriptionist transcribed the majority of the interviews⁶. Upon receiving the transcripts, I reviewed each of them for accuracy and completeness. Additionally, when necessary, I contacted the PNTs for clarification. In addition to hiring a professional transcriptionist, I transcribed Jan's and Carmen's final interviews from the fall of 2012.

Observations and field notes. In addition to audio recording all PNT interviews, I also audio recorded selected lessons. For consistency purposes, I observed the same classes for each observation. I observed Carmen's first-period Math 7 class in the spring of 2012 and her third-period Honors Math 8 class in the fall of 2012. I observed Jan's fourth-period test preparation class in the spring of 2012 and her third-period Math 8 class in the fall of 2012. In the spring of 2012, I observed Chris' second-period test preparation class. A professional transcriptionist transcribed most of the classroom

⁶ I transcribed Chris's 4th interview and Jan's and Carmen's 5th interviews.

observations⁷. Upon receiving the transcripts, I reviewed each of them for accuracy and completeness and substantially revised many of them for mathematical accuracy. The audio recordings and related transcripts allowed me to find instances in the data that were related to the research questions. Additionally, these observations served as points for discussion during subsequent interviews.

In addition to audio recording the abovementioned interviews and observations, I kept detailed field notes as I observed all of the classes. While recording observations via field notes, it was important to distinguish between “accurate and detailed description and . . . interpretive comments” (Anderson-Levitt, 2006, p. 286). Thus, when taking field notes in each PNT’s class, I tried to capture classroom details and interactions while suspending my interpretation; however I did have some instances of analysis in the field notes. I also flagged particular episodes in my field notes that I wanted to pay particular attention to in the analysis phase. Upon leaving the observations, I reviewed my field notes to parse out any over-interpretation. Some the initial interpretations I had during my observations were cataloged for analytic memos, which will be detailed in the upcoming data analysis section.

Artifacts. I used several types of artifacts as a means of data triangulation (Yin, 2009). These artifacts included electronic documents from the summer 2011 summer seminar, course materials, each PNT’s lesson plans, and lesson planning prompts.

Summer message board postings. During the summer 2011 seminar, I required all teachers to post weekly reflections to our course discussion board. I then selected the PNTs’ posts that were salient to this study. The posts selected covered topics such as

⁷ I transcribed three of Jan’s observations (Spring 4, Fall 1, and Fall 2) and one of Carmen’s (Spring 1) observations.

developing teacher persona, creating a vision for teaching and learning mathematics, and attending to mathematics identity in practice. These postings provided pertinent information that helped me draft a biographical sketch for each PNT. In addition, the summer message board postings were helpful in my analysis of how the PNTs were conceptualizing mathematics identity during the summer seminar.

Summer portfolios. As a culminating activity for the summer seminar, each teacher had to complete a summer portfolio. These portfolios required students to complete tasks related to major three domains covered during the course of the summer: (a) being a reflective mathematics/science practitioner, (b) participating in the summer field teaching experience, and (c) sending messages to students regarding expectations, classroom management, and discipline in mathematics and science classroom.

One of the tasks included in the PNTs portfolios, under the domain of being a reflective practitioner, involved reflecting on their mathematics autobiographies written at the beginning of the course. Drawing on deFreitas's (2008) and Leonard's (2006) work with preservice secondary mathematics teachers, I asked each PNT to respond to a series of prompts about their experiences as a mathematics doer and learner. Toward the end of the course, as a requirement for their portfolios, I then asked them to revisit their mathematics autobiographies, but to do so looking for instances of privilege or oppression based on ability, race, gender, class, or other sociopolitical factors. Additionally, I asked them to connect their mathematics autobiographies to the readings we read over the course of the summer. Both the autobiographies and the reflections served as useful data to this study, as they helped me think about each teacher as the

subject of their activity system. In addition, I used the data to inform my first and second rounds of interviews with each PNT.

Related to the summer field teaching experience, each PNT conducted a mathematics life history with a participating student at the field experience site. Guided by a set of prompts, each MST-Res preservice teacher interviewed students about their experiences as mathematics or science learners and their identities within and outside of the mathematics or science classroom. These documents served as baseline data, in that they provided some insight as to how each PNT was conceptualizing middle-school aged students and mathematics identity prior to participating in the study.

Lesson plans and course materials. I obtained copies of the lesson plans for the lessons I observed when available. Additionally, each PNT provided me with either hard or electronic copies of the materials they used, including warm-ups, mathematical tasks, and exit tickets.

Mathematics identity lesson prompts. In addition to lesson plans and course materials, about halfway through the data collection process, I asked each PNT to a complete mathematics identity lesson prompts for each of the lessons that I would be observing. Using the PNTs responses in the first two rounds of interviews, I ascertained that they were struggling to identify instances of mathematics identity in their practice as well as having difficulty thinking about how to incorporate attention to mathematics identity in their lessons. With these dilemmas in mind, I created the lesson prompts (see Appendix D) to encourage the PNTs to decompose (Grossman, Compton, Irga, Ronfeldt, Shahan, & Williamson, 2009) their teaching practices with regard to issues of mathematics identity. Borrowing from the educative practices of other practice-based

professions (e.g., medicine, theology, and engineering), Grossman and her colleagues described the decomposition of teaching as a process involving novice teachers and teacher educators “breaking down practice into its constituent parts for the purposes of teaching and learning” (p. 2056). They theorized that by decomposing complex teaching processes into meaningful components, they would become routinized for novice teachers over time. In this case of this study, the PNTs and I aimed to decompose the complex practice of attending to mathematics identity in practice. We used the mathematics identity planning lesson prompts as a starting point for decomposition.

I developed the lesson planning prompts with the purpose of assisting the PNTs’ efforts to decompose what it meant to attend to mathematics identity in their practice. The prompts were grounded in the work of Gresalfi et al.’s (2009) model of mathematical competency as constructed through mathematics classroom interactions, which was highlighted in Chapters 1 and 2. I found this model useful, as the dimensions of mathematics identity highlighted in this study are embedded within this framework. Guided by the framework, I wrote questions for the PNTs to consider as they planned their lessons. PNTs responded to the first set of prompts while planning their lessons. After teaching, the PNTs reflected on how they attended to issues mathematics in their class at the class- and individual-level via the post-question prompts. When we met to complete our interviews and post-observation debriefing, we used the prompts as a way to organize our conversations.

While acknowledging decomposition as a useful practice with novice teachers, it is also important to note that mathematics teaching does not happen in a disembodied or discrete way as decomposition suggests; however, I hoped, like Grossman and her

colleagues (2009) asserted, that by decomposing this particular element of mathematics teaching, considering mathematics identity would become routinized in their planning.

Alignment of data sources to research questions. Table 2 highlights how the data sources for this study align with the research questions.

Table 2

Research Questions and Data Alignment

	How do novice middle-school mathematics teachers conceptualize mathematics identity?	In what ways do the teachers in this study attend to the dimensions of mathematics identity in their planning and practice?	What forces appear to influence these teachers' attention to these dimensions of mathematics identity in their practice?
Interviews	X	X	X
Observations		X	
Message board responses	X		X
Summer portfolio	X		
Mathematics identity planning prompts	X	X	
Lesson plans		X	X

In the following section, I present my rationale for using case study methodology and cross-case analysis. I also detail my data analysis procedures.

Methodology: Case Study and Cross-Case Analysis

I used case study methodology (Creswell, 2007; Merriam, 1998; Miles & Huberman, 1994; Yin, 2009) to illuminate each teacher's salient academic and personal experiences, approaches to teaching mathematics, and ways that he or she attended to mathematics identity in practice. In addition, I used cross-case analysis (Borman, Clark, Cotner, & Lee, 2006; Yin, 2009) to examine salient themes that were common or disparate across teachers.

A case study is “an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon are not clearly evident” (Yin, 2009, p. 18). Case study was appropriate, as my goal in this study was to understand *how* PNTs were conceptualizing and attending to mathematics identity in their particular school contexts. Researchers note that exploratory questions, that is, those that seek to answer *hows* and *whys* in contemporary contexts, often lend themselves to case study methodology (Merriam, 1998; Yin, 1994, 2009). Case studies arise “out of the desire to understand complex social phenomena, ” while “allow[ing] investigators to retain holistic & meaningful characteristics of real-life events” (Yin, 2009, p. 4). Further, case studies have a bounded nature, meaning that while there are numerous influences and contextual factors within a case, case study allows for a particular phenomenon to be examined within the context (Merriam, 1998; Miles & Huberman, 1994). Thus, case study allowed me to capture the specific phenomenon of teachers attending to mathematics identity within the dynamic and ever-changing nature of the middle-school classrooms where I visited and, at times, participated. Moreover, as the lived experiences of PNTs were an essential component to

understanding each teacher as the subject of his or her activity system, case study allowed me to address how “organizations, communities, crucial events, and significant others in shaping the subject’s evolving definitions of self and their perspectives on life” (Bogden & Biklen, 2003, p. 57), particularly as these factors pertained to how teachers saw themselves and their students as learners and doers of mathematics. I present analytic episodes, either from interviews, observations, or written artifacts that correspond with one or more of the research questions and align with the theoretical framework.

I used cross-case analysis to illuminate the various and unique ways each teacher was conceptualizing mathematics identity and attending to it in his or her practice. Researchers posit that the use of multiple cases strengthen external validity and strengthen the generalizability of findings (Merriam, 1998). Yin also noted another important advantage to adopting a cross-case analytic approach, the potential for cases to be modified as new information arises or new discoveries occur during data collection. Thus, through the use of cross-case analysis, I was able to refine my cases, as data and analysis in one case informed the others.

Each case in this study is an interpretive case, meaning that I “used [descriptive] data to . . . illustrate, support, or challenge theoretical assumptions held prior to data gathering” (Merriam, 1998, p. 38). In this study, I used the cases of three PNTs to highlight illustrative examples of teachers’ practices that supported or impeded mathematics identity as theorized in Chapter 1. Highlighting an important use of theory in case studies, Yin (2009) also noted that “appropriate developed theory also is the level at which the generalization of the case study results will occur” (p. 38). As noted earlier, I used activity theory at the classroom level to unpack classroom interactions. With this

in mind, Chapter 7 will provide cross-case analysis, implications, and discussion that can be generalized to the classroom level.

Data Analyses

Data analysis followed Merriam's (1998) recommendation of taking several passes across the data sources. Analysis involved identification of relevant excerpts from interview transcripts, summarizing each PNT's relevant actions and utterances, considering alternate interpretations of PNT's statements, and examining transcripts, written artifacts, classroom tasks, and observations for confirming or disconfirming evidence. The goal was to characterize each participant's understandings of their salient life experiences, the nature of mathematics, mathematics identity, and related instructional practices to identify the connections between these elements and how each PNT attended to mathematics identity in practice.

Coding procedures. I primarily coded my corpus of using Dedoose software. This coding and analysis software allows for qualitative data coding as well as frequency counts, matrices, and other ways to quantify qualitative data. Given the versatility of Dedoose, I was able to code my data and then organize it in ways to seek patterns and themes. Given the nature of my data, I used two coding schemes, which I will describe in detail below (see Appendix E for coding scheme).

Biographical interview data. The first round of interviews served a purpose that was distinct from the other rounds of interviews in the corpus of data. As activity systems highlight the role and importance of the subject in the system, I planned to learn important academic and biographical data regarding each PNT during the first round of interviews. Additionally, when trying to code the biographical data that I collected while

piloting my interview questions, I quickly learned that the codes I developed based on this study's framework for mathematics identity would not be sufficient to code the PNTs' biographical interview data.

On my initial pass of the transcripts related to the teachers' biographies transcripts, I engaged in the practice of pre-coding (Saldaña, 2009), meaning that I read the biographical interview transcripts and flagged, highlighted, or underlined portions that I believed would be important to this study and in need of attention during the coding process. I began to identify common patterns in the nature of the participants' biographical and academic experiences during the pre-coding process. Upon several reads and annotations of the biographical transcripts, these themes eventually became codes and subcodes. After coding the biographical data and adding and collapsing codes through several passes of the data, the final coding scheme included: (a) biographical/demographic information, including the sub-code "otherness." The "otherness" subcode arose as I noticed that all three PNTs highlighted experiences of being seen as "other," either based on race, ethnicity, or language as influential to their mathematics learning experiences. Other codes included: (b) personal mathematical experiences (later divided into sub-codes to account for instances of success and failure), (c) success/failure in mathematics (intrinsic), (d) success/failure in mathematics via others (extrinsic), (e) personal motivation to teach (including sub-codes factors attributing to desire to teach and factors attributing to teaching style). After creating this initial coding scheme, I later revised my coding scheme to accommodate coding regarding PNTs' beliefs about the nature of mathematics, and each teacher's initial conception of mathematics identity.

Coding scheme for subsequent interviews. Drawing from Clark's (2009) synthesis of the mathematics identity literature, I used the four mathematics identity dimensions as the foundation for the coding scheme for each PNT's subsequent interviews. Using this framework, I coded teachers' interview responses as related to, attending to, or being in opposition to one or more of the dimensions of identity: (a) ability, which included two subcodes, labeling and othering, (b) importance, (c) nature of tasks, and (d) motivation. Often, I used multiple codes on single excerpts or exchanges between the PNTs and me. The data collected and analyzed as a result of piloting interview questions illuminated that the dimensions of mathematics identity utilized in this study are not discrete or mutually exclusive. For example, if a teacher spoke of motivating a group of students based on how they were assigned to their course (e.g., It is so much easier to motivate my honors kids), this utterance was double coded for motivation and ability, as the teachers' perceptions of the students' abilities was central to the way they motivated the students. The use of overlapping coding speaks to the integrated and interdependent nature of the dimensions as explained via the gear metaphor in Chapter 1.

While pre-coding, I noted that the identity dimension codes addressed the dimensions the PNTs discussed in their interviews, however they did not capture how the teachers saw themselves attending to these dimensions. To address this concern, I created another code called "strategies." This code was used to highlight when teachers either talked about practices they used during instruction or described practices they believed would attend to identity. Eventually, as the number of utterances and exchanges coded as "strategies" grew, I parsed out a distinct set of utterances and exchanges and

called them “relationship building,” which encompassed issues of classroom management and norms. This code was warranted once I realized how much classroom management and norms influenced the PNTs’ attention to mathematics identity.

In addition to these identity codes described above, as I listened to the PNTs’ interviews, pre-coded, and considered my research question regarding the influential forces on teachers’ ability to attend to mathematics identity, I realized that I needed additional codes to capture forces that were influencing the PNTs’ attention to mathematics. Thus, I added additional codes: school/structural concerns and dilemmas to teaching with identity in mind to address this issue.

Coding observational data. Coding observational data included using the identity codes as well as creating a coding scheme for the ways in which teachers attended to these identity dimensions in practice. This coding scheme originated from my extension of the mathematics identity framework, which was detailed in Chapter 1. I developed a set of codes, which I called “means of addressing identity” that were created to capture a teacher attending to mathematics identity in a particular way. I began with a larger set of codes that I eventually collapsed into two categories: (a) teacher discourse, which indicated a teacher making statements to or engaging in an exchange with the class, a student or group of students and (b) instructional move, which indicated a move like grouping students in a particular arrangement, calling a particular student to the board, or responding to a question in a particular way that promoted or impeded mathematics identity. As I pre-coded the data, the need arose for other codes that addressed contextual factors in the observational data that influenced mathematics identity. I eventually ended up with two codes: (a) addressing misbehavior and (b)

school structural, which was used when the teachers explicitly discussed a school- or district-level influence during class such as testing or earning points in a district-wide mathematics competition. When considering excerpts from the observational data that I found to be important to this study, I cross-tabbed these instances with the identity dimension code(s) and the means of addressing identity code(s). After looking across my observational data, I made the decision not just to address how teachers promoted positive mathematics identity but also as they impeded it as well. So in addition to the cross-tabbed codes, I also decided to code each observational excerpt as impeding or promoting mathematics identity based on how I operationalized attention to it Chapter 1.

Coding artifacts. Depending on the artifact, I used the coding schemes above to analyze the artifacts described earlier in this chapter. For instance, the nature of the mathematics autobiographies made it easy for me to code them using the initial codes developed for the first round of interviews. I used the cross-tabbing method as described above for coding the observational data and to code the planning template documents.

Analytic Process

While coding data is a part of the analytic process (Saldaña, 2009), I also used the coded data to look for patterns and themes relevant to each of my cases as well as across all three of them. Looking within each teacher's data set, I looked for patterns such as the dimension of identity that was most prevalent. This was done by looking at code frequency and the nature of what was coded under each category. For instance, I noticed that within Jan's interview data set, she had a high frequency of utterances coded with the ability code. Using Dedoose, I was able to filter out and create a file of Jan's utterances coded as "ability" either as a single code or in co-occurrence. From this file, I looked at

the nature of what Jan was saying, and from that point, I began to write analytic memos with regard to the nature of her perspectives and actions with regard to ability. I used a similar process to cull the observational data and artifacts of each PNT as well. Once I coded and looked for patterns within a PNT's data set, I then looked across all three data sets, observing frequencies, patterns, and dissimilarities. I then crafted analytic memos with regard to not only what I was observing within teachers' data sets, but also what was similar or disparate across them.

Analytic memos. I organized my data into themes, which eventually became useful to creating my cases. I created analytic memos based on my impressions of the data and some initial data analysis. Some of the memos were teacher specific (i.e., Chris' influential background experiences), while other memos were written broadly across teachers (i.e., school and structural concerns as they relate to promoting positive mathematics identity). These memos were distinct from field notes, in that they allowed me to go beyond what I observed during my classroom visits. Considering data from multiple sources, I also wrote biographical sketches of each participant. These sketches which later proved to be helpful as I thought about each PNT as the subject of his or her activity system.

Methodological Considerations and Limitations

Positionality. It is understandable that some could argue that my positionality in this study is a limitation due to the nature of my relationships with the participants and the participating school district, thus introducing some bias (Guba & Lincoln, 1994). However, I would counter that my positionality gave me particular insight that would not have been available to me as an uninformed observer. As noted earlier, I was able to

develop strong working relationships with the PNTs, which led to candid and highly personal conversations regarding their personal experiences and teaching practices, some of which will be shared in the cases following this chapter. Further, because I established personal and professional relationships with these teachers, how I represented them was of utmost importance. While not shying away from instances in the data that cause some alarm or discomfort, I also wanted to ensure that I represented them as accurately as I could with respect to the tensions they faced as novice teachers navigating the complexities and bureaucracies of public schools.

Interpretive challenges. While qualitative case studies are not neutral and objective, I aimed to interpret the data with fidelity. I found myself faced with what Birky, Chazan, and Morris (2013) called the “interpretive challenges” of making sense of how each PNT’s personal and academic experiences as a learner of mathematics might serve as resources for teaching. Thus, I used member checking with PNTs as a means of improving the validity and trustworthiness of my findings and interpretations. Member checking includes “confirm[ing] the researcher’s interpretation of meaning with informants’ perceptions” (Brenner, 2006; p. 368). The member checking procedures employed in this study included: (a) asking clarifying questions during follow-up interviews with two of the three PNTs in the fall of 2012, (b) sharing some of my preliminary findings and interpretations with the PNTs, (c) and allowing the PNTs the opportunities to clarify or expound upon any of the ideas discussed in previous interviews.

I entered this study aware of the perceived power dynamics between researchers and educators when conducting research (Gaskell, 2008; Kvale, 1996, 2006).

Additionally, I also knew that the relationships I had built with the PNTs, both personal and professional, meant that there was space for unpredictability and candidness in our conversations (Brenner, 2006). Before becoming the PNT's mentor teacher, I was their course instructor. However, once the course ended, and I assumed the role of their mentor teacher in MST-Res, my position became non-evaluative. I believe that the non-evaluative nature of our working relationship helped to limit the hierarchical nature of our working relationship and I hope that it opened us up to more authentic conversations about mathematics content, instruction, and dilemmas associated with relationship building and classroom management. Further, as a resident and former teacher in the participating school district, I felt a personal responsibility to represent the district, PNTs, and our experiences as accurately and fairly as I could.

Case study. As with all methodologies, case studies have limitations. Case studies are highly contextualized, which often creates issues of generalizability for some researchers (Gaskell, 2008). Given this concern, I chose to not only use cases, but to engage in cross-case analysis. Yin (2009), likening multiple cases to conducting multiple experiments, posited that cross-case analyses have analytic benefits, in that analytic conclusions independently arising from two or more cases are more powerful than those coming from a single case (or a single experiment in his parallel comparison). Thus, while I cannot claim that my findings are generalizable to all teachers, I do contend that my findings are applicable to teachers in comparable teaching contexts.

Student voice. While this research was conducted in classrooms, I was not able to interview any students regarding their perspectives about mathematics identities or how they understood their teachers' attention to it. Thus, in this study, I rely on

classroom observations, teacher interviews, and mathematics identity literature when I make claims that particular teaching strategies (i.e., tools in the activity system) impeded or promoted teachers' attention to mathematics identity.

Overview of Cases

With the methodological considerations outlined in this chapter in mind, I will present the case of one teacher participant in each of the following three chapters. Each case will begin with an introduction of the teacher participant to give the reader a sense of their teaching demeanor and relationship with her or his students. I will also present personal and academic experiences that are salient to their case and this study.

As the focus of this work is how novice middle-school mathematics teachers conceptualize and engage in planning and instructional practices that promote or impede positive mathematics identity construction, each case will also present data that demonstrates how each teacher participant is conceptualizing mathematics identity and how they characterize their students' collective and, in some cases, individual identities.

Using activity theory as a theoretical lens and drawing on the information presented in the earlier half of the chapter, I will then highlight how the of the elements of each teacher's activity system contribute to the object of the system. Activity systems present numerous reflexive relationships to examine. For the purpose of this study, I will primarily focus on how the other elements of the system (i.e., subject, community, division of labor, and tools) influence the object of the system, that is how he or she plans lessons and employs instructional strategies that influence students' mathematics identity construction.

Each element of the teachers' activity system influences the object differently. At times, various elements cause contradictions (Engestrom, 1987) in the system. The tensions that emerge as each teacher tries to plan and engage in identity-promoting practices will also be discussed in each of the following cases. Chapter 7 will present cross-case analysis (Yin, 2009). I will discuss themes that emerged across all three teachers. Additionally, I will draw on data from all three cases to think about them collectively as well as the implications for this work

Chapter 4: Jan Dan

Jan Dan, a recent college graduate enrolled in the MST-Res Program, brought a set of personal and academic experiences to her mathematics classroom that were unique from the other PNTs. These experiences influenced how Jan both conceptualized and enacted practices that supported and, at times, impeded her students' construction of positive mathematics identity. In addition to her personal experiences, Jan also faced contextual factors at the classroom, school, and district levels that further complicated her desire to enact positive identity promoting practices.

Jan's case illuminates the complexities and tensions that many teachers, whether seasoned or veteran, have to navigate as they teach mathematics in this current age of accountability. Jan often found herself trying to attend to her students' collective mathematics identity while balancing new instructional ideas from her methods courses with the realities of her students' diverse needs. I argue that Jan, influenced by personal experiences and institutional forces (e.g., her schools need to meet Adequate Yearly Progress, as established by No Child Left Behind policies), conceptualized mathematics identity through an ability lens. This means that while Jan highlighted all dimensions of the identity framework as purposeful, she believed that her students' mathematical competencies (the ability dimension) were a primary driving force as to (a) how they viewed mathematics as important and useful to their lives and future endeavors (the importance dimension), (b) how they persisted when working through difficult tasks (the motivation dimension), (c) and how she selected activities for her courses (the nature of task dimension).

This chapter has three major sections: (a) an introduction to Jan's teaching persona, (b) Jan's conceptualization of mathematics identity, and (c) Jan's attention to mathematics identity via her activity system. As noted earlier, teachers' lived experiences are influential to their perceptions of mathematics teaching and learning, and subsequently, how they attend to mathematics identity. Thus, the first section of this chapter begins with an introduction to Jan, including my description of her mathematics-teaching persona in her classroom context. Jan's teaching persona is also reflective of her notions of smartness and success in mathematics, which I discuss in the second section of the chapter, which shaped her approach to teaching mathematics. This section will also highlight salient features of Jan's instructional approach. With all of this information in mind, in the second section, I examine how Jan understands mathematics identity and how I would characterize her understanding of it using the identity framework detailed in Chapter 1. Finally, I examine Jan's attention to mathematics identity using Engeström's (1987, 1993, 2001) activity system. I discuss how each element of the system contributed to Jan's attention to mathematics identity as well as the contradictions that arose between various nodes in the system of activity and the object.

Jan's Mathematics Teaching Persona

Across the corpus of data, Jan's teaching persona emerged. While the nuances of her teaching persona do not appear as codes in the data analysis, after listening to the audio from her observations and interviews and revisiting my field notes, I found it important to address how Jan's demeanor elicits particular responses and behaviors from her students, responses and behaviors that shape her students' notions of what it means to be a mathematics student and what it means to be a successful participant in Jan's class.

Jan's personal experiences were also influential to how Jan attended to mathematics identity in practice. As I analyzed Jan's data, I coded for personal experiences, both academic and non-academic, that were influential to how Jan understood the nature of mathematics and mathematics teaching and learning emerged across the corpus of data. These glimpses into her Jan's teaching persona serve as a means of providing a better sense of who Jan is as a teacher and a person before sharing the findings related to this study.

A Glimpse into Jan's Classroom

During one of my final observations in the fall of 2012, Jan and her students were reviewing the rules for adding integers. As a means of summarizing the lesson, Jan planned to teach her students a song to the tune of *Row, Row, Row Your Boat* to help them remember how to add integers with like and unlike signs. The noise level had gotten too high for Jan's liking, and I could sense she was growing impatient. She calmly, but sternly, stated to the class:

I'll wait (long pause, room started to quiet). It seems to me that there was something in your food at lunch today, and you all don't know how to act. Keep in mind I don't care who's in my room (referring to me, her mentor teacher). Do not show off because you think there's somebody in the room. I will get you no matter what. You all know how to act. You all know what is expected of you. (Looking at a student) George, do not ask weird questions. I already know what's gonna come out of your mouth. (Students snicker.) You all need to pay attention to this, and Keisha, you better sing! (Jan and her students start laughing.) (Classroom observation, October 5, 2012).

The episode described above encapsulates Jan's demeanor when working with her students, firm and stern, yet warm. As her mentor teacher, I was always amazed at how within the first few weeks of teaching, she could command the attention in her students with just a look, a skill that some teachers with much more experience take years to master (Brown, 2004). While some may read Jan's statement above and find her approach to be a bit harsh, I would characterize Jan's demeanor as no nonsense. "I will get you," as she stated, often meant having her students write essays about why they were not paying attention in class or requiring them to rewrite a student's mathematical explanation when they were caught being inattentive. Sometimes it meant getting a verbal admonishment like the one above. Just as Jan stated, it did not matter that a visitor was in her room. Jan remained true to who she was as a teacher during my visits and when being observed by school administration.

Jan's Approach to Teaching Mathematics

I recall during one of our first meetings of the school year, I asked Jan if she enjoyed teaching because she expressed very little emotion and could be quite stern in her interactions with her students. She immediately responded with "Yes!" and broke into a huge smile. What I interpreted as lack of enjoyment while teaching, I would soon come to learn was Jan's development of a mathematics-teaching persona that would allow her to help her students keep focus, even the ones who gave her the most difficulty. When I reviewed her summer portfolio from the summer seminar, she was quite explicit when it came to issues of classroom climate. In describing the vision for her classroom, she wrote: "In and out of my class, when things get chaotic, I want my students to be able to tell each other that in Ms. Dan's class that's not cool, so behave yourselves" (Summer

portfolio, August, 2011). I frequently observed her students doing this exact thing. Jan desired for her students to self-regulate when it came to issues of behavior, thus she established norms that were conducive to this. Of the three teacher participants in this study, she was the only one who did not require a great deal of assistance in developing classroom norms that were conducive for learning.

Throughout the study, Jan maintained a stern, but caring, way of working with her students. Jan's tough-love demeanor, she explained, was her way of drawing out the best in her students. Her students seemed to understand her dry sense of humor and deadpan expressions. They filtered Jan's tough-love reprimands, hearing more care than criticism. Jan acknowledged that this tough-love mathematics-teaching persona was one that she had developed over the course of the school year. She attributed some of it to interning with Andrea, a highly-respected African-American teacher who was known for having high student proficiency rates on the state-mandated standardized mathematics exam. I had an opportunity to observe Andrea's teaching during Jan's first semester in her classroom, and she exhibited a "take no excuses" approach with her students, reminiscent of Ware's (2006) description of African-American teachers who were considered warm demanders.

Jan and I also shared ideas about how to build and foster relationships with her students while maintaining order and a productive classroom flow. On visits to her classroom, I would observe Jan making statements to her students and trying out teaching strategies that were reflective of our mentor-mentee conversations. Like her cooperating teacher, I would characterize Jan as a warm demander. While observing her class, it was common to hear expressions such as, "If I get a test that's not in pencil, I'm not grading

it.” When students would challenge the fairness of statements like this, Jan often had quick retorts like, “What’s not fair? That I don’t have a pencil to provide you? That’s not fair?” (Classroom observation, May 7, 2012). Jan’s responses were often met with sighs, laughter, and smiles from her students, but they quickly addressed whatever issue was at hand. Her students knew she meant business, and her business, as she explained it to me, was to help students develop a “holistic and conceptual” (Interview, March, 19, 2012) understanding of mathematics and to help them rely less on her and more on their own investment in their mathematical performance and success. Through interactions with Jan across the span of a school year, I watched her grow as a mathematics teacher. I also observed her struggle with what it meant for mathematics to be conceptual, what it meant to shift mathematical authority to her students, and what each of these meant to attending to mathematics identity.

At the beginning of this study, Jan Dan was a first-year teacher who became teacher of record for two 7th-grade mathematics classes at Emerson Middle School, which is predominately African American with an increasing population of Latino students over the past few years (comprising approximately 20% of the total student population at the time of this study). During Jan’s second year at Emerson, she taught Mathematics 8 to two sections of 8th graders and to a section of 7th graders enrolled in AVID, an academic acceleration program for students who show academic potential. She also taught two sections of Mathematics 7 to 7th graders.

Jan’s System of Activity

As explained in Chapter 1, I considered each teacher’s attention to his or her students’ collective mathematics identity in practice through the theoretical lens of an

activity system. While each of the elements of an activity system are related, as Figure 4 suggests, I will primarily focus on how each element of Jan's system of activity influenced how she engaged students in building positive mathematics identity based on how she understood it, which is the object of the activity system. The elements of interest are: (a) Jan's personal and academic experiences, including her understandings about the nature of mathematics and mathematics identity and notions of smartness and success in mathematics (subject); (b) her language and instructional moves (tools); (c) Jan and her students (community); (d) and the district and school-level forces rules that govern her classroom (rules). Note that while all three of these elements influence the object of the system, I use breaks in the arrows to represent the contradictions between several elements of the system and Jan's practice.

Jan As the Subject of Her Activity System

The subject is a featured element of a system of activity. The subject of an activity system is the person or group of persons' whose viewpoint is adopted. In this study, I sought to understand identity building from Jan's perspective. Jan, shaped by her personal narrative, influenced how she participated within the activity system of her classroom. Throughout her interviews, Jan shared biographical information that is important to consider as it relates to how she attends to mathematics identity in her practice.

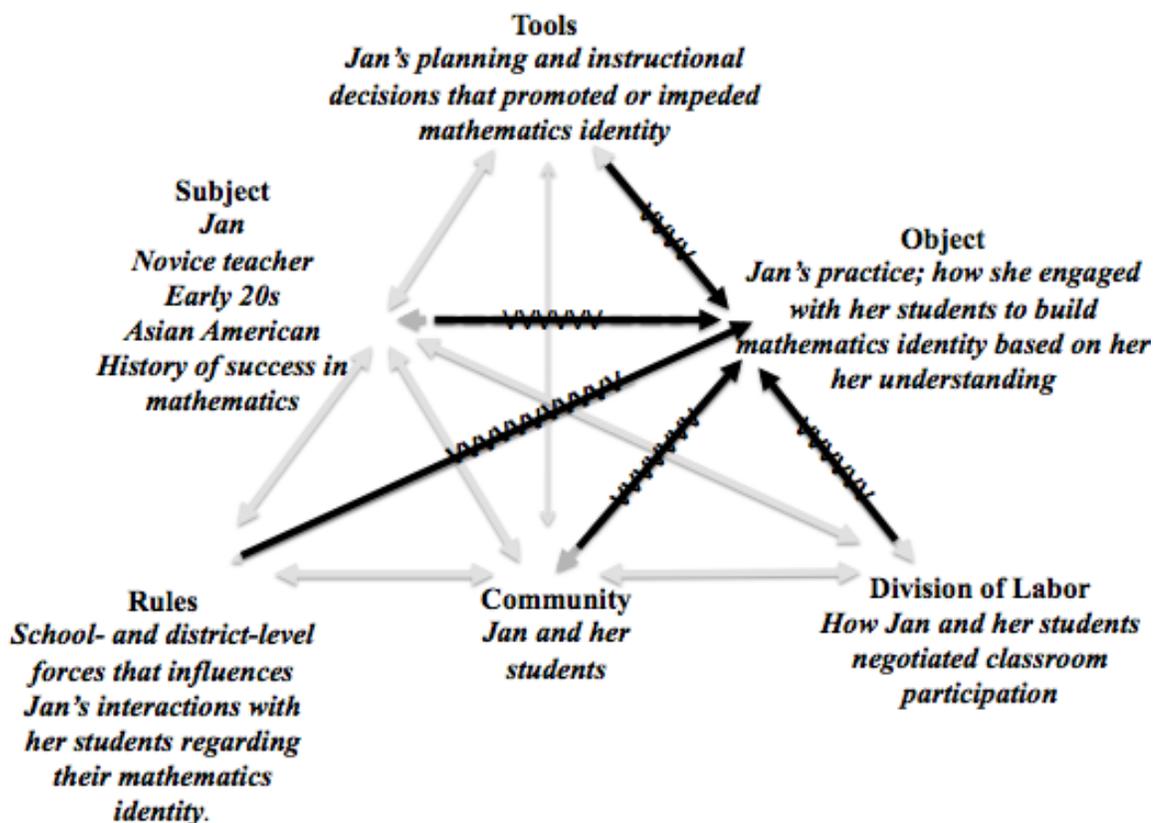


Figure 4. Jan's activity system

Salient personal and academic experiences. Jan identified herself as Korean and as an Asian American who was born in Korea. She was in her early 20s during the time of data collection. In our initial interview, she recounted the story of moving to the United States with her parents when she was eight years old. Her father, a former member of the Korean military, brought Jan and her family to the United States when he resigned from the military for health reasons. Upon her father's resignation from the military, Jan and her family moved to the Mid-Atlantic region of the United States to an area where they had relatives who had already immigrated. Jan completed elementary, middle, and high school in the Mid-Atlantic region and also attended college in the same area.

Experiences as an English language learner. As we discussed Jan's upbringing and path to teaching, she shared some of her early schooling experiences. In particular, she shared experiences about being a student who received extra academic support for English language learners (ELL) while also succeeding in her mathematics class because she had strong computation skills. Jan recalled being the only ELL student in her school:

Toya: Did you speak English when you came here?

Jan: Mm-mm. Not a word

Toya: So, you learned to speak English while you were going to elementary school?

Jan: Mm-hmm. I didn't know my ABCs. A week before we moved, my mom got me a poster that had all the alphabets, and I didn't know the point of the poster, so I just played school with it
(Interview, March 19, 2012).

Later in the same interview, Jan noted that school administration had to hire an ELL to accommodate her. She got pulled out of all of her classes, with the exception of mathematics, the once course where she was mainstreamed. In her summer portfolio for summer seminar, she also noted, "It was difficult to learn the concepts due to my limited abilities in English; however, pictures and body language got me through it until I became proficient in English" (Summer portfolio, August 2011). As Jan was learning English and relying on non-verbal resources, she experienced a significant shift in her mathematics identity. She explained:

In Korea, I understood what the teachers were saying. I understood the problems that were given. Even if it was word problems, I still understood to a point where

I could solve it and it wasn't an issue. So, when I came here [to the United States], every time [a word problem] was given to me and I couldn't do it, *it was just like I don't know and I don't know how to define myself as a student anymore because I didn't know how to solve those problems* (italics added for emphasis). But, when the teacher walked by me, all she would do is setup the problem for me, and then it was easy going afterwards. So, every time there was a [symbolic] problem, I was always the one participating and all that, but every time there was a word problem, I was the first one to shutdown.

This excerpt is important, as Jan recognized that she was positioning herself in particular ways that influenced her mathematics identity. Jan's notions of mathematical competency were tied to her ability to compute algorithms and arrive at correct solutions. When thinking about how Jan privileged doing mathematics in a step-by-step fashion, I drew a connection between her comfort in solving problems that depended on procedural competency and her initial approach to instruction. Throughout our time together, Jan frequently referred to her own experiences as an ELL student learning mathematics and their influence on her approach to teaching mathematics. Her experiences were particularly influential as to how she thought schools could best serve ELL students in mathematics.

Path to teaching mathematics. Jan did not attend college with the intention of becoming a middle-school mathematics teacher. She completed a degree in biochemistry with plans of becoming a pharmacist. In the midst of applying to pharmacy school and working part-time at a pharmacy, Jan had a revelation that she did not enjoy the work. She explained, "I [was] not satisfied. There's something in me that [was] not drawing me

into this pharmacy [work]” (Interview, March 19, 2012). After a discussion about her career path with her pastor who encouraged her to pursue a career in education, Jan looked into enrolling in a teacher certification program. Jan happened to visit the education office at her university on the day that they were planning an interest meeting for MST-Res. Jan attended the interest meeting, applied to the program, and was accepted. We met in the summer of 2011 when she enrolled in my summer course.

One thing that often struck me as interesting was that given Jan’s extensive science background, she chose to teach mathematics. I had the opportunity to ask her about her choice to teach mathematics over science while I was in the midst of analyzing the data I collected from her and writing my preliminary draft of salient biographical information. She stated: “Math just came naturally to me. With science, it was something that I really just studied” (Interview, October 25, 2012). She went on to add:

So, I struggle with all of the conceptual science. You know, memorizing the facts, that stuff. I was just like, “How do I memorize?” There’s so much to memorize. I can’t memorize it. But once it came to physical chemistry, and just regular chemistry, and balancing equations . . . I was knocking it out because it was all math related . . . So for me, when I decided to teach math, I think the more important question I asked myself was the delivery. Am I going to have an easier time delivering a lesson when it’s science, or am I going to have an easier time delivering a lesson when it’s math? And, naturally, math made more sense – that I could break it down and show it to them, and there are different ways show it. But with science, it’s just – I felt that it’s just very conceptual (Interview, October 25, 2012).

Jan ultimately concluded that the choice to teach mathematics came down to an issue of comfort. She was more comfortable teaching mathematical content than science because, in her words: “I think just the numbers makes it . . . Just straightforwardness, like there’s nothing, like, roundabout about it - at least at the middle school level. 2 plus 2 is 4. There’s no other way.” (October 25, 2012).

Jan’s perception of herself as a “math person.” Throughout our interview, Jan recalled how her success in mathematics classes, which she attributed to her “strong math ability” (Interview 1) as she described it, led to feelings of competency throughout her academic career. She shared with me that mathematics had always been her favorite subject. While always having a fondness for mathematics and receiving good grades in the subject area, Jan recalled one exception. She described an advanced-level mathematics class in college, of which she noted, “No matter what I did, I could not get a success.” Jan’s body language shifted as she talked about this experience and changed the topic of conversation quickly, noting that failing the course was something she tried not to think about.

Jan went on to explain how all of her positive K-12 and early college mathematical experiences helped her to see herself as a “math person.” When asked to describe what being a math person meant to her, she replied:

I think that – or when my friends say that I'm a math person, they're trying to imply the fact that I use numbers a lot, and I do. I do calculate which [item] is cheaper [when shopping] and those types of things. And so, they're just like, ‘Oh, that's such a math person thing of you.’ Like, only a math teacher would do that type of thing’ (Interview, March 19, 2012).

I soon learned that Jan's perceptions of what it meant to be a math person was laden with notions of ability. Those notions of ability influenced Jan's interactions with her students as she developed her conception of mathematics identity and interacted with her students.

Jan referenced her successes and failures as a mathematics student as important to how she approached mathematics teaching. She highlighted how she came to see herself and was positioned by others as a "math person" based on her success with computational mathematics. Additionally, given her understanding of mathematics as straightforward and lending itself to be broken down into components, it was not surprising to see her approaching mathematics from an incremental, procedurally-based perspective. Further, in terms of building mathematics identity, I observed a connection between Jan's personal experiences with mathematics and how she built identity through rewarding her students' effort and persistence as well as when her students "showed the steps" when solving mathematics problems, tools that will be highlighted later in the chapter. Jan's reflections regarding how her personal failures in advanced mathematics at the college level led her to consider more affective dimensions of teaching mathematics in her own teaching. In all, I assert that Jan's salient personal and academic experiences were important to the ways she engaged in identity-building practices in her teaching.

Jan's understanding of mathematics identity. I view Jan's understanding of mathematics identity as an essential component to understanding who she is as the subject of this particular activity system as well as how she influences classroom activity with regard to her students' collective mathematics identity. As mentioned earlier, Jan participated in the Summer 2011 course where we discussed issues of mathematics identity and the ways that teachers could attend to it in their classrooms. When I began

collaborating with the PNTs in this study, I was interested in knowing how their understanding of mathematics identity had evolved since they were practicing teachers in their own classrooms.

In this subsection, I am honing in on how Jan was conceptualizing mathematics and mathematics teaching at the time of our work together. I present this data in the hopes of addressing the first research question regarding mathematics identity that I presented in Chapter 1. The data presented in the following subsections represent findings as a result of using the coding procedures outlined in Chapter 3. The quotes and episodes I have selected are salient because they reflect evidence that directly relates to one or more of the following: (a) one or more of the four dimensions of mathematics identity (ability, importance, motivation/attribution, and nature of tasks); (b) the ways in which a teacher enacts practices that attend to the identity dimensions (classroom activities, planning, discourse, and instructional moves); and/or (c) structures that impede mathematics identity development at the district-, school-, or classroom-level.

Defining mathematics identity. During my second round of interviews, I prompted each teacher in the study to define mathematics identity in his or her own words. While I hoped they would be reflective about our course during the summer, I was not looking for recall of any formal definition or even a direct reference to the course. While Jan did not concisely define mathematics identity, through analysis of her data, I contend that Jan's definition of mathematics identity included all four of the dimensions highlighted in this study; however, she placed particular emphasis on ability.

In the duration of the data collection period, I tried to get Jan to arrive at a concise definition of mathematics identity with minimal success. Throughout the course of our

time together, Jan struggled to arrive at a concise definition of mathematics identity. Rather than define mathematics identity in her own words, she instead described the vision of mathematics identity that she wanted her students to reach: “I want my students to build an identity and understanding that math can fit into their life [sic], and it is not just about quantitative thinking, but math also deals with qualitative reasoning” (Interview, March 22, 2012). Her framing of mathematics identity in the previous excerpt highlights the importance dimension within the framework of mathematics identity in this study. That is, she wanted her students to see mathematics as something that could be useful and purposeful in their future endeavors as well as tied to their personal interests.

After looking across Jan’s data, I would summarize Jan’s definition of mathematics identity as the following: how students’ mathematical abilities influence their self-perceptions and participation in relation to how mathematics fits into the larger scheme of their lives. I found that Jan’s conceptualization of mathematics identity highlighted all of the dimensions of the mathematics identity framework presented in Chapter 1; however, it primarily emphasized the ability dimension. In her interviews and writing prompts, she made reference to all of the facets of the framework. Further, each element is evident in her practice. However, Jan’s discourse, both in and out of the classroom, is permeated by references to ability, whether providing and explanation for how her students are grouped, describing the types of tasks she assigns based on her students’ abilities, or the ways in which she positions her students through instructional decisions while teaching. Thus, how she attends to the other facets of identity is filtered through her perceptions of their ability to do mathematics.

Given Jan's attention to ability dimension of her practice, Figure 5 represents how Jan I interpreted Jan's understanding of mathematics identity at the time of this study. In the figure, all four of the dimensions of mathematics identity are present. Further, the interlocking nature of the gears is intended to show how the dimensions are interrelated and working together in her practice. The size of each gear was determined by using code counts from Jan's interview and observational data. As explained in Chapter 3, I coded each salient interview and observation excerpt according to dimension referenced or attended to in practice. As ability showed up as the most frequently used code in Jan's data set, the largest gear in the figure represents it. The other gears are also represented according to their frequency in the corpus of data. Referring back to the gear metaphor, by representing ability as the largest gear in her gear system, I assert that her notions of ability "drove" the way she attended to the other dimension.

Conflation of mathematics identity and equity. While I described Jan's understanding of mathematics identity in light of the four dimensions of mathematics identity in this study, Jan also made connections between issues of equity and mathematics identity that I believe are salient to how she attended to mathematics identity in practice. At several points in our interview that was specific to defining mathematics identity, I prompted Jan to explain what mathematics identity meant to her. An excerpt of our exchange is as follows:

Toya: We spent [some time during the Summer 2011 seminar] on issues
 of math identity and how issues of race and gender and class

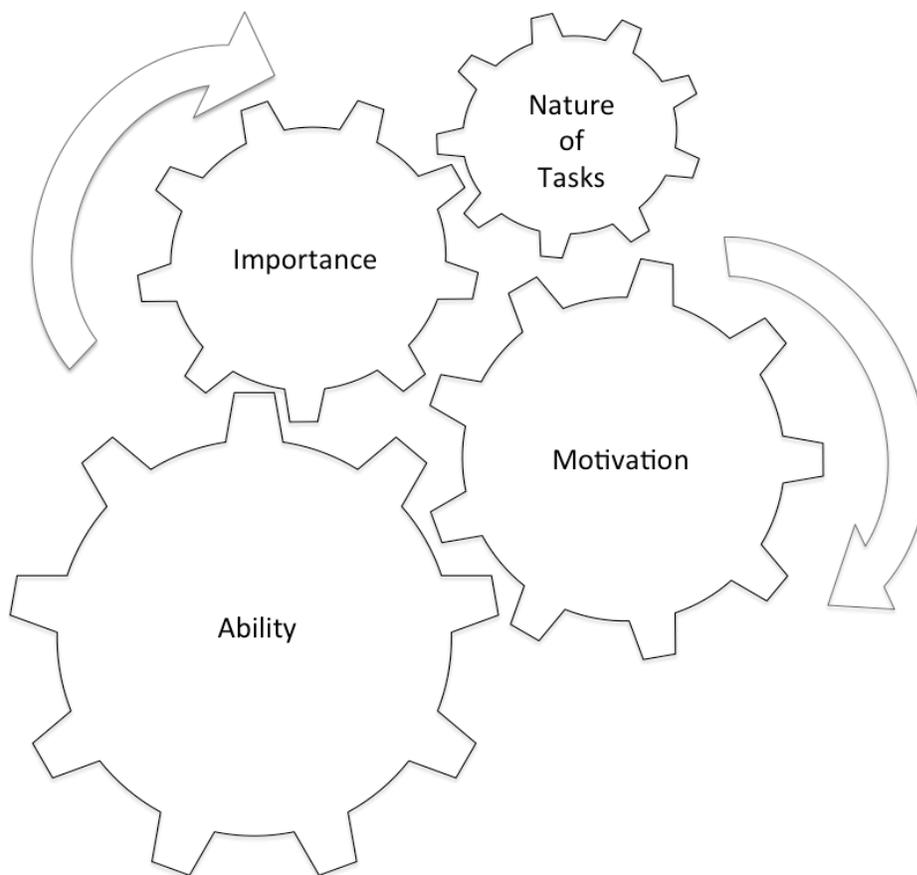


Figure 5. Jan's Conception of Mathematics Identity

affect how students see themselves as mathematics learners . . .

So, just from what you remember, and even from just from your own personal understanding , how would you describe math identity? What do you think it would look like if a teacher attended to it in her classroom?

Jan: So, that's what we were talking [about in our diversity class]. . . . That's kind of some of the stuff that we were talking about in Dr. Harmon's class, as far as equity versus equality. And many of us got to thinking more about equality than equity. So, I don't think

we, as a group, still don't have a strong understanding of equity
(Jan, Interview, March 26, 2012).

In this excerpt, Jan is expressing that mathematics identity has an inextricable relationship to mathematics identity. That is, she sees attending to mathematics identity as having an equity implication. Perhaps my framing of the question and the way that I connected mathematics identity to issues of race, class, and gender, prompted Jan's response. Alternatively, perhaps the fact that I wove an equity strand through the all of the topics in our summer course influenced Jan to reference issues of equity when pressed about what mathematics identity meant to her. A third hypothesis is that as her mentor teacher, she knew that issues of equity in mathematics instruction were very important to me, so perhaps she was trying to provide an explanation that she thought I would find satisfactory. She discussed issues of equity and identity interchangeably throughout most of her interviews, even once I was more explicit about my own personal understandings of mathematics identity and once we discussed the summer seminar's readings and activities.

The instance that stood out most to me as a conflation of mathematics identity and equity occurred when I asked Jan to prepare for our last interview of the Spring 2012 semester by thinking of the ways she attended to mathematics identity in the lesson I had observed during the previous week. I also asked her to consider how she attended to mathematics identity more generally in her practice. When I visited her to conduct the interview, Jan began our conversation by telling me that she thought she had really tackled the issue of identity with her students during her class earlier in the week. When I asked her to tell me more about this instance, we had the following exchange:

Toya: So, you said you and the kids had interesting conversation about race and identity in terms of math, or just [in general]?

Jan: I think it was [related to] one of the questions [on their mathematics assignment]. It could have been something in the context [of a word problem] that triggers some students about to talk about race. And it just happened that they asked me that what I am, and I had already explained to them that I am Korean, and I moved here when I was little (Jan, Interview, March 19, 2012).

In response to my question, Jan addressed how she and her students discussed racialized identity as a result of the context of a word problem. True to Jan's candid nature, she addressed her ethnicity with her students in the midst of the mathematics lesson. Our exchange continued:

Toya: Oh, so you told them all these things?

Jan: Uh huh. I told them. . . I did not want them start making assumptions [about my ethnicity] and go about it about in their imaginations. So, I had already talked about it but, of course, they all forgot. One of the kids said, "It bothers me when other students that think that just because I am Hispanic, I moved here from Mexico." And I said, "So why does that bother you?" He said, "Because they assume that every Spanish person or Hispanic person is Mexican." And so then the kids were saying, "Well then where are you from?" And he is like, "I am Salvadorian." . . . [I asked the class], "Ok well if you know that if you call somebody

Spanish, that you are assuming that they coming from Spain, so why do you call this group of people ‘Spanish?’” and they said, “Because we don’t know the other term.” . . . And that just confirmed my reason to *teach in a way and in another, like, level beyond math content* (Interview, May 7, 2012).

Jan felt that it was important for her to have these types of conversations about ethnic identity with her students. In fact, she saw these things as giving her some greater purpose for her teaching, as she described it, “beyond the math content.” Jan’s empathetic stance toward issues of ethnic identity in her class could possibly be related to her field experiences during the summer. In an earlier conversation and in an assignment for her summer portfolio, Jan mentioned an issue she had with a few students being insensitive with regard to her ethnicity during the summer field experience that complemented the summer seminar, so I knew from the experiences that she shared during the summer that issues of racial and ethnic identity were important to her.

Jan went on to explain how she saw this conversation about ethnicity as a turning point in her class. While the conversation had no direct connection to the mathematics topic at hand, she felt that this conversation, this relationship-building activity, allowed her to get to know her students in a more intimate way. She believed that this whole-class conversation about identity and ethnicity made her and her students more comfortable with each other, which in turn, made them more at ease to share their mathematical ideas aloud during class. She described how many of her students stopped being embarrassed at the board because they now had a better understanding of each other. Jan believed this experience helped her and her students become a “family” as she described it.

While researchers contend that attending to mathematics identity has implications for equity (e.g., Horn, 2008) and some argue that racialized experiences are central to mathematics identity (e.g., Martin, 2000; Nasir, 2006), I am intrigued by Jan's conflation of mathematics identity and racialized identity. In an effort to make sure that Jan and I were using shared ideas about how I was operationalizing mathematics identity for the study, we began using the mathematics identity planning prompts before and after her lessons so that I could help her hone in on features of instruction that were in the mathematics identity framework.

Jan's perceptions of being "smart" and succeeding in mathematics. Because I claim that Jan defined mathematics identity through an ability lens, her notions of what it means to be smart and successful in mathematics are important to note. As noted in an earlier section, Jan described herself as a "math person." When pressed further about what it generally means for someone to be considered a "math person" and how this related to her students, Jan responded:

I have mixed feelings about [what makes someone a math person]. I still think that everybody is somewhat of a math person. They just have different approaches about it. Like, there's different learners. So, not everybody may be an English person, but if I would talk to a language arts teacher, they would say, "Well, everybody can be a reading and a speaking type of person, but they just learn different ways." And I think its the same way for math – that they learn differently and they learn at their own paces, *but with the fast pace of the curriculum, I feel like there's a system part of it where I might have to label those*

students not a math person (Interview, March 19, 2012, italics added for emphasis).

In the excerpt above, Jan acknowledged that those who have success in mathematics could do so in varied ways. She also recognized that people could learn mathematics at different paces and still be considered a “math person” in her opinion. However, Jan, like the other two PNTs whose cases will be presented, alluded to the “system,” i.e., the prevalent school and structural forces like the fast pace of the curriculum that would cause her to see her students as not being “math people.” Further, in trying to express openness and inclusiveness with regard to whom she would consider “math people,” she, in essence, concretized the label (Ellis, 2008) and did the same in saying people can be “English people.”

Jan also acknowledged that her ideas about what constituted a successful student had evolved as a result of her teaching experiences. She described shifting from the idea that a successful student understood all of the material and earned As and Bs to a more effort-based notion of success. She shared, “Being a teacher, it, like, [changed] me. Like, my idea of a successful student is one who may be struggling all the way but gets [to the place where they understand] eventually” (Interview, March 19, 2012). At the end of the Spring 2012 semester, Jan shared some interesting insights about being successful:

Jan: [My students] don’t have to be confident in the math . . . but they should feel comfortable and feel safe to express their questions. And to express their confusion or [and] what they also know. It could be little things that they know, but just expressing that as well and making those small gains, so that at the end of year they

are walking out and they are walking out with their heads up.

Proud.

Toya: So, they don't have to necessarily be comfortable in the math, but you want them comfortable enough to express the confusion?

Jan. And I want them to be comfortable enough to take the steps that they need to get there. Ultimately, I would like to see every single student succeed in math [according to] their own definition of success (Interview, May 7, 2012).

As Jan's mentor teacher and as a researcher, her statements about being comfortable with mathematics intrigued me. She noted that her students did not have to be comfortable with mathematics content, but that they should be comfortable with asking questions and expression confusion. Creating a safe space for students to be comfortable with confusion is important, but in attending to students' identities as learners and doers of mathematics, I was anticipating a response that eventually led to some growth in learning, thus making students more comfortable with the content. And while we want students to be comfortable with confusion, teachers should also want students to develop procedural fluency (Kilpatrick et al., 2001) and to arrive at correct answers, as success in mathematics is linked to success on standardized assessment, as well as future academic and career opportunities (Moses & Cobb, 2001; Schoenfeld, 2002).

In addition to her own notions of ability and smartness, Jan also acknowledged that her students brought their own notions of what it meant to be a smart person into her classroom. She shared, "There's that 'You're smart' or 'So-and-so is smart.' There's that classification or that labeling *already in them*. They probably already *know who's*

advanced and who isn't" (Interview, October 25, 2012). Consistent with her evolving conception of what it meant to be successful in mathematics, she tried to counter her students' notions of smartness and success in mathematics: "But as far as in this class, even if they do know, I come back and say, 'I bet you that down the line . . . there may be something that they struggle with that you get and vice versa'" (Interview, October, 25, 2012). I also asked Jan a more pointed question about how she managed the issue of students labeling themselves as "smart" and "basic" in her classroom. She quickly commented, "I don't. I don't acknowledge those messages. As far as they know, they're all the same" (Interview, March 26, 2012).

During Jan's first year of teaching, she became the teacher of record for two sections of 7th graders classes. The classes were intended to help students pass the state-mandated mathematics standardized assessment. While her courses were intended to focus primarily on test preparation, she expressed a desire for her students not only to improve their mathematics skills, but also to leave the class feeling better about themselves as mathematics learners. She shared that she also wanted to deemphasize ability, though Jan saw this as a challenge due to the variety of needs, both academic and social, in her classes. Jan's approach to teaching mathematics represents interplay between her desire to evolve and use research-based practices and her struggle to hold on to what worked for her as a student.

Jan spoke often about developing her students' mathematics identity in terms of moving them to a place of self-sufficiency, particularly when it came to their performance on the upcoming standardized assessment. She described her process as giving her students hints and then slowly removing the supports. She told her students,

“Look, I’m not going to be next to you [on the day of the exam]. If that’s the case, I might as well take the test for you” (Classroom observation, May 7, 2012). This desire for her students to be self-sufficient drove Jan to want to prioritize motivation as the dimension of mathematics identity that she wanted to attend to during out time together.

Jan’s dimension of interest: Motivation. Given Jan and the other PNTs’ responses to defining mathematics identity, the PNTs and I reviewed the dimensions highlighted in this study’s framework during one of our weekly meetings. Once we reviewed them, I asked each of them identify a dimension of mathematics identity that they wanted to address in their practice. When asked to choose one dimension to primarily attend to, Jan immediately chose motivation. She shared, “I just feel like if I motivate them internally, they can push themselves, and if they can push themselves one more step, then its adding on to their identity in a positive way” (Interview, March 26, 2012). She described instructional practices she would consider illustrative of attending to motivation in practice. An excerpt of our exchange was as follows:

- Toya: Okay, so if you looked into a teacher's classroom and you said, “Hmm, Mrs. Smith is really working on her kids’ motivation.” Like, what kinds of thinks would you see Mrs. Smith doing with her kids to make you say that?
- Jan: Um, like, I would say interaction with the kids and having a positive interaction. [The teacher would say things like,] “Okay, like, good try . . . and not necessarily say, “No, it’s not right. No, lets go onto somebody else” (Interview, March 26, 2012).

When encouraged to elaborate, Jan responded:

Or [the teacher may] even take a poll, [asking,] “Who got this as the answer and who got that as the answer?” And not necessarily shutting that one kid down. If you call on that one kid who got it wrong and say, “No, you're wrong.” Then, [other students with correct answers may feel] that's just that one kid[’s problem] . . . Everybody else who got the same answer as that kid, they may feel like, “Oh, whatever. It was just that kid, and that kid, and that was it” (Interview 2, March 26, 2012)

In this excerpt, Jan highlights how opportunities for all students to learn and engage are limited when teachers only focus on correct and incorrect answers during mathematics instruction. She explained that she viewed only seeking correct answers as limited to her students’ She continued:

But, then [polling the class makes] *the whole entire class responsible*. So, if half of them said “one” and half of the other said “two,” and the answer is two, now, I have this [answer of] one that I need to work with and say, “Tell me what happened with your one so I can get you to understand that it really is a two.” Like, I would see some sorts of that, where it’s not just singling out a kid (Interview, March 26, 2012, italics added for emphasis).

Jan’s understanding of shared responsibility in the classroom not only speaks to motivating students to persist when they are struggling, it also speaks to a Jan’s cognizance of the importance of shifting some of the mathematical authority from her to her students, similar to Gresalfi et al.’s (2009) notion of building competency through participation.

Jan was also quick to mention that she was more interested in attending to issues of intrinsic motivation than extrinsic. She pointed to the awards program, Scholar Dollars, that her school had implemented and how its positive effects had dwindled during the school year. More specific to mathematics, Jan referred to the extrinsic rewards provided by her school district related to using county-approved mathematics software, Math Excel, a computerized game that timed students' responses to problem sets that reviewed basic skills. At the time of the study, the school district rewarded the students individually with stickers for completion of modules, and the class with the best scores in the district earned a trophy. Jan was critical of how the use of Math Excel promoted extrinsic motivation, rather than inquiry and intrinsic motivation:

I was trying to encourage [my students to] get the most amount of stickers in the whole entire county, then our class would get a trophy from the county. They were excited about the trophy, but they were asking me, "Do we get anything thing in here?" and I was like, "What do you mean do you get anything in here? You get trophy from the county." But they were just like, "No, there should be a prize if you get the most amount of stickers." . . . How do I do this? Like, how do I help kids build identity? How do I help kids motivate themselves internally? It's always like that. It's always like, "Do we get something? Do we get a candy?" I'm just like, "No, you get a grade. You learn." And I just look at them, and I shrug my shoulders, and I'm just like, "I don't know what else you want" (Interview, March 26, 2012)

So with the tension of intrinsic and extrinsic motivation in mind, Jan and I tried to work through issues of motivation during our time together, though we often ended up attending to all four elements of the mathematics identity framework.

Jan began to explore what it meant to motivate her students according to the types of courses that they were assigned to, again foregrounding the ability dimension of mathematics identity. During an interview, Jan shared how her students' motivation varied across her classes. The following excerpt was recorded when Jan was teaching Mathematics 8 to 8th graders as well as to 7th graders who were in an accelerated AVID program. She also taught several sections of "on-level" (as described by the school) Mathematics 7. Jan characterized her AVID students as being primarily internally motivated. She continued:

They want to do [their work in mathematics class] because they have a goal.

They want to go to college; that's their ultimate goal. And they know that succeeding in middle school is gonna help them be better placed in high school, hence, college. And they understand that there are options for them in college – that there are options to get to college, to pay for college. Not a lot of them are financially stable. Not a lot of them can afford to go to college, but they understand that there are options to enter into college, so they're gonna work hard to get there. So, they have an internal motivation (Interview, October 25, 2012).

Consistent with her conceptualization of mathematics identity, Jan's explanation as to why her students are internally motivated was filtered through an ability lens. She noted that because these high-performing students knew the importance of doing well in mathematics, another dimension of the identity framework, they were intrinsically

motivated to be successful in contrast to her students in lower-tracked classes who consistently seek external rewards for doing well. Jan often made comments regarding her students' motivation as in direct relationship to their academic standing while expressing little or no cognizance of her or the school's role in positioning her lower-tracked mathematics students for particular types of opportunities to experience success in mathematics.

Taken in concert, Jan's personal and academic experiences, construction of mathematics identity through an ability lens, construction of the interrelated nature of mathematics identity and equity, and interest in issues of motivation are all salient components to understanding Jan as the subject of the system of activity. Jan's purview provides the point of view by which I will unpack the system of the activity in her classroom.

The Community

The community of an activity system refers to the participants in the activity system who all share the same object. In this study, Jan and her students comprised the community and interacted to negotiate mathematics identity construction. While I initially set out to follow one of Jan's classes for a semester, the role of being her mentor teacher and dealing with numerous scheduling conflicts afforded me the opportunity to observe all of Jan's classes during the 2011-2012 school year, all of which were remedial in nature. During the fall of 2012, I was able to observe her AVID class, a class with a different purpose and vision than the ones she taught during the previous school year. In retrospect, having the opportunity to observe Jan interact with a wide array of students with different needs, talents, and abilities provided me with a more comprehensive

understanding of how Jan was conceptualizing mathematics identity through an ability lens and enacting practices according to how she positioned her students.

In the spring of 2012, Jan characterized her students' collective mathematics identity as "low." I surmise that this assertion was rooted in Jan's views on mathematics ability, meaning that the nature of the classes she was assigned to teach may have been influential in how she characterized her students, as she was responsible for standardized test preparation and remediation at the beginning of the data collection period. She described her students' collective mathematics identity as the following:

To me, [mathematics identity is] a sensitive area, because some of the kids are coming in with a really bad identity of themselves in regards to math. They can't do it, and that's why they're here. . . I told the kids, "I can't hold your hand on the [standardized] test and give you hints." So, at some point, I'm going to have to take away those hints (Interview, March 19, 2012).

In noting how "they can't do it," Jan isolated ability as a primary reason for her students' lack of success, again disregarding her role as teacher or the dominant messages of ability being sent by the school just by virtue of being in a class that was characterized as remedial.

In the fall of 2012, after having experienced teaching mathematics to students who were labeled as more advanced, Jan began to make distinctions among her classes as she characterized their collective mathematics identities. These distinctions were often along the dimension of ability. For instance, she often talked about how working on issues of motivation and the nature of her tasks often depended on whether she was planning for an AVID class or a group of struggling 7th graders. Jan noted in her post-

lesson reflection writing prompts and in her interviews that the nature of her tasks often changed as she considered the class she was planning to teach. Jan was more apt to provide students with tools for visual representation and to shorten the time allotted for group work and student-to-student discourse when working with her students in lower-tracked mathematics courses. The diverse needs of her classroom community created a tension in her activity system with respect to attending to mathematics identity, which will be discussed in detail later in this paper.

Jan's Tools

Tools in an activity system mediate the object of activity. In relation to this study, this means that Jan's lesson planning, instructional decisions, and interactions with her students were the tools that mediated how she attended to her students' mathematics identities.

As noted earlier, at the onset of this study, Jan suggested that she focus on issues of motivation with her students. Trying to observe Jan's classes while primarily focusing on her attention to motivation made me quickly realize that it would be almost impossible to parse out her attention to motivation without making note of how the other dimensions of identity were also embedded in her planning and practice. In particular, Jan sent numerous ability messages that both promoted and impeded her students' development of positive mathematics identity. Thus, I will highlight how Jan used her tools to attend to mathematics identity more broadly. Her tools included (a) stressing effort over ability, speed, and correctness via grading policies and instructional moves and discourse; (b) shifting mathematical authority during instruction; (c) minimizing grades while providing her students with feedback on assignments as a means for them to revise their work; (d)

incorporating practices that promoted student-centeredness; and (e) committing to tackling affective issues around learning mathematics in her classroom.

Tool: Stressing effort over ability, speed and correctness. Jan stressed the importance of effort and not necessarily getting correct answers. When asked about her goals around promoting positive identity in her classes, she stated that she wanted her students to understand that, “You may not know it, and it’s okay” (Interview, March 26, 2012). She continued, “There are people who are strong in math and they are people who are not strong in math, and there are people in this group – there are kids who are more stronger [sic] in math versus other kids, but for me, it’s that trying part.” While I can understand that this stance with regard to effort versus correctness could be potentially problematic in a school district that was immersed in test-driven practices (Valli et al., 2008) at the time of this study, I highlight this stance this as a tool in Jan’s activity system, in that it promoted mathematics identity in Jan’s classroom via increased student participation and student discourse.

Stressing effort via grading. Jan stressed the importance of effort in our interviews. On the subject of grading, she described how she sometimes avoided giving her students grades on their assignments; instead, she provided feedback in lieu of marking problems wrong with Xs and giving the percentage correct. She noted, “All those [grades represent] are just a number I need to put into [the grading system], but to them it has so much meaning on whether or not they're successful” (Interview, March 19, 2012). In this excerpt, Jan highlights the influence of school’s structure on the learning of her students, an observation raised earlier and an issue that serves as a contradiction to this activity system. She distinguished between learning mathematics and receiving

feedback and putting number grades into her grade book to satisfy the requirements of school mathematics. To satisfy both the requirements of school mathematics and to drive home her point about effort, she began giving students full credit for incorrect answers that demonstrated their thinking and partial credit if their answers were correct but showed no work as to how they arrived at their solution. Jan reflected on her personal experiences with being a mathematics student as she rationalized this process:

And I'm like, "Why am I doing this?" And I remember my high school student Calc[ulus] teacher. She said, "I'm going to grade your process and not just your end result..." She said, "If your process is right, I may only take off a point. If the problems were 20 points, she may take off one point and gave me the 19 [for an incorrect solution that had a solid process]" (Interview, March 26, 2012)

Stressing effort via instructional moves and discourse. Jan not only stressed the importance of effort in building mathematics identity during our interviews; she also emphasized it as she taught her classes. When explaining why she highlighted effort during instruction she shared, "I don't think they see the effort part, but they see the end result part" (Interview, March 26, 2012). Many times, I would visit Jan's classroom and find her at the back of the room observing her class, acting as facilitator rather than telling students what to do. Jan allowed for long, uncomfortable silences and made a conscious effort to push her students to respond to each other's ideas. Group work was commonplace in Jan's classroom, and as her students worked, I would often hear her reminding the groups in her tough-love fashion, "I will only be able to answer one question per group. So if I answered one question for you . . . I'm done with your group, so you need to work it out between your group" (Classroom observation, March 22,

2012). When working one-on-one with students, she also tried to promote process over solution. I would often overhear admonishments such as, “Why are you erasing that? Mia, stop erasing stuff and explain to me what you are doing.” and “You have to push yourself.” (Classroom observation, March 22, 2012)

Jan also privileged effort over speed. Because her classes did a fair amount of group work, I often watched Jan make in-the-moment decisions to push students to work hard rather than work quickly. During one class visit, Jan had set up stations. She intended for her students to work at each station for about 10 minutes and move to the next station until they had rotated through all of them. Though she explained in a post-observation interview that she wanted to move at a faster pace, she told the class, “It seems like everyone is working at different paces. So I’m just going to change your stations once you finish” (Classroom observation, March 22, 2012). In reviewing the audio recordings, transcripts, and field notes from Jan’s observations, I found that she tended to disregard her timer and instead circulate the classroom and push her students to think through their task. Further, Jan placed no value judgment on whether her students moved quickly or slowly as long as they were working productively. While Jan was accommodating and worked well with students who did not work as quickly as others; however, she was less explicit with her students about how to be respectful of each other in this way. Despite missed opportunities in this area, Jan seemed determined that her students persist as they worked through mathematical tasks that they found difficult.

Jan often rewarded student’s courage to come to the board and attempt problems, rather than their actual correctness. During one of my observations, one of Jan’s students stood at the board embarrassed that he had not gotten a correct answer; some students

began laughing at him. Jan, realizing his embarrassment, handed him a Scholar Dollar, imitation money that teachers used to reward students for good behavior and effort. Students could spend Scholar Dollars at the school store and sometimes cashed them in as homework passes. Students complained when Jan awarded the Scholar Dollar to this particular student. Jan quickly retorted:

Well part of the condition of the Scholar Dollar is that he was ready to learn. It's written [in the rules] that you are to be . . . respectful, ready to learn, and responsible . . . Whether he got the answer right or wrong, it makes no difference to me. He came up, tried, put forth effort, and for me, that says something bigger than just getting the answer right. He did a good job (Classroom observation, May 4, 2012).

This scenario, while emphasizing effort and hard work as supported by research on helping students develop growth mindsets about success and smartness (Dweck, 2006), also left me wondering if in Jan's desire to encourage effort, she sometimes minimized competency in a way that that was unproductive to her students' mathematical trajectories. Jan sent a message about effort being valued over ability, yet ultimately, she knew that to be successful according to how her school and district assigned competency, the students would have to eventually get correct answers to pass the high-stakes assessments her students would have to take. Nonetheless, in the particular moment presented above Jan an important message about mathematics identity, both to the student at the board as well as the whole class. She noted that effort was important, thus giving her students who were not traditionally successful in her class an opportunity to

experience success. Second, she affirmed her student who was feeling incompetent; in that moment she positioned him as capable and a successful doer of mathematics.

Tool: Shifting mathematical authority. Jan described, and I also witnessed, the ways in which she tried to scaffold mathematics tasks and eventually pulled away from making her students overly reliant upon her during instruction. She believed that if she could find ways to encourage them to persist when they were struggling with a mathematics task, then they would learn to intrinsically motivate themselves. During the spring 2012 semester, Jan shared about prepping her students for the upcoming standardized exam and their reluctance to engage with the content:

They can't do [the mathematics required to pass the standardized exam] and that's why they're here [in my test preparation class] . . . [I am] not going to give them aaaall (exaggerated tone) the help that they want. I told the kids, "I can't hold your hand on the test and give you hints." So, at some point, I'm going to have to take away those hints (Interview, March 26, 2012).

On numerous visits to her class, Jan would "check out" during the class, telling her students that she forgot how to do the material that they were covering that day. She often refused to give explanations until she had exhausted all of the student explanations and clarity was needed. In subsequent interviews, she explained that "playing dumb" (as she described it) or feigning tiredness was her way of shifting the responsibility of their learning back onto them. Jan could often be found at the back of the room watching her students' interactions and interjecting with comments like, "Do you agree with what he just said?" and "How do you think she did that?"

Jan also noted the importance of giving students mathematical authority in her lesson planning: “I do think of their identity and I do try to . . . give them more of the ownership [of the content], where all the work that I do comes before [class], and the work that they do is the action that goes on [in class]” (Interview, May 7, 2012). Jan went on to explain that planning with mathematical authority in mind required more work for her on the during the planning phase of instruction than planning a lesson that relied more on the traditional didactic format.

Tool: Revising student work from teacher feedback. In addition to pretending to be forgetful, Jan also talked about trying to motivate her students via the type of feedback that she gave, particularly when it came to grading. As mentioned earlier, Jan often avoided giving percentages and marking their answers wrong as she graded. Instead, she offered more qualitative feedback. Additionally, citing her students’ lack of motivation to complete assignments, Jan began the habit of making her students revise their work. She explained her rationale for doing this as follows:

[I tell them] “I need you to do this for me. It's not going to be graded, but it's going to help you and all I'm going to do is provided feedback for you and you're going to have to go back and fix your mistakes and then, I'm going to check again” (Interview, March 26, 2012).

Jan hoped that by showing students that learning mathematics was an ongoing process that did not end with a grade on a paper, they would be more inclined to try tasks that seemed daunting, or they would persist and put forth effort when they were stuck in problem solving. Again, like her efforts to shift mathematical authority and to stress effort over ability and speed, Jan’s method of providing qualitative feedback and giving

her students the opportunity to revise their work positioned them as being capable of doing mathematics and about the nature of mathematics itself as something that one can work at and improve upon, both messages important to building positive mathematics identities with students.

Tool: Setting a student-centered, collaborative tone. As Jan's mentor teacher, I noticed the change in the physical space of Jan's classroom as well as the structure of her lessons. Jan's classroom evolved from traditional row-and-column seating to seating that allowed students to collaborate. Sometimes this meant students sat in pairs. Other days this meant that students sat in a circle. During a unit on decimals and percentages, Jan observed that a majority of her students were having a persistent issue with place value. To tackle this issue, Jan opted to create a roundtable format for sharing their ideas about the topic in a way that was nonthreatening. In our post-observation debriefing, she shared "I [conducted class in] the layout of a semicircle ...because think made it less of an evaluation or test type of thing" (Interview, March 26, 2012).

I also noticed that Jan's classes began to take on more of a workshop structure than a traditional classroom format as the spring 2012 semester progressed. She began to open class with a brief mini-lesson or launch problem, but for the majority of the class, her students worked in pairs or small groups to address the topic of the day. I watched Jan adopt and become comfortable in the role of facilitator rather than transmitter. The workshop-style course structure also supported her homework and classwork revision procedures. Jan often gave speeches such as these before her students dispersed to work in small groups:

Since it's the day before [the standardized assessment], I will allow you to pick who you work with. However, please keep in mind you need to talk about the work. And here's the other thing. One last rule. One last rule. You have to push yourself. You guys should be talking and helping each other out (Classroom observation, March 26, 2012).

Jan remained committed to the ideas she expressed in the excerpt. While facilitating group work, Jan rarely answered her students directly. She often referred them to one another or, as noted earlier, feigned confusion when they asked her to show them how to do a particular problem.

Based on her experiences in methods courses, Jan's desire to be more student centered was emerging at the time of this study. I would primarily characterize Jan's instructional approach to teaching mathematics as incremental. In other words, Jan prided herself in giving her students step-by-step approaches to doing mathematics. However, Jan expressed interest in approaching mathematics from a more student-centered perspective and strived to do so through assigning tasks that frequently required group work and collaboration. She attributed her interest in student-centered teaching to her experiences in her summer mathematics methods course. She felt that the instructor of the course pushed her think about teaching and learning mathematics in new ways. Our exchange about the influence of her summer methods class was quite insightful as to how it shaped her perspective on teaching mathematics:

Jan: [The methods course] just opened my eyes to see math in a different way, because I approached it [in a] one step, two-step, three step [fashion]. The instructor just threw a lot of stuff and

said, ‘Just go with it,’ and it bothered me so much, because I was such a ‘Explain to me step one, step two, step three’ type of learner. I can mimic those. I can learn those and understand those after you explained it to me, but I needed you to explain it to me. X, Y & Z. And he was like, “Oh, you can go X way. You can go to the same answer by doing Y...It bothered me so much, because I was just not that liberal of a learner. I learned it by the book and I learned it . . .

Toya: By the steps

Jan: Yeah! (Interview, March 26, 2012)

Having interned and co-taught middle-school mathematics methods with Jan’s methods instructor, I knew that he did not “just throw a lot of stuff” on the board. He carefully selected tasks that would engage his methods students. They had opportunities to experience mathematics as their students would as well as opportunities to teach concepts to their classmates in an inquiry-based fashion. What Jan is referring to is the openness of her instructor’s lessons. While most of the students anticipated doing mathematics in the traditional rote, step-by-step fashion, her instructor wanted to make them aware of the multiple entry points one can provide students and the importance of allowing student to construct their own knowledge. Jan continued:

So, the instructor was just like, “Go home and do it.” After the first couple of classes, I literally just sat there and looked at him, and I waited until other people got up and did it. I was just like, “Okay, whatever.” But, [by] the end of class, he just proved a big point that there's so many ways to get to the final answer and it

doesn't matter which way you take as long as you get there and there's some openness about how you're getting there and what you're doing (Interview, March 26, 2012).

Guided by her methods course experiences, Jan often highlighted the importance of having her students pose questions and solve their own problems in class. Once she completed her student teaching and was placed in her own classroom, she frequently partnered students and encouraged discourse around mathematical tasks. In all of my recorded observations, Jan could be heard saying things like:

I will only be able to answer one question per station. So let's say you're at the orange [station], and I answered one question for you. I'm done with your group. And then you get one more chance when you get to a different station, and then I'm done for the group. So you need to work it out between your group (Classroom observation, March 22, 2012).

Jan's emphasis on collaboration and student-to-student discourse sent distinct messages regarding her faith in their abilities. Further the collaborative nature of these tasks encouraged students to see each other as resources, which is an important facet of mathematics identity.

Tool: Attention to issues of affect. Jan also had other commitments to mathematics instruction that attended to more affective dimensions of teaching. In her summer portfolio she described her ultimate goal, as a mathematics teacher:

[I want my students] to take more than just the understanding of math content, I want my students to walk out at the end of the year proud of their own accomplishment as a student and as a person . . . I want my students to build an

identity and understanding that math can fit in their life and it is not just about quantitative thinking but math also deals with qualitative reasoning (Summer Portfolio, August 2011).

As shared above, Jan understood her responsibility as a mathematics teacher was to “to teach [at] another like level beyond just, like, math content” (Interview, May 7, 2012).

Jan stressed the importance of relationship building and its importance to teaching mathematics, a content area that made some of students were incredibly uncomfortable, according to her. She noted that her efforts to build relationship, through activities like learning about each others’ ethnicities and family life, “. . . made us closer knit. I was just, like, [able to] be sarcastic with them and they would understand . . . *And* still be productive . . . *And* produce the work that they wanted to produce. We are all family here” (Interview, May 7, 2012).

Partly because of her desire to connect with her students beyond mathematics content, I contend that Jan became concerned with issues of mathematics identity. Jan cited her own experiences with failing a college mathematics course as motivation to build up her students’ confidence in their capacity to do mathematics well. Jan highlighted how this particular experience also influenced her approach to teaching mathematics to middle schoolers. When reflecting on reasons why she may have struggled in the course she stated, “It may have been the teacher, but I just had such a bad experience that no matter what I did, I didn't get a success. So, now when I'm teaching math, I think of the things, I think of the experiences that I had early on” (Interview, March 19, 2012).

As Jan reflected on failing this course, what I found most interesting was her acknowledgement that her failure was not nearly as damaging to her perception of her mathematical ability as it could have been because she experienced during college, a time in her life when she felt she had the maturity to handle that type of failure, rather than as an elementary or a secondary student. Had she experienced this type of failure earlier in her mathematical experiences, Jan noted, “I seriously feel that I would have crashed” (Classroom observation, March 26, 2012).

Conversely, Jan’s desire to have her students engage in small-group work and classroom discussion encouraged students to rely on themselves and each other, shifting the responsibility for learning. Implicit in this is an ability message that starkly contrasts the one implicit in taking an incremental approach to mathematics. Jan, like most teachers in this age of accountability, found herself trying to balance the need for her students to be correct and finding the space to let them struggle and grapple with mathematical ideas.

Jan’s attention to more affective dimensions of teaching and learning mathematics also had the potential to influence student identity. Teaching mathematics in a way that encourages students to develop positive identities also requires teachers to think beyond instructional moves. I contend that Jan had a stance toward and personal commitment to teaching mathematics with more affective considerations like mathematics identity in mind.

Taken together, all of the tools highlighted above influenced the object of Jan’s activity system. These tools impacted how Jan was able to enact practices that promoted positive mathematics identity in her classrooms. Jan’s desire to shift mathematical

authority to her students as well as her creation of tasks that were collaborative and student-centered in nature fostered her students' perceptions of themselves as capable. Further, her approaches to grading and student feedback encouraged her students who had experienced limited success in mathematics to persist. Thus, through the use of all of these tools, all four dimensions of mathematics identity are working together in an integrated fashion as Jan attends to mathematics identity in practice.

Division of Labor

Engeström (1987, 2001) described the division of labor in an activity system as being how tasks and roles are divided among the community of the activity system and how this influences the power and status structure. In this particular activity system, Jan remained the primary authoritative figure in the classroom; however, she and her students negotiated participation while working through mathematical tasks to more equitably divide the labor between Jan and her students, regardless of their classroom status.

During instruction, Jan organized the labor in the room in a fashion that pushed students to rely on each other. In fact, Jan was the only teacher in this study who was able to get her students to work with each other productively, sans her presence, for extended periods of time. Jan was steadfast in making sure that her students were getting the most out of their interactions with each other, and often required them to look to each other in lieu of answering their questions. I attribute Jan's ability to foster this type of labor division among her students and herself to her ability to set the tone for productive mathematical activity early in the school year. Jan and her students negotiated and established very clear rules, procedures, and norms. Because those things were in place,

Jan was able to facilitate her tasks with minimal interruption for nonrelated concerns like classroom management.

I argue the distribution of labor between Jan and her students promoted positive mathematics identity. Jan was explicit with her students that they were learning not just mathematics but other strategies, like posing questions and participating in discussions, which would be useful in their other mathematics classes. She shared with them how she wanted them to realize that they, too, had mathematical knowledge that was valuable. During one visit, Jan's student Tamara was at the board. As Tamara worked the problem for the class to see, Jan decided to not only address the problem at hand, but also the ways in which her students communicated with each other. She interjected:

Jan: Remember, starting this week, . . . we're gonna practice how you guys ask questions. So this week, your starting question is, "How did you . . .?" You guys can start your questions with "How did you . . .?" if you can't come up with any other questions . . . Do you understand what I'm saying?

Girl Student: Yeah.

Jan: Like, "Tamara, how did you get negative 27?" That could be a question that you could ask her, right? Without me having to ask her all of the time, right? Or without you asking me (Classroom observation, May 7, 2012).

Pushing students to question each other and discuss the mathematical tasks was a practice Jan implemented early in the school year, even before she became the teacher of record for her own classes. While she was diligent about making them pose questions, she acknowledged that she was not as diligent about working with students on how they responded to each other. Upon reflection about this issue she explained:

I am more consistent in making sure the kids ask other students questions, and they hold themselves responsible for doing that. And I wasn't as adamant, where I did not push the kids enough to be respectful of the fact that, yes that concept maybe easy to you, but it is difficult to that other students. And then vice versa, there might be a topic that is going to be difficult to you but really easy to her
(Interview, May 7, 2012)

Jan was also conscious of how her students with lower status in the classroom often went unnoticed during classroom discussions. To remedy this issue, Jan started to use equity sticks. She explained:

Jan: So, for the past – like three weeks ago – I actually took into account how I called on kids who were participating. . . . I realized when I'm grading, the same ones who are struggling are the same ones who are not participating because they are not voicing their opinion. They are not sharing their answers, so I don't know what's going on until I get it on paper. So I'm just like, I need to fix this. So I went back to the equity sticks and just started pulling [names] out.

Toya: So this is your way of randomly choosing so that you can hear different voices during class? Ok.

Jan: So I feel like it helped as far as, well, one, bringing their grade up, and two, me being able to address the majority of the class without me independently having to address all 34 (Interview, October 25, 2012).

While equity sticks provide only a surface treatment for encouraging student participation, in that they do not address why students opt not to participate, this excerpt demonstrates that Jan was taking student status into consideration as she and her students divided the classroom labor.

Activity System Contradictions

Many of Jan's personal and academic experiences as the subject of her system, several of the tools she employed, as well as her and her students' division of labor around mathematical tasks all contributed to the building positive mathematics identity at the collective level in her classroom. However, Jan's system also consisted of rules, aspects of her experiences as the subject, and tools that impeded the construction of positive mathematics identity as well. I will refer to these elements as contradictions in system of activity. In Figure 5, the breaks in the arrows represent these breakdowns in the activity system. Jan experienced contradictions between several elements of the system and the object of study. Specifically, I will highlight contradictions between: (a) the rules of the system and the object, (b) the subject and the object, (c) the tools and the object, and (d) the community and the object. More specifically, I will highlight: (a) how the accountability mandates she was responsible for meeting (rules) impeded her attention to mathematics identity, (b) how Jan's personal and academic experiences (subject) impeded her attention to her students' positive mathematics identity construction, (b) how she struggled to determine the role of attending to mathematics identity in practice and to find instances of attention to mathematics identity in her own practice (tools), and (c) how Jan struggled to find ways to attend to mathematics identity given the diverse needs of her students (community).

Contradiction between the rules and the object. Engeström (1987, 1993, 2001) referred to rules as explicit and implicit norms that regulate actions and interactions within the system of activity. I contend that in Jan's case, the school and district mandates played a role in how Jan was conceptualizing mathematics identity through an ability lens. Further, being assigned to teach test preparation courses and working under testing pressures also influenced her instruction and perceptions of her students, thus impacting how she attended to mathematics identity.

During our collaboration, Jan reiterated the challenges of working under the pressures of accountability mandates and school structures. Jan described how school, district, and statewide mandates around curriculum and standardized testing permeated most aspects of her work, including helping her students build positive mathematics identity. She cited school and structural forces as impediments to helping her students develop positive mathematics identities. As a former teacher in Griffin County Public Schools and a member of the MST-Res staff, I knew that our teachers would be immediately met with the demands of accountability, achievement gap rhetoric, tracking and sorting students, and other structural issues that research has found to impede student learning and mathematics achievement (see Diamond & Spillane, 2004; Oakes, 2005). While we on the staff of the program tried to prepare our prospective teachers for these challenges during our summer courses, oftentimes when immersed in the day-to-day challenges of being a mathematics teacher in a district facing sanctions for test performance, the PNTs frequently found it difficult not to succumb to the taken-for-granted nature of labeling and sorting students that permeates the many school systems in the United States.

As mentioned earlier, Jan described what it meant to her for someone to be a math person. She noted that students should be able to “learn differently and . . . at their own paces,” but even after saying this, she immediately cited district-level forces that limited her idea of who could be considered a math person, noting, “I feel like there's a system part of it where I might have to label those students not a math person” (March 19, 2012). In her characterization of a math person she recognizes cites the pervasiveness of her school’s accountability system, and in particular the fast pacing of the curriculum guides, and its role in shaping how she came to see her students as mathematics people.

Despite Jan’s best efforts to reward effort and process over correct or incorrect solutions, the reality of standardized testing was always present. In one instance, a student was at the board working a sample standardized test item. The student, Kim, used to Jan’s awarding of partial credit, had worked through the problem using a partially correct process and did not get the correct answer. An excerpt of their exchange was as follows:

Kim: So Ms. Dan, because I put a decimal, is that wrong, or should I get half credit?

Jan: I don’t know. (To the class) What do you all think? Should I give her half credit, or is she wrong? (Students’ muffled responses in the background). So tomorrow, when she gets the exact same question on the MSA, is she going to be marked wrong. Or is she gonna be marked right?

Boy Student: Wrong.

Girl Student: She’s gonna be marked wrong b/c you have to be exact.

Jan: Exactly. It's not a percent. You only converted it to a decimal.
Do you see that? (Classroom observation, March 19, 2012)

So while Jan worked to build a classroom climate that encouraged effort and persistence while deemphasizing correct answers, ultimately, Jan found her self in situations where she had to defer to the accountability system put in place to determine mathematics proficiency.

Jan also shared how her beliefs of what constituted a successful mathematics student had evolved as a result of her classroom experience. However, even in her evolution in thinking, Jan was still mindful of the ever-present school structures and how they positioned students as successful or unsuccessful. The following is an excerpt of our conversation regarding mathematics ability and success:

Toya: So, can a student be successful and earn a C in your class?

Jan: I think so.

Toya: Really? And why do you say that?

Jan: Because, how the system is set up, it requires that I put in grades every week, but at the beginning, the student may have not been doing well because they didn't understand the introductory part of the lesson, but they got more exposure, more hands on, and more practice. They ended up understanding it. So, I may have had a couple [of failing grades in the grade book], but ... towards the end, they received those A's and B's, so it . . . unfortunately will average out to a C (Interview, March 19, 2012).

Jan's statement above highlights the tension of building her students positive mathematics identity in a school system that does not necessarily acknowledge or reward the indicators of success that Jan does.

Even within Jan's day-to-day practice, she struggled with creating lessons that were engaging and nontraditional, as she typically faced some resistance from her students. In our initial interview, she talked about trying to teach in a manner that was reflective of her methods courses and how her students were reluctant to it. She noted, "These kids are so system driven. They know what's coming, and when you throw a curve ball, they're just like 'Huh?'" (March 19, 2012). Over time, she found her way, and her students became more receptive, but even up until my last observation, I always noticed some reluctance from her students when she "threw a curveball" and stepped out of the traditional mode of instruction.

Jan also attributed the school structures to limiting the amount of student-centered, conceptually-driven instruction she could offer to her students. She shared:

The problem-based [tasks] and getting [students] to think about concepts on their own, like big picture instead of little parts – and I don't know if its my situation of being switched into this [test preparation] class and having to start . . . all over again and the standardized test being around the corner, but I'm just crunched [for] time and pushed and limited to time, but I would definitely like to push for more of that [type of instruction] after the test and develop, like, my teaching style (March 19, 2012).

In essence, it seemed that Jan did not see problem-based tasks as something that could be enacted alongside preparing her students for the standardized exam. After the

standardized exam, and in particular during the last quarter of school, I did notice Jan make more strides toward incorporating student-centered, not necessarily problem-based, tasks in her teaching.

Even as Jan pushed back against ability and accountability rhetoric, it was still tacit in her thoughts on schooling and student identity. As an exercise in refreshing my participants on issues of mathematics identity and their work over the summer, I used excerpts from their summer portfolios to drive our discussion. In the first excerpt I had Jan read, she discussed how she felt teachers did not have the agency to reverse student labels such as “smart,” “slow,” “proficient,” or “basic.” Here is a brief excerpt of her response

I think that more of our focus should be at changing weaknesses to strengths and slow to fast, and not necessary focusing on labels. So I am concerned with what kind of identity that the students are building in my class whether my class is labeled basic, proficient, or advanced. I am more concerned that IN my class that my students identify themselves as capable and great learners of mathematics (Discussion board excerpt, July 2011).

Upon rereading her response, she initially disagreed with what she had written, but then after a long pause, she changed her mind and said that she was in agreement with what she wrote, noting that it is the teacher’s job to “push the kids to turn weaknesses to strengths, then slow to fast.” She then pointed to the county-recommended software that she uses as a tool to help her students gain proficiency and speed. Jan’s comments regarding slow and fast students were laden with ability messaging. In the comments above, she never challenged the labels of fast and slow, but rather tacitly accepted them.

Though these comments were from her summer portfolio, this line of thinking was evident in most of her interviews, and I observed her try to counter it in her instruction. Further, Jan's response to her summer portfolio entry serves as an example of how Jan's notions of ability permeated how she attended to mathematics identity.

Contradiction between the subject and the object. While Jan's personal experiences promoted positive identity building in her classroom, other personal experiences created a contradiction in the activity system. In other words, some of Jan's personal experiences were influential to Jan's engaging in practices that impeded her attention to attend positively to mathematics identity. Consistent with how Jan foregrounds mathematics identity with ability, her experiences as a student in an ELL program were influential in how she perceived her ELL students' capacities for doing mathematics. Through my analysis of Jan's interviews, I also assert that Jan had a way of *othering* her students, which also influenced her perspective and practice as it pertained to mathematics identity. Theorists have described othering as excluding or seeing non-dominant groups as inferior by those who privilege their dominant ways of knowing and being (Borrero, Yeh, Cruz, & Suda, 2012; Kumashiro, 2000). Just as Jan experienced being othered because of her ELL status, Jan similarly othered her students in our interviews in the way that she talked about her students in relation to herself.

Jan's ELL experiences. Jan's experiences as an elementary student who received ELL services shaped her opinions regarding how ELL students should be taught mathematics. More specifically, Jan had a very strong opinion as to how ELL students should be assigned to mathematics classes. Jan recalled that when she was in elementary school, her ELL support included a class outside of her regular courses where she and an

ELL teacher would go through her work from other classes, find her grammatical errors, and have her correct them. However, Jan noted that mathematics was the only course in which she did not receive this type of support. She remembered being very strong at computational mathematics but feeling confused and incompetent when she had to tackle word problems. In the school where Jan taught during the time of this study, the ELL students were mainstreamed in mathematics classes, similar to Jan's own experiences. Recalling her own struggle with this issue, she wanted the school to provide a different type of support for her ELL students. She wanted her ELL students to have a separate ELL mathematics course. She shared her rationale for this below:

The culture is different. The culture of our lives and the lives of the kids that we have in the mainstream classes are different than the kids who come to us from a foreign country. *So when they come, I don't know much about their culture, but I feel like there's something that is different and it blocks them or hinders them from solving the word problems, and I guess this just goes back to my own experience about me not knowing those word problems.* So, I guess, having the teacher who's trained in ESOL and who specialized in math would be something really great for the kids. So, that they can break down the problems and they learn at a pace that's appropriate for them. So, its not shut down type of thing, because I feel those kids get shut down here, because if they don't know and *there's no way for me to reach out, [there's] one of me to reach out to every single one of them* (Interview, March 19, 2012, italics added for emphasis).

In some ways, Jan's recommendation, while intended to be supportive, runs counter to literature that suggests effective practices for teaching mathematics to English language

learners. Recently, mathematics educators who study issues related to ELL students suggest adopting a sociocultural approach that emphasizes interaction and a student's language of origin as an asset (Moschkovich, 2007). Jan benefitted from having an ESOL support class when she was younger, but what she described above sounds less like an academic support course and more like a way of tracking her ELL students into a sheltered course where they could receive more intense support. Jan's statement above reflects the way that she conceptualized middle school mathematics as straightforward as well as her desire to teach it in a step-by-step manner. Jan stressed the need for a separate course for ELL students so that an ELL teacher could "break down the problems . . . at a pace that's appropriate for them." Absent from this desire to help ELL students is a desire to highlight the mathematical understandings and resources that they possess, regardless of their country or language of origin.

Additionally, implicit in Jan's statement is the lack of agency that she feels as a mathematics teacher with ELL students. Jan, having experienced being an ELL student, felt that the differences between her and her ELL students were almost too large to overcome in her instruction, leading her to feel that "there's no way to reach out." Jan was a novice teacher at the time of data collection; she had more experience as a student than as a teacher, so her limited sense of agency in terms of providing effective instruction for ELL students is understandable.

Jan's perspectives on teaching ELL students, filtered through her personal experiences as an ELL student, have implications for how she attended to mathematics identity in her classroom. Knowing that Jan had yet to develop the agency or the understanding with regard to teaching in a way that adequately supported ELL students

had implications for how she positioned these students for learning during mathematics class as well as the ability messages she sent as she taught, the nature of the tasks she selected them, and the ways that she motivated (or did not motivate) her ELL students when struggling.

Instances of othering. Jan's perspectives on teaching ELL classes could be considered an example of othering, which would be consistent with how Jan othered students more broadly. I asked Jan how teachers could counter ability labels like basic, slow, and dumb in their classrooms. She agreed that teachers could counter labels, but then noted that this could be done if teachers grouped students who had similar abilities. A bit confused by her response, I probed deeper.

Toya: I'm wondering, . . . If you make homogenous groups . . . So you mean within your class? So, the kids who are doing well go together and your kids who are struggling, go together, your ESOL kids . . .

Jan: Mm hmm...

Toya: Oh, okay. So, that's what you mean by homogenous grouping?

Jan: So, I guess I'd be more enforcing the labels, but I feel like maybe in a more productive...I want to say productive way that fits the needs of the students (March 26, 2012).

Jan went on to say that she felt like her way of grouping students would be more productive than the current system in place because students are currently grouped according to their reading scores, rather than their mathematics assessment scores. She was advocating for grouping students according to their mathematics performance on

standardized assessments and saw this as the way to best meet the needs of the students. I find her response interesting, given that she was teaching a course that enrolled students based on their standardized test performance.

Jan also othered her students on their life experiences, which were different from hers. As noted earlier, Jan and her colleagues were teaching in schools that were considered high-needs and urban, two terms that are laden with deficit meaning. Jan reflected on her desire to teach in a community where she could make a difference, yet having to process the reality of what that desire entailed:

[Teachers in the program] have this grand idea - we know we are going into high needs schools, but we don't really know what that means. In our my world, thinking about . . . when I was a student and what classrooms looked like when I was in school, but it's not the same thing. *We are dealing with high needs, where I didn't go to school in a high needs area.* So, I had pretty much all the support I feel like I could have available to me (Interview, May 7, 2012, italics added for emphasis).

Jan acknowledged that her schooling experiences were vastly different from those of her students. She also expressed that she entered the MST-Res program with a certain naiveté about what it meant to teach in schools that are labeled as “high needs.” When discussing how she supported her students and accounted for their lived experiences in her teaching, Jan reflected on her parents’ high academic expectations for her and how her students lacked this type of support and accountability from their parents. In thinking of ways to support her students, she noted that she had to be mindful of what she asked her students to do for homework because she explained, “These kids have no support at

home” (Interview, March 26, 2012). I could not confirm whether this statement was true; however, what is more striking is Jan’s broad labeling of all of her students as having negligent parents, a theme all too familiar in the literature regarding parent-teacher relationships in underserved schools (Civil, 2002).

Thus in drawing distinctions between herself and her students based on language and family structure, contradictions arose between Jan as the subject of her system and the object of the system, attending to mathematics identity in practice.

Contradiction between tool and object. While Jan exhibited tools such as creating a collaborative tone and attending to affect, she also exhibited tools that, at times, impeded her attention to mathematics identity. I consider these barriers to positively attending to mathematics identity to be contradictions in Jan’s activity system, creating tension between the tools and object. As she worked toward being more open and student centered, she often exhibited an incremental teaching style, which she explained was rooted in her earlier career experiences as a pharmacist. This style sometimes diminished the rigor of her tasks, which in turn, impeded her attention to mathematics identity, and specifically the messages she sent regarding mathematics ability. In addition to exhibiting an incremental teaching style, Jan struggled to determine the role of attending to mathematics identity while facilitating mathematics instruction. Also, while Jan employed tools to attend to mathematics identity, she struggled to recognize instances of attending to mathematics identity in her practice.

Teaching mathematics incrementally. Jan’s conceptions of the straightforward nature of middle-school mathematics were evident in her teaching. Jan tended to take an incremental approach to teaching mathematics. Even her tasks that required student

inquiry were built to explore the topic in a hierarchical fashion. Jan described her mathematics teaching style as being “step-by-step” (Interview, March 19, 2012). In one of our post-instructional conversations, Jan noted that clarity was a priority in her teaching, and as such, she found the step-by-step approach to instruction as the best way to limit her students’ confusion. She pointed to her former pharmacy career as being influential in developing this style of teaching, and particularly her experiences of working with other pharmacists to calculate prescriptions. She recalled:

So with working with a pharmacy, there's a lot of calculation as far as calculating what they supply with whatever quantity the doctor prescribed for and follow the directions and divide to get the days supply and I remember doing it step by step. And I remember teaching, like, the new techs that came in that had to take the certification exam. I was just like, “You just take it step by step.” Whatever the directions say, you multiply it by what you have to take in a day (Interview, March 19, 2012).

Even while being inspired by her methods courses and our mentor-mentee interactions around more student-centered, inquiry-based approaches to mathematics, she still found comfort in breaking down the content of her course into a step-by-step fashion. Realizing the success of this method, if success is measured by correct answers, she carried it into her instructional approach with her students.

On visits to Jan’s classroom during the data collection period, I watched her attempt to balance her desire to teach in a student-centered, inquiry-based fashion with the comfort she found in incremental, step-by-step instruction. For instance, on one visit to her classroom, she provided integer chips to her students in an effort to get them to

think about integer addition and subtraction. In her lesson planning writing prompt, she shared:

This lesson gives my students agency, particularly with the pair work. The students not only have to use manipulatives in order to navigate around the problem/task, but they also have to come up with a rule that they will be able to use for adding integers (positive and negative) (Mathematics identity lesson planning prompt, October 5, 2012).

Thus, Jan had an expectation that students collaborate and seek patterns to arrive at a general rule for adding integers. While students used the chips during their small-group practice, and Jan used them as she helped groups that were struggling, ultimately, when the whole group came together to discuss their solutions, Jan resorted to having students share their answers and explain their work using the “keep-change-change” method of integer subtraction. No mention was made to the integer chips that the students used during the small-group activity.

Jan’s incremental instructional practice was laden with messages about mathematics identity. For instance, acculturating students to the idea that mathematics is rigid and is done primarily in a step-by-step fashion sends a particular message about the purpose of doing mathematics and its usefulness in their lives, i.e., the importance dimension of mathematics identity. Further, teaching mathematics in an incremental fashion, particularly with students who already have low status as a struggling learner sends ability messages to student, or rather a message regarding their lack of ability.

Determining the role of and identifying mathematics identity in her practice.

When Jan and I began explicitly discussing mathematics identity as a component of her mathematics instruction, she struggled early on to see how it could fit into her instruction. In our initial interview, when asked how she attended to mathematics identity or wanted to attend to it in her teaching, she stated:

It's just something I'd like to do, but I know it's something that I don't want to spend all day doing it, but I feel there are moments and I feel is that in my lessons and in the flow of the lessons there are pinpoints where I could go into it and its appropriate timing and appropriate place to go into it (March 19, 2012).

Because I knew that Jan struggled with how to explain what mathematics identity was in her own words, I also anticipated her struggling with what it looked like in her own practice. With this in mind, I probed her further. Below is my response to her concern:

Jan, what if math identity happened during your teaching? What if, maybe, there are just teaching strategies that lend themselves to attending to it? Not like, "Hey guys! It's identity time!" What if there are just features embedded within the lesson? (Interview, March, 19, 2012)

Throughout the period that we worked together, I found myself highlighting features of Jan's teaching that I found to be characteristic of what the literature supports as conducive to helping students build positive mathematics identities. More often than not, I identified identity-affirming practices that Jan did not recognize in her work. Helping Jan to see that attention to mathematics identity was not happening separately from mathematics instruction was an ongoing challenge during our collaboration.

After listening to Jan's and her colleagues' initial interviews about mathematics identity, I knew that they were struggling to embed mathematics identity-building strategies into their lessons and to identify points in their lessons which could be considered important to building positive mathematics identity. This is understandable, as defining and attending to mathematics identity is not straightforward, linear work in a mathematics classroom. I also considered that I might not have been as clear as I could be during our interviews and working meetings. Thus, in an effort to provide some clarity, I created a set of prompts, the Mathematics Identity Planning Template as described in Chapter 3. The template consisted of a set of questions for the PNTs to consider as they planned lessons and a second set of prompts to consider post-lesson.

Though I introduced them to the PNTs in the spring of 2012, Jan began to use the prompts to plan and reflect during the fall of 2012. During the final interview of the study, I again asked Jan how she was attending to identity in her lessons. She shared the following:

I think answering those questions that you sent me, those pre- and post- questions you sent me, made me think about [math identity in practice]. I think really those may be the only times that I'm really thinking about it. But at the same time, I feel like I'm thinking about it, but not saying that I'm thinking about it. Like, it's happening, but I don't realize that it's happening (Interview, October 25, 2012).

The excerpt above stands in contrast to Jan's initial ideas about attending to mathematics identity while teaching mathematics. While she admitted to not always consciously considering mathematics identity as she planned her lessons, she believed that she was considering issues of mathematics identity in a more tacit way. While her response is not

what I would consider an optimal outcome of our work together, this excerpt served as evidence that Jan may have been starting to see the role mathematics identity as an important element of practice that happens *during mathematics instruction*, and not in some separate space outside of the content.

As Jan stated during an interview regarding her attention to mathematics identity in practice, “It’s happening, but I don’t realize that it’s happening.” Often, when I pressed Jan about how she was approaching issues of mathematics identity in her instruction, she either claimed that she was not doing anything or that she could not think of any instances. This was an issue that we tackled as we worked together. As mentioned above, we started using the lesson planning and post-lesson prompts as a means of highlighting her attention to identity in practice. The lesson planning prompts highlighted issues including: (a) creating mathematical tasks that give students agency; (b) identifying high and low-status students; (c) anticipating how low-and high-status students would respond to a mathematical task; (d) considering a task’s entry points for high and low-status students; and (e) identifying what it means to be successful on assigned tasks. Jan acknowledged that the prompts helped her think about her practice and how she promoted positive mathematics identity; however, she still struggled to target specific instances in her practice. As her mentor teacher, I recognized that I could not allow her to think that we had worked together on this issue and that she made no progress. During our meetings, I began highlighting the ways in which I saw attention to identity in her practice.

Through our work together, Jan noted that she was more confident about highlighting some of her practices that promoted mathematics identity. In terms of lesson

planning, she noted, “I’m not always saying, ‘This is the identity portion of it.’ But if I was given a task to go through my lesson plans to see where identity fits, I could probably find it here and there . . .” (May 7, 2012).

Contradiction between the community and the object. As Jan and I worked together, she spent time pondering how to address her students’ collective mathematics identity in her classes where students had diverse needs. Providing meaningful mathematics instruction is challenging work without the additional (yet necessary) responsibility of attending mathematics identity in practice. Jan’s classes were not just diverse in terms of race, gender, and class; they were also diverse in terms of academic, social, and personal needs. Jan spoke candidly about the struggle to embed identity-promoting practices in her work because of the diverse needs in her classroom. When I pressed her about working with one of her lower-tracked Mathematics 7 classes on issues of motivation, we had the following exchange:

Jan: There are so . . . many . . . different . . . problems (said slowly, emphasizing each word). I can’t say problems, but there’s so many different (long pause) kids in the class. There are kids who are high performing and know this stuff, and there are kids who can’t read. Can’t say the word “consider.”

Toya: This is in the section that you said you struggle a lot with?

Jan: Yeah. They can’t say the word “consider.” And where with my Math 8, if they don’t get it, they’re gonna think about it and gonna try and attempt and struggle with it, This group is gonna act out and shut down (Interview, October 25, 2012).

This exchange highlights how Jan often highlights ability when discussing mathematics identity. Jan spoke of the heterogeneity of her students' abilities within one class section and across her classes. She also made note that some of her students who were struggling mathematically also struggled with reading, taking special note to mention that some of them struggled with pronunciation. She also noted that the students that she identified as struggling often acted out when they became frustrated with struggling with the content. Jan went on to discuss the vast and varied needs of the students in her classes:

Jan: I have this sleeping disorder kid. ADD or ADHD or . . . I have 3 kids who are constantly suspended. In and out . . . So it's one thing to have all these learning issues and learning problems and styles going on . . . But that class is very transient. I had 2 kids, no, I had 3 kids up for expulsion, and they were gone for a month, all at different times.

Toya: Uh huh, and so you're saying that presents an issue when planning around building positive identity.

Jan: I would love to have that class in its entirety, for a whole unit, to see how different it is. Because, at the end of the day, the fingers are gonna get pointed at me. Unfortunately, the fingers are gonna be pointed at me when the [standardized exam] scores don't look right. But at the same time, we're not looking into those factors, the fact that they're never here (October 25, 2012).

While Jan cites reasons such as truancy, misbehavior, and low academic ability as obstacles to planning with attention to building positive mathematics identity, she positions her students as oppositional and uncooperative without acknowledgement or awareness that her students are co-constructing the "acting out" and "shutting down"

(Hand, 2009) during her lessons. As Jan's former mentor teacher, I feel it is important to interject that I did not observe the level of disruption or off-task behavior that Jan described in our interviews. When we debriefed, I often shared with her that the instances she cited as extreme were usually cases of her students simply behaving as adolescents. Jan had a tendency to be incredibly hard on herself in her quest to be an excellent mathematics teacher, and I often found myself highlighting the positive aspects of her teaching. I would definitely underscore classroom management, even with her most difficult students, as one of her strongest qualities as a novice mathematics teacher, and because of this, she attended to mathematics identity in her instruction even when she was not aware of it.

It is important to note that our above exchange began with my question about how she built positive identity via motivation with her students in lower-tracked classrooms and evolved into Jan's concern with being pinpointed as the primary reason her students are unsuccessful on the standardized exam. The issues Jan raised are real and challenging. They complicate attention to mathematics in ways that I anticipated, just not at the magnitude that Jan expressed.

Summary of Jan's Case

Jan Dan's case is illustrative of the challenges of not only attending to mathematics identity, but also doing so as a novice teacher in a school district saddled with accountability pressures. Jan's no-nonsense teaching demeanor and strong teacher presence helped her negotiate norms, rules, and expectations that permitted her to attend to mathematics identity during instruction, a feat she had the most success in accomplishing when considering the practices of the other PNTs in this study. I would

characterize Jan's instructional style as a balancing act, wherein she found herself working toward open, student-centered instruction while still holding on to an incremental approach that she attributed to her earlier training as a pharmacist.

Jan's understanding of mathematics identity included all four dimensions of identity highlighted in this study. However, I also assert that Jan's particular attention to her students' mathematical ability influenced how she attended to the other three dimensions. I contend that Jan's emphasis on ability was informed by her history of academic success, family structure, and the prevalent accountability rhetoric she experienced as a new teacher in Griffin County Public Schools.

Jan's activity system was comprised of her experiences as the subject of her system as well as tools that helped her attend to mathematics identity in practice. Specifically, Jan's experiences with supportive teachers who stressed process over product influenced Jan's decision to replicate similar practices that attended to affect in her classroom. Jan also employed tools like adopting a student-centered, collaborative approach, taking a less evaluative approach to grading and feedback, and trying to stress effort over ability and speed. These tools aided her in effectively attending to mathematics identity in practice.

While Jan employed several tools that assisted her in attending to mathematics identity in practice, I also contend that certain aspects of her personal and academic experiences, as well as certain tools and rules impeded her ability to attend to it at the level that she desired. Additionally, Jan cited her students' diverse needs, talents, and abilities as challenges to attending to mathematics identity. I considered these obstacles

to be contradictions in Jan's activity system, in that they inhibited her from positively attending to mathematics identity.

In the next chapter, I present Carmen Laureta's case. Carmen and Jan share some similarities with respect to their upbringing and some of their understandings of mathematics identity. Further, both Jan and Carmen struggled with enacting identity-promoting practices in similar accountability milieus. Despite their commonalities, Carmen enacted identity-promoting practices were different than Jan's.

Chapter 5: Carmen Laureta

Carmen Laureta, a former culinary instructor who became mathematics teacher via MST-Res, brought a set of experiences to the classroom, which shaped her mathematics instruction, including her attention to mathematics identity. Of the three teachers in this study, Carmen was the most vocal in expressing her interest in exploring ways to attend to mathematics identity in her practice. Carmen was also the only teacher in this study who explicitly addressed mathematics identity through activities and discussions. Further, because she enjoyed the content of the summer seminar and wanted to know more, Carmen volunteered to co-teach it for the cohort of MST-Res teachers following her cohort. She became co-instructor of the course in the summer of 2013.

Carmen's case highlights the dilemmas teachers face when trying to honor their students' ideas and lived experiences while bridging their ideas to more mathematical ones. She saw this as an essential component to attending to mathematics identity. Carmen decided that in order to attend to mathematics identity in practice, she should focus on the nature of the tasks that she assigned during class. She explained that, in her opinion, attending to the nature of the mathematical tasks she created would also address the other three dimensions of mathematics identity highlighted in this study. Of the teachers in this study, Carmen created the most interesting and engaging mathematical tasks for her students. Some of these tasks and their relation to mathematics identity will be highlighted in this case.

Similar to Jan's conception of mathematics identity, Carmen's understanding was filtered through an ability lens. Thus, Carmen's attention to the nature of her tasks was highly influenced by how her students were labeled according to their standardized test

performance (e.g., Advanced, Basic, and Proficient), the mathematics courses in which they enrolled, and her positioning of them as capable or incapable based on the first two factors. As noted earlier, Carmen was the only teacher in this study who was teaching at a school that was being restructured by the State Department of Education. The Department of Education's supervision of Carmen and her fellow teachers' instructional practices also shaped how Carmen thought about the nature of her tasks through an ability lens. In other words, when thinking about Carmen's attention to identity in light of the mathematics identity framework presented, Carmen's desire to create rich mathematical tasks (the nature of tasks dimension) was filtered through how she perceived students' mathematical competencies (the ability dimension). Additionally, Carmen's conceptualization of identity included a belief that her attention to the nature of the tasks she presented would influence (a) how her students saw mathematics as important and useful to their lives and future endeavors (the importance dimension) and (b) how they persisted when working through difficult tasks (the motivation dimension).

Following a structure similar to Jan's case, Carmen's case consists of three primary sections: (a) a description of Carmen's mathematics-teaching persona, (b) her conceptualization of mathematics identity, and (c) her attention to mathematics identity via her activity system. In the first section of this chapter, I introduce Carmen and her teaching persona to give the reader a feel for Carmen, her instructional style, and her students. I also address Carmen's practice in a more subject-specific manner, in that I discuss her understanding of the nature of mathematics and highlight salient features of her mathematics instructional approach. Taking the information presented in the first section into consideration, in the second section, I will examine how Carmen

conceptualized mathematics identity and how I would characterize her understanding of it in light of the identity framework presented in this study. Finally, I will examine Carmen's attention to mathematics identity using Engeström's (1987, 1993, 2001) activity system. I will present data and build an argument about how each element of the system contributes to Carmen's attention to mathematics identity as well as the contradictions that arose between various elements in the system of activity.

Carmen and Her Evolving Mathematics Teaching Persona

After several passes of the data, Carmen's teaching persona emerged. Additionally, serving as Carmen's mentor teacher gave me a first-hand perspective on Carmen's evolving teaching persona. I found it important to address how Carmen's laid-back approach and attention to identity and affect led to mathematics instruction that elicited particular responses and behaviors from her students, responses and behaviors that sometimes interfered with her students' opportunities to learn. Further, it was informative to look at the data in a chronological fashion to see how Carmen's persona evolved from her first to second year of teaching. I assert that the advanced courses she taught in her second year of teaching were influential to the shifts in her teaching persona that I observed. Moreover, the shift in her teaching persona influenced how she attended to her students' mathematics identity in practice. The next section will provide a glimpse into Carmen's classroom, followed by data and interpretation that supports my claim of Carmen's shifting teaching persona.

A Glimpse into Carmen's Classroom

I visited Carmen's classroom one spring morning to observe her introducing the concept of functions to her first-mod Mathematics 8 class. The following conversation took place after she and her students reviewed the warm-up problems.

Carmen: Well, we talked in the warm up about an example of function. You guys know about functions. Have you heard the word? Thank you to the middle section [for behaving].

Students: Oh yeah...One time.

Kim: I know it's a pattern like adding, subtracting . . .

Marcus: Yeah, like subtract one and dividing . . .

Carmen: Ok. So, function has a rule.

Tamika: I went to a function. Like a go-go.

Tara: Yeah!

Carmen: Ok, so you go to functions every Saturday?

Tamika: Yes

Carmen: Ok. So it's something special . . . something unique
Tara, you went to a function?

Tara: I did.

Carmen: Ok, so, if you guys go to special functions every Saturdays. (long pause) Alright, soooo (exaggerated) this is a function machine. [Have] you guys seen this before? Can you see it? (To a group of boys engaged in conversation) Eyes up front (Classroom observation, May 4, 2012).

Consistent with Carmen's approach to teaching, she began this particular lesson with an attempt to assess her students' prior knowledge, and as it often happened, her students responded in unique and unanticipated ways. In an interview that followed this lesson, Carmen shared that she was expecting her students to reference things about functions that they had learned in earlier grades. Instead, a few of her students drew on a more everyday use of the word *function*. Tamika and Tara referenced their recent trip to a social function, specifically they mentioned attending a go-go, which is a party where go-go music, a style of music that incorporates live instrumentation and heavy percussion that is specific to the school community's geographic region, is played. This was not the first time I witnessed Carmen handle this type of situation during a lesson. Carmen consistently built lessons around her students' interests and experiences, and because she was open to incorporating her students' ideas and perspectives, she sometimes wrestled with the tensions associated with bridging her students' everyday understandings to more mathematically focused ideas.

Carmen's Approach to Teaching Mathematics

I would describe Carmen's approach to teaching mathematics as laid back. She was incredibly respectful of her students, rarely raising her voice, always trying to integrate multiple perspectives, and usually trying to seek out ways to encourage on-task behavior without embarrassing her students. She often facilitated her lessons in a conversational fashion. As she noted in her summer portfolio: "I'm a strong supporter of open interpersonal communication" (Summer portfolio, August 2011). At times, her laid back approach contributed to the busyness, and sometimes chaos, of her classroom, as it was always abuzz with her students' on- and off-task behavior. Carmen and I

collaborated during her first year of teaching to create an environment conducive to learning mathematics. We spent a fair amount of our time together discussing how to harness her students' energy and direct it toward productive mathematical activity.

While Carmen struggled with classroom management during her first year of teaching, she was successful at carefully and thoughtfully creating mathematical tasks for her students. Carmen often included opportunities in her lessons to learn more about her students' feelings and personal experiences, both related and not related to mathematics. She used this information to create context for word problems and to create mathematical tasks. Additionally, because Carmen expressed the desire to give all of her students some access to the content, she asked them to write observations about what they saw or thought about as they engaged in mathematics tasks. The responses varied from making impressive mathematical conjectures to expressing everyday and commonsense ideas that were not easily relatable to the mathematics content that was at hand. Carmen and I spent some of our time together discussing how to bridge her students' responses to the mathematics she wanted them to learn.

Despite the frequent admonishments to her students regarding their behavior, Carmen presented mathematics lessons that were creative and relevant to her students' lives. As we continued to work together and use the Mathematics Identity Planning template, she began to create tasks that gave her students more mathematical authority and agency. Carmen noted that most of her early mathematics experiences were filled with teaching that prioritized rote memorization. She also noted that she had experienced success with this style of instruction. However, after taking mathematics methods

courses as a part of the MST-Res program, Carmen acknowledged that her students needed a different instructional approach. She shared,

[I'm] always trying to remember how I learned it and how Mrs. Smith, my eighth grade teacher, taught it...but I'm like, 'Oh, I can't teach it that way!' because, it's [sic] just different kids. [Ms. Smith] taught it very rote, and it made sense to me, but if I try to teach that way to these kids then it's just not possible (Interview, March 23, 2012).

With this in mind, Carmen sought out and created tasks that were in contrast to the type of mathematical activity that was most familiar and comfortable to her.

After spending time in Carmen's classroom, revisiting her summer seminar portfolio, and analyzing her observational and interview data, I contend that because Carmen spent a considerable amount of her energy attending to her students' social and academic identities and their affect, she built very strong interpersonal relationships with them, which helped her attend to their mathematics identities. It was evident in observing student-teacher interactions that Carmen's students admired her. They opted to visit her during classroom lunch instead of going in the cafeteria. They sought her out when they were supposed to be in other teachers' classes. While she had won their admiration, Carmen had to work much harder at garnering their attention and focus during mathematics instruction. This was an ongoing challenge that we revisited throughout her first year of teaching.

When I began collecting data in the fall, I observed a noticeable shift in Carmen's approach and demeanor. Carmen exhibited a level of withitness (Kounin, 1970), "a keen awareness of what is going on in [the] classroom," whereby a teacher "makes students

aware that she knows what is going on as though she had the proverbial eyes in the back of her head” (Snoeyink, 2010, p. 101), that was not apparent in her first year of teaching. She also expressed a greater level of confidence regarding classroom management and content. When debriefing with Carmen during an interview, she alluded to the fact that besides having more confidence because she was teaching content that she had taught during the previous year, she also attributed some of her confident teacher presence to teaching more advanced courses to students she identified as her “high-performing kids” (interview, October 26, 2012).

Despite the shift in her teaching persona, Carmen’s commitment to using her students’ ideas and lived experiences as a central component to creating tasks remained consistent. Below I describe how her commitment to leveraging her students’ experiences and ideas sometimes coupled with her issues regarding classroom management complicated the work of mathematics teaching and, more specifically, her attention to mathematics identity. This will be detailed using an activity theory framework as highlighted in earlier chapters.

Carmen’s System of Activity

Carmen’s attention to mathematics identity in practice will be examined via system of activity (Engeström, 1987; 2001). Though all of the elements of the system share reflexive relationships, I will focus on how I interpreted each element of Carmen’s system of activity influencing her attention to mathematics identity based on how she understood it. Thus I will explore how each element influenced the object of the activity system. The elements of interest are: (a) Carmen’s personal and academic experiences, including her understandings about the nature of mathematics and mathematics identity

and notions of smartness and success in mathematics (subject); (b) her instructional moves, considerations during planning, and tasks (tools); (c) Carmen and her students (community); (d) and the district and school-level forces rules that govern her classroom (rules). Note that while these elements influence the object of the system, I used dashed lines to represent the tensions i.e., *contradictions* (Engeström, 2001) between elements of the system and the object of the system, Carmen's attention to mathematics identity.

Figure 6 highlights the elements of the activity system that I will refer to in the following subsections.

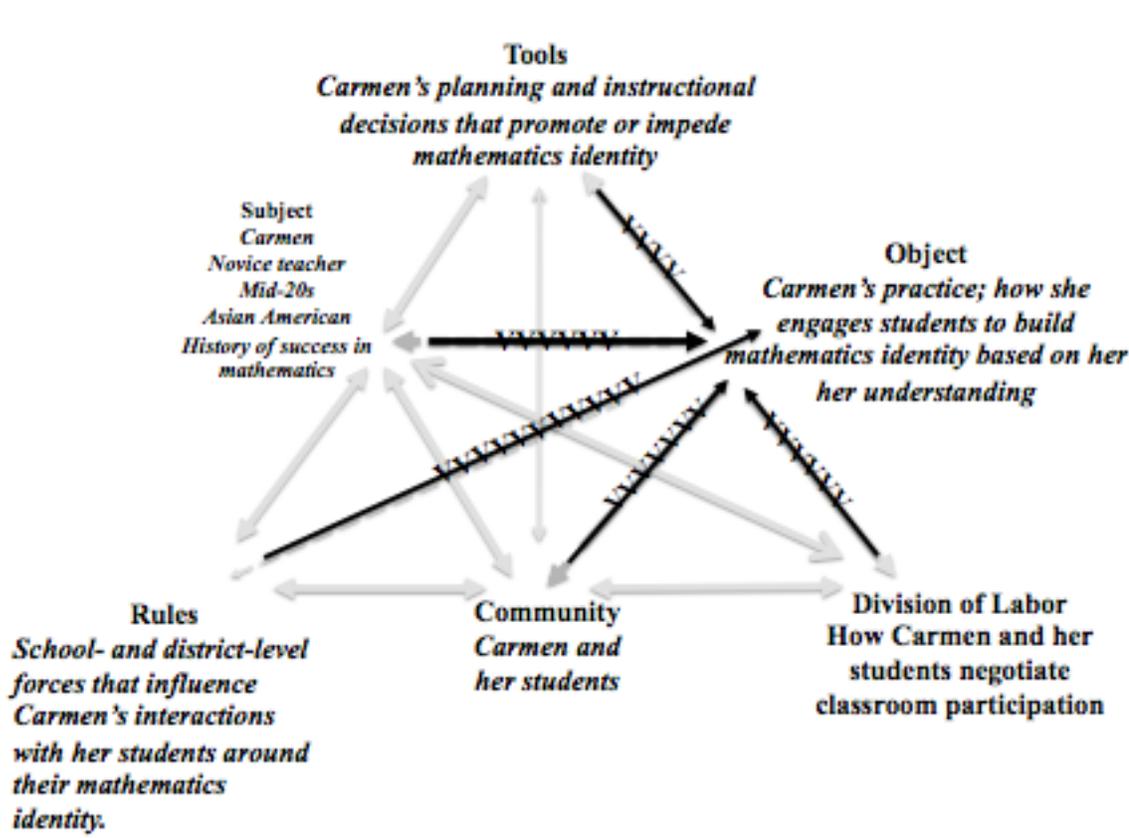


Figure 6. Carmen's Activity System

Carmen As the Subject of Her Activity System

Carmen's personal experiences were influential to how she positioned her students and attended to mathematics identity in practice. As I analyzed Carmen's corpus

of data, I coded for salient personal experiences, both academic and non-academic, that influenced her understandings of the nature of mathematics and mathematics teaching and learning. The pieces of Carmen's experiences that I present below serve to give the reader a better understanding of Carmen as a person who brings unique in- and out-of-school experiences to her teaching and attention to mathematics identity.

Salient personal and academic experiences. When asked about her background, Carmen immediately began to talk about growing up in a small Mid-Atlantic town and being one of the few students of color in a predominately White community. Carmen identified as a Filipina who was born in the Philippines and immigrated to the United States with her parents when she was a toddler. Carmen recalled being the only person of color in her community, but did not express a feeling of being maligned because of her differences in way that the other teacher participants in this study did. She noted:

I only noticed it when kids would point out that I don't look the same as them or if they would ask me what I am. Other than that I never really, like, felt like I was different until I someone pointed it out (Interview, March 23, 2012).

Instead of highlighting the racial and cultural differences between she her peers, she noted that she felt "the same" as them in terms of class. As the daughter of a mother who earned a chemistry degree and a father who had taken some college courses, Carmen noted that her family, via her parents' ownership of a chain of local restaurants, was comfortably middle class. Thus, Carmen pointed out the unifying experience between her and her classmates, her similarity in socioeconomic status.

Carmen noted this similarity with regard to class and social status in her interview, but upon revisiting her summer portfolio, I discovered that she was candid with respect to how race shaped her perceptions of herself as a mathematics learner. She wrote:

My peers and teachers continuously noted me as the Other, and this affected the shaping of my identities. I was marked as different – I was often asked to share information about my culture and language, mainly because I was one of very few non-whites in school. In alignment with Steele’s perspectives, my race ultimately influenced and coordinated how I was judged and treated (p. 112). Furthermore, I felt I was expected to excel in mathematics, solely based on my race and its relevant academic stereotypes; this form of stereotype threat was added pressure and another challenge to manage, in addition to racial and cultural differences (Summer portfolio, August 2011).

In this excerpt, Carmen cited Claude Steele’s stereotype theory, a theory whose premise is that a student’s performance can be significantly influenced by the mere suggestion that she is expected to confirm the stereotype that she will fare less successfully than their counterparts of another race, nationality, gender or other demographic. While I would not characterize Carmen’s experience as stereotype threat, because her peers probably expected over- rather than underperformance from her based on her Asian-American ethnicity, it does highlight the salience of race and ethnicity in her academic experience. Distinct from her response during our interviews, she acknowledged the role of race and the pressure to live up to the “model minority” (Lee, 2009) stereotype often projected upon her by her classmates.

In spite of experiencing feelings of otherness and what she believed to be stereotype threat, Carmen described having rather successful mathematics experiences in elementary and secondary school. Reflecting on her youth, Carmen stated that she considered herself a good student and, in particular, a good mathematics student. She reminisced about successful moments such as being the first person to finish timed tests that drilled basic operations. In her summer portfolio, she noted:

In third grade, my major goal was to successfully pass the timed division test (correctly answer 100 division problems in 90 seconds) in order to be first in my grade to complete all four timed operations tests. In this specific goal-oriented situation, I engaged with mathematics in a manner that helped me acknowledge that I was *capable* of learning mathematics (Summer portfolio, August 2011).

Carmen's reference to a goal-oriented situation is related to Anderson's (2007) theory of the four "faces" of mathematics identity. In this instance, she was pointing out that because she had a goal that was important to her, she viewed mathematics as aligning with her interests. This is what Anderson would call the alignment face of mathematics identity. Despite this success, she noted that she faced some struggle once she began middle school. She noted "balancing equations. . . didn't make sense to me . . . I think that's when I would be frustrated, and I remember being upset a lot" (Interview, March 23, 2012). Carmen sought the help of her mother, who she viewed as a "math person" when she needed help. Carmen described the experience as being filled with "a lot of screaming, and it was not helpful" because her mother would get frustrated (Interview, March 23, 2012).

However, with the exception of some struggle with learning to solve equations in middle school, Carmen recalled being rewarded by her teachers, particularly her secondary mathematics teachers, for excelling in their courses. Carmen also recounted feeling pretty successful in high school. She noted that she was an honors student who opted not to take calculus in her senior year and instead took AP Statistics. She shared that statistics was confusing to her because she was trying to do it in a procedural way, the way that had led to success in her other mathematics courses, but it did not work in that course. Carmen's distinction between procedural and conceptual mathematics was prevalent throughout our discussions, both about her learning experiences and how she approached planning instruction for her students.

Path to teaching mathematics. Carmen brought various experiences across several disciplines to her mathematics classroom. Upon graduating from high school, Carmen transferred to several colleges and finished her degree at a prestigious college in the Northeast. She began college as a business major, but discovered that she really did not like it "because it was just very procedural. I was just memorizing everything" (Interview, March 23, 2012). She graduated with a degree in communications and began her career working for a nonprofit organization that supported substance abusers that was located in the same city as her alma mater. She led the nonprofit's training division where trained social workers to work with clients suffering from addiction. Upon leaving this job, Carmen began doing communications work for another nonprofit organization that promoted culinary arts skills in her local urban public school system. After resigning from this position, she returned to her mid-Atlantic hometown and accepted a position that changed her career trajectory, managing a small farm that hired adjudicated young

men in the hopes of teaching work and life skills. At the same time, she also began teaching culinary classes at a local private school. Finding satisfaction in both teaching culinary skills and working with young people, Carmen knew that she needed to make some decisions about her future career plans. During our first interview, she mentioned that when her mother was younger, she, too, had aspirations to teach, but she did not pursue them because her father (Carmen's grandfather) discouraged it. Below is an excerpt from our conversation about her choice to join the MST-Res program:

Carmen: I felt like I had two options at the time. I could either go to culinary school or become a teacher. I felt like those were my two paths, but I knew I had to get some higher education for both of them. And then, I opted for being a teacher.

Toya: So what was the big deciding factor?

Carmen: I think it was...Well, there's a few things. I felt like I didn't really need to go to school if I wanted to pursue something in the culinary field. But, if I wanted to pursue something in teaching I would have to go back to school. Also, I remembered when my mom was my age she wanted to be a math teacher, but my grandfather said, "No, you're not going to make a lot of money." (Laughs) I was talking to my mom about my two different options. And then, she and I discussed which benefited me more, like education-wise, with going back to school for teaching as opposed to [culinary arts].

With the suggestion of her mother in mind, Carmen looked into residential teacher programs and opted to join MST-Res. One reason she cited for choosing MST-Res was the similarities between the students she teaches and the students she worked with at her other jobs. She used the labels such as “at risk” and “low income” to describe the students she worked with in the adjudicated youth program, and also hesitantly used these terms to describe her students at Booker T. Washington Middle School.

When I listened and analyzed Carmen’s sharing of salient personal and academic experiences, I found her language choices telling of other issues of identity and positioning. Carmen’s positioning of others as “mathematics people” or labeling her students as “at risk” proved to be important to how she constructed her students’ abilities and competencies as well as how she positioned them to participate in mathematical tasks. Her use of language was instrumental in my analysis regarding how she conceptualized mathematics identity.

Carmen’s perception of herself as a “mathematics person.” While developing into a talented mathematics teacher, Carmen readily admitted that she did not see herself as a mathematics person. In fact, she shared that the company she surrounded herself with often determined how she perceived her mathematical competency. Among the students in her methods classes who had majored in mathematics and when in the company of her mother who was a chemist by profession, she struggled to see herself as a “math person.” However, among friends, Carmen stated that she felt like a mathematics person and her friends corroborated this description of herself:

- Toya: I think I hear you saying it sort of depends on where you are, whether you see yourself as a math person or not . . . because you said, “When I tell my family, they're like, math?”
- Carmen: Yeah. When I tell my family, they're like, “Math?” Then they give me that look, but with my friends it's like, “Oh okay.” It's different.
- Toya: Oh, okay. It's different? Uh huh . . . Right, because your mom is a chemist? She's in chemistry right?
- Carmen: Yeah. She's a *straight up math person* (Interview, March 23, 2012, italics added for emphasis).

In this brief exchange, I interpret Carmen, like Jan, to have concretized what it means to be a mathematics person. This interview occurred early in the data collection process, however her language choices with regard to ability were prevalent throughout all of her interviews.

As far as returning to school and learning more mathematics, Carmen found her first methods course, which emphasized middle school mathematics topics, as “easy to get into” (Interview March 26, 2012). She enjoyed the course because it covered material that she liked and was successful with when she was a middle school student. She also noted that the rote methods her mathematics teachers used with her as a student did not fare as well with her students because her students were academically, socioeconomically, and culturally different from her and her peers. She credited the MST-Res summer methods courses with giving her new ways to think about providing conceptual understanding for her students.

While she enjoyed both her summer and fall methods classes and found them challenging, she preferred the writing portions of the courses and courses that did not necessarily focus on mathematics. She explained that she shut down in her fall methods course at times because the “math people” (interview, March 23, 2012), meaning her methods classmates who had majored in mathematics or had stronger mathematics backgrounds, sometimes made her feel intimidated or less knowledgeable. In reference to being a mathematics person in this context, she noted: “And then . . . I don’t see myself as a math person, because it takes me – I have to sit and do math to really feel, like, comfortable with it.” Additionally, some of the material in the second methods course she found to be a far stretch from what she was teaching, and ultimately, not helpful to her practice. When seeking help in her classes, she shared that she usually worked with someone else in her cohort for help.

While I coded other instances in the data that were related to how Carmen perceived her own mathematical competency, I chose to share the excerpts above for three primary reasons. First, they highlight how positioning with respect to mathematics identity is not just prevalent in student-teacher relationships. Teachers are subject to positioning as well, and often their positioning influences their practice (Ma & Stinger-Gabell, 2011). Carmen negotiated her mathematics identity in spaces within and outside of the mathematics classroom. Carmen’s negotiation of her mathematics identity influenced how she engaged with her students with respect to theirs. For instance, Carmen always looked for ways to highlight and honor her students’ differences within her lessons. Upon reflection of how she succeeded in mathematics, she realized that she

would have to provide her students with mathematical experiences that were vastly different than her own middle school experiences.

Second, Carmen reference to her mother as a “straight up math person” and calling some of her peers in her fall methods course as “math people” suggests that she accepted the social construction of “mathematics people.” In other words, she assigned particular meaning and importance these labels. She discussed how her identity as a math person shifted because she had to “sit and do math” to feel comfortable, and implicit in this statement is the notion that those who are successful in mathematics do not have to necessarily work at it. It was interesting to juxtapose Carmen’s notions of her self as a mathematics person with how she responded to identifying and classifying her students as mathematics people, which will be discussed later in this chapter. Related to being positioned by others as mathematically competent, it is also interesting to note that when I asked Carmen to highlight instances of feeling like a mathematics person or exhibiting mathematical success, she immediately referenced moments of external validation, i.e., being acknowledged as the fastest in a mathematics game or having her middle school teacher give her extra time and attention based on her mathematics ability.

Third, Carmen’s understanding of her mathematics competency and notions of smartness in mathematics help to shed light on how she understood the nature of mathematics. Over time, and partly due to working with a skilled methods teacher, Carmen saw mathematics as a subject that was not merely procedural and step-by-step. She acknowledged that her students’ success was dependent upon taking up new ways to present mathematical ideas that presented mathematics topics as connected and relevant to lived experiences instead of being steeped in recitation and memorization.

As discussed in Chapter 4, salient personal and academic experiences often influence mathematics teachers' approaches to teaching (deFrietas, 2008; Leonard, 2006). I assert that Carmen's personal and academic experiences influence her teaching practices. Carmen expressed awareness with regard to her positioning as a mathematics learner by others, including family members and classmates. In her own teaching, I watched Carmen evolve into a teacher who, over time, reflected about issues of positioning and the messages she sent her students via the tasks she selected and facilitated. Additionally, Carmen acknowledged that much of her success in mathematics was due to her ability to memorize procedures and excel at computational mathematics. As she experienced mathematics in a more conceptually-driven manner in her methods courses, she made an effort to integrate more student-centered, conceptually-rich tasks in her own instruction, which in and of itself sends students messages about their mathematics ability. Carmen's desire to teach in this manner required us to spend time during our mentor-mentee meetings unpacking mathematical ideas so that she could present lessons that went beyond showing students how to do procedures.

In relation to building mathematics identity, I view Carmen's personal experiences of being seen as "other" as central to her desire to understand her students as young people *first* before engaging in mathematical content. Examples of Carmen's commitments to understanding her students will be presented as I highlight the tools she employed within her activity system. Further, Carmen's reflections about her feelings of otherness led her to think of ways to honor her students' realities and develop mathematics tasks that were inclusive and accessible. Moreover, her feelings of being different were influential in her consideration of more affective dimensions as essential to

teaching mathematics. In all, Carmen's personal experiences and perspectives led her to engage in identity-building practices in her teaching in particular ways.

Carmen's understanding of mathematics identity. Using the coding and analysis procedures outlined in Chapter 3, in this section I present quotes and classroom episodes that reflect evidence that support my construction of how Carmen was conceptualizing mathematics identity at the time of this study. First I will highlight how Carmen described mathematics identity to me. During our interview sessions, Carmen described what she thought attending to mathematics identity in a practice should look like, strategies that teachers could employ to attend to it, and instances from her own practice that she believed exemplified attending to the mathematics identities of her students.

Defining mathematics identity. At several points during the course of the data collection period, I asked Carmen to concisely define or explain what mathematics identity meant to her. Of the teachers in this study, Carmen's expressed the most content-specific understanding of mathematics identity. She chose to define the term by explaining how she thought I used the term: "The way I feel that you are [using] it is like having the idea of multiple entry point for students of all levels." (Interview, May 4, 2012). She further elaborated that she thought of attending to mathematics identity as having openness in her lessons and giving all of her students an opportunity to participate. In her words, "I like for everyone to have a say" (Interview, May 4, 2012).

I would summarize Carmen's understanding of mathematics identity as giving students access to conceptually-rich tasks that account for their lived experiences and interests, which in turn influenced their motivation and how they saw mathematics as

important to their lives. Like Jan, Carmen's conceptualization of mathematics identity included all of the dimensions of the mathematics identity framework presented in Chapter 3, but her understanding also emphasized the ability dimension. Figure 7 represents how I understood Carmen's understanding of mathematics identity during this study. Carmen referenced all four dimensions of the mathematics identity framework, yet her discourse, particularly with regard to lesson planning and task facilitation, was permeated with references to ability. Carmen was careful to plan lessons that drew on students' ideas and interests, but she filtered this work through a lens of their ability that was rooted in how her students were assigned to particular courses as well as their standardized assessment performance. When analyzing across Carmen's coded data, it appeared that most of her statements that I coded as attending to the nature of her tasks, I also coded with an ability code, which indicated that she was using ability language or her statement suggested some tacit understanding about student ability. Thus, I see Carmen's gear system as being driven by both ability and the nature of her tasks.

Carmen's perceptions of being smart and succeeding in mathematics. Because I claim that the nature of Carmen's task selection and facilitation was rooted in her perceptions of ability, it is important to examine her perceptions of student smartness and success in mathematics. Carmen, like Jan, often slipped into what I would call ability-based deficit language when discussing her students' actual performance. Because I spent an incredible amount of time with Carmen, I believe that her language choices around ability were often tacit and unexamined, which is a typical phenomenon among mathematics teachers in test-driven contexts (Ellis, 2008; Horn, 2007).

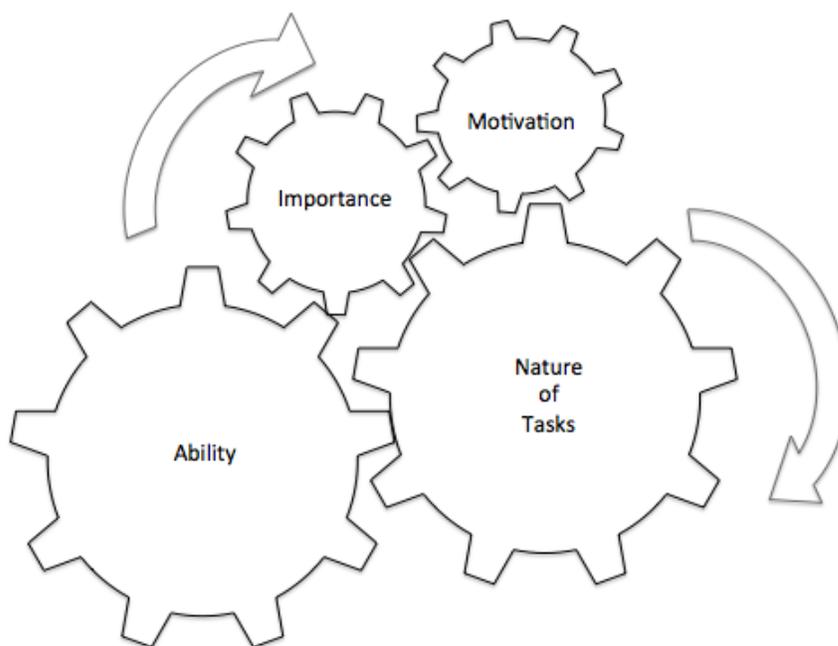


Figure 7. Carmen's conception of mathematics identity

Further, watching Carmen in action with her students and collaborating with her, I also assert that she had no ill intent with regard to how she positioned her students based on their ability. She struggled to re-conceptualize ability during our time together, though I believe that the demands of teaching and testing sometimes shaped her language choices. Throughout our time together, I observed Carmen try to make sense and balance the tensions between what it meant for her students to be successful and the prevalent performance- and achievement-based notions of success that are more readily accepted in schools.

In our first interview, I presented Carmen with the following prompt: “A successful student in Ms. Laureta’s class is . . .” she responded, “Is a student who puts in effort, but a certain type of effort” (Interview, March 22, 2012). Note that her description of a successful student lacked any reference to achievement or performance. However,

when she further expounded, she acknowledged that her successful students mostly received As or Bs in her class. When asked if her perception of what characteristics make a student successful had changed since she began teaching, she replied, “I think so.” She went on to explain that during her first few months of teaching, she thought that successful students would be those who understood things the way that she explained them:

Well, first it was starting as a teacher, I thought a successful student had to understand everything that I say and the way that I say it or present the content, and they would have to get it right away. I was like, oh, that's success. But now it's like, no matter how long it takes them if they get it on their own pace, I consider them successful (Interview, March 23, 2012).

Somewhat concerned that Carmen was responding in a manner that she thought I would find pleasing, I decided to push her thinking:

Toya: So, would a kid with a D in your class be considered successful?

Carmen: Well...(nodding her head)

Toya: You're nodding your head [as if to imply] “Yes.” Why?

Carmen: Um, because . . . Well, I guess it depends on what kind of D [they're earning]. If they're putting in the effort to turn in work, see me after class, and call me over during class, and they still get a D, I still think that maybe they're successful. Maybe they're just not the best student in math, but if they're getting a D because they don't really care, then I don't see that as successful (Interview, March 23, 2012).

In Carmen's data set, I flagged this exchange as one of note. While the fact that Carmen would be open to looking beyond grades to position her students as successful based on their effort is promising, her conclusion that earning a D could indicate success is also troubling. In particular, this is troubling because of the consequences that students who are not traditionally successful face in her school district, including being tracked into low-level courses and failing the standardized assessment administered at the end of her course.

Carmen's dimension of interest: Nature of tasks. From the beginning of this study, Carmen stated that she was interested honing in on the nature of tasks dimension of mathematics identity. The conversation below took place during our first interview:

Toya: So, if you were going to think about an identity dimension to attend to . . . You have ability. You have importance of math. You have the kind of tasks you create. You've got motivation. I don't know which of these four would appeal to you the most, but . . . (voice trails off)

Carmen: I think the task one . . . to help them build their identities
(Interview, March 23, 2012)

Carmen went on to share how she initially wanted to address motivation but opted instead to explore mathematics identity by looking at the nature of her mathematics tasks:

I wanted to choose motivation because I feel like a lot of the kids struggle or don't have any type of motivation, but I feel like the tasks – and we learned this in your class over the summer – how like everything is tied together. So, if there's a task

that they don't really care about, then they're not going to be motivated to do it (March 26, 2012).

In the excerpt above, Carmen expressed that if she created and facilitated meaningful tasks, then other dimensions, like motivation, would be attended to as well. She referenced the summer seminar as influential to her adopting this line of thinking, where we often talked about creating engaging tasks and facilitating them in ways that minimized the amount of classroom management that was necessary during instruction.

After some collaborative lesson planning, I prompted Carmen again about how she understood attending mathematics identity via the nature of mathematical tasks:

Toya: If you were watching a teacher create tasks and you said, “Wow, this teacher is really attending to her kids’ identities as she plans theses tasks,” like, what kinds of things would he or she be doing?

Carmen: I guess one of them would be – the hardest thing is the cultural context part of it, but its also like, for example, if we're doing functions and we're introducing them through the example of a pizza delivery person. Yeah, it’s pizza. That's one thing [that students can relate to], but what else about [the problem] makes it relative to the students? . . . I mean, like, there’s kids who can relate to pizza, but is that necessarily understanding who the kids are [in terms of] their identities? We talked about this a little bit in Dr. Harmon’s class, too (March 26, 2012).

During our exchange, Carmen acknowledged that part of creating tasks with identity in mind involved taking students’ cultural backgrounds into consideration. In the summer

seminar, the MST-Res PNTs and I pushed ourselves to go beyond equating culture simply to race or ethnicity. Additionally, Carmen discussed about how the professor who taught her diversity class, Dr. Harmon, also wanted the PNTs to think beyond superficial notions of culture as they interacted with their students. In the above exchange, Carmen explained that considering students' cultural contexts was important to planning with identity in mind; however she wondered if putting a mathematics problem in a familiar context was enough to say that a teacher was considering her students' cultural contexts and identities.

Carmen's experiences as the subject of her activity system both promoted and constrained her ability to enact positive identity building practices. Her personal and academic and experiences, construction of mathematics identity through an ability lens, and interest in creating tasks that would impact students' mathematical identities are all salient components to understanding Carmen as the subject of the system of activity. I contend that her understanding of herself as an Asian-American mathematics learner and her experiences of being othered and the shifting nature of her perception of her mathematical competency provided her with a certain awareness of and attention to affective dimensions of learning mathematics such as mathematics identity. In contrast, similar to Jan and her conception of mathematics identity, Carmen's understanding of mathematics identity emphasized ability, which impacted her lesson planning and classroom moves, thus influencing the ways in which she attended to mathematics identity. Her point of view as the subject provides the point of view by which I will unpack the other elements of the system of the activity in her classroom as it pertains to mathematics identity.

The Community

In this study, Carmen and her students comprised the community and interacted to negotiate mathematics identity construction. As noted earlier, I had the opportunity to observe Carmen as a first year teacher, teaching primarily on-level (as categorized by the school) and inclusion classes. A special education teacher co-taught the inclusion classes, and an assistant who was provided due to Booker T. Washington's turnaround status helped in her on-level courses. I then had the opportunity to observe her with her honors class in the fall of 2012. As with Jan, I believe having the opportunity to observe Carmen interact with students' who had varying academic needs, talents, and abilities provided me with a more comprehensive understanding of how she conceptualized mathematics identity through an ability lens and enacted practices according to how she positioned her students based on her understandings of ability.

In the spring of 2012, Carmen characterized her students' perceptions of themselves as "slower because there's more people to help them" (March 26, 2012 interview). She shared how her students, both on-level and inclusion, saw having an additional teacher in the classroom as some indication that they were not as advanced as other mathematics classes. However, Carmen believed that the assistant was there for her because of inability to raise her students' low benchmark scores that administration used to forecast standardized test success. In terms of her courses designated as "on-level," she cited other instances that she believed influenced their negative perceptions of themselves as learners and doers of mathematics:

More recently, a lot of [my students] have been asking me like what kind of math class this is and what is the math class called. And I say, "Math 8." And they're

like, “Well, what's Math 8?” And I say something like, “Well, its a mix of algebra, pre-algebra and geometry.” Today Trenise saw an algebra book and she was like, “Why aren't we doing any work from the algebra book?” And I was like, “Well, we're doing some algebra.” The kids know whether they're in an honors class or a straight up algebra, geometry class (Interview, March 26, 2012).

This excerpt is interesting to note because Carmen’s students are thinking about their mathematical ability based on a structural issue of tracking rather than a particular message that Carmen was sending in her teaching.

In marked contrast to Carmen’s Spring 2012 students, she characterized the honors students in the fall of 2012 as having a positive collective mathematics identity. She described them as follows:

The honors class will ask me things in return, like, um, the term you guys use is pushback. So I get more of that with the content with the honors class versus the other classes. Like, if I just tell them something, or we discuss something, they won’t ask further questions about it. They’ll just believe, like, just what we discussed and be fine with it. . . . Like, I feel like with the honors class, I feel like they do care about their education more. And then, they’ll be more into whatever we’re doing. With the other classes, I feel like it’s – they care to the point where they’re passing a class (Interview, October 26, 2012).

In addition to the statement made above, Carmen also pointed out that her honors students had different personalities from the students in her lower-tracked classes. For instance, she mentioned that they understood sarcasm and subtle humor in ways that her other students did not. Carmen’s characterization of her honors students’ mathematics

identity includes both mathematical and non-mathematical descriptors. While Carmen explained that her honors students were more willing to challenge ideas during mathematics class (i.e., pushback), she also noted that these students seemed to care more about their education and the mathematics tasks she presented. Absent from Carmen's description of her honors' students' collective identity is an awareness of her role in how her students learn to engage in class, i.e., how she promotes or inhibits her students' pushback during class. Further, Carmen's description of her students' collective mathematics identity is comprised of non-academic descriptors such as their sense of humor and care about their education has been highlighted as problematic when helping students develop positive mathematics identities (Varelas, Martin, & Kane, 2013).

Just as Carmen assumed that some people are simply "math people" when talking about her mother and her fellow classmates, she also identified some of her students as "math kids," based on "the way that they carry themselves in math class" (Interview, March 23, 2012). When probed by what she meant by this term in the Spring of 2012, she explained that some of her students were predisposed to do well in mathematics despite the fact that they didn't necessarily "get it" all the time. Questioned further, Carmen elaborated that she saw them "kind of getting it" but that their final product did not necessarily match what she thought they should know, but noted, "I don't worry about in terms of understanding it because I know they'll get it eventually" (Interview, March 23, 2012).

After analyzing Carmen's perceptions of her students in different academic tracks, I contend that Carmen's teaching assignments influenced how she characterized her students, as she was responsible for more lower-tracked students at the beginning of

the data collection period. As Carmen and I collaborated about her lessons and used the mathematics identity planning template, Carmen's thinking regarding who she deemed a "math kid" began to shift. Carmen began to think about students in terms of their status based on perceived mathematics ability instead of simply thinking about their perceived capacity to do mathematics. Additionally, she began to think about how the nature of her tasks would influence the participation of students varying status.

Carmen's Tools

Tools mediate the object of activity in an activity system. In Carmen's case, her lesson planning and instructional decisions are the primary tools that I will highlight with respect to how they mediate the object, her attention to her students' mathematics identities.

From the onset of the study, Carmen suggested that she focus on the nature of her tasks. Singling out Carmen's attention to the nature of her tasks without also noting how the other dimensions of identity were also embedded in her planning and practice proved to be difficult, in particular regarding issues of ability. Carmen's planning decisions and approaches to teaching were laden with perceptions of ability that both promoted and impeded her students' development of positive mathematics identity. Thus, I will highlight how Carmen used her tools to attend to mathematics identity more broadly. Her tools included (a) making sense of her students' ideas and bridging them to more mathematical understandings, (b) considering her students' lived experiences, and (c) creating tasks that explicitly addressed mathematics identity.

Tool: Making sense of and use of her students' ideas. During instruction, Carmen strived to honor her students' ideas and to find mathematical reasoning in them.

Upon analysis of Carmen's interviews, observations, and artifacts, I contend that Carmen made sense of and used her students' ideas in two primary ways, through honoring student observations and by allowing for multiple entry points in the mathematical tasks she assigned them.

The following exchange took place at the end of the same class that I described at the beginning of Carmen's case. She and her students began the lesson with a warm-up where students had to provide their own definitions of the term function. After accepting a range of mathematical and non-mathematical definitions, Carmen and her students discussed functions more formally. Carmen explained functions using the commonly used function machine example. She provided her students with a more formal definition of function, discussed how to evaluate functions given specific values for x , and introduced four ways to represent them (words, graphs, equations, and tables). The following excerpt comes from the last 10 minutes of class during this lesson:

Carmen: So what I'm going to ask you guys to do for the next 8 minutes, very quietly, because you need time to think – I am going to ask you to complete the three observations. Define the function in your own words. It does not have to be perfect; just give what you think it is based on what we've done.

Student: So you want us to . . . (Voice trailed off.)

Carmen: Define it in your own way. I want to know what it means to you.

This short excerpt is important in that it highlights Carmen's attention to her students' sense making. Carmen had provided her students with a formal definition of function earlier in the lesson; however, Carmen was more concerned with how her students

understood the concept, rather than if they could recite the formal definition back to her. After about 8 minutes elapsed, Carmen called the group back together for whole group discussion and a summary of the lesson for the day.

Carmen: Wait, because this part is very important. I want to hear some definitions of what a function is. I'm going to hit up Kayla, Brittany B., and Marissa. Ok . . .

Kayla: It's a get together

Carmen: Ok. A function in a non-math way is a get together. So it's something special. Good. Brittany?

Brittany: It's an equation that has a rule.

Carmen: So, it is an equation that has a rule. Calista, I want you to add to what Brittany B said. Ok, Calista. Nice and loud please.

Calista: A function is when you put in an input and you use the rule to find the new output.

Carmen: Good! So a function is . . . Say it one more time please.

Similar to the opening of the lesson, Carmen still accepted her students' everyday understandings of terms that held mathematical meaning. Despite defining functions and looking at their multiple representations, one of Carmen's students still defined a function as "a get together" at the end of the lesson. This was not the first time I witnessed this everyday use of mathematics terminology in Carmen's class, nor was it the last. When possible, Carmen tried to bridge their ideas to more mathematical understandings, but it was not always as easy as she hoped it would be. While I see Carmen's openness to her

students' ideas and observations, I also see this as a contradiction to Carmen's attention to identity, which will be discussed later in the chapter.

One of the prominent features of Carmen's attention to her students' mathematics identities was the space that she made for student observations during instruction. Sometimes these observations were made aloud during classroom instruction, like in the example provided at the beginning of her case. At other times, students wrote their observations on handouts that she created to accompany her mathematics tasks. Carmen would create task sheets, and in the margins, she would create a separate section titled "Observations" where student were instructed to write ideas that came to them as they worked or questions they would like to ask during the whole-group discussion. Carmen saw these observations as providing multiple entry points to her students. She likened them to opening a lesson with a math talk, a pedagogical strategy that she learned about at the annual National Council of Teachers of Mathematics conference. Carmen explained:

The example that [the presenters at the conference] used was a picture of ducks [arranged in] rows and columns and maybe there were, like, thirty-five ducks.

And then so the question was like, "How could you find how many total ducks are in this picture?" And then [participants provided] different answers like, "Oh I would find the area of the rectangle of the picture." Or, "I would group the first two columns together and just like count them this way" and so on. That offers, like, multiple entry points (Final Fall 2012 Interview)

Hearing Carmen's explanation, I returned to how she saw this being implemented in her classroom.

- Toya: Mm-hmm. So math talks remind you of your observations?
- Carmen: Yes, the observations. That is why I work with math talks.
- Toya: And so one thing we talked about working on was how to take their ideas [from the observations] and connect them back to mathematics or push them to think mathematically.
- Carmen: Yeah (Interview, May 4, 2012).

While Carmen saw her observations as comparable to the math talks, I would argue that while the math talks presented at the conference seemed to specifically elicit mathematically-focused discourse, Carmen's observations opened her students up to making observations that were not always directly related to mathematics.

During a post-lesson interview in the spring of 2012, Carmen and I discussed her use of observations and why she saw them as a viable strategy for attending to mathematics identity. In the exchange below, we discussed a lesson where Carmen incorporated observations as a tool for teaching geometric constructions:

- Carmen: Well, specifically with the constructing perpendicular line segments, I wanted to put in [conceptual] questions. But . . . they won't know [some of] this stuff until [high school] geometry, so it won't really make sense. And then, that's when I added in the observations to sort of . . . Like, we talked about the idea of multiple entry points. And so, we got answers it looks like a football . . .
- Toya: Or the moon

Carmen: Yeah, or, like, Stewie's head. Stewie is a cartoon character
(Interview, March 26, 2012).

In the excerpt above, Carmen was referring, to an earlier conversation we had regarding teaching geometric constructions, where I pushed her to think about why the constructions she was going to teach worked, that is why particular constructions bisected lines and angles or created perpendicular lines. Carmen noted that this would probably be too advanced for her students because they were only responsible for doing constructions, not knowing how they worked, which was a high school geometry standard. However, Carmen thought that adding a space for multiple entry points in the task would give her students multiple entry points, and it did, but they were not necessarily mathematical in nature. While Carmen anticipated more mathematical observations, like the formation of right angles when a line segment was perpendicular to line, most of her students opted to focus on the arcs made by the constructions. They made observations about what the intersections of the arcs looked like (e.g., footballs and cartoon characters).

Carmen also noted that her first period class often needed more support with regard to making mathematics connections when compared to her third period class: “I get answers from my third mod; they use the mathematical language.” (Interview, March 23, 2012). Carmen acknowledged that her students, particularly her first-period students, experienced frustration. She believed that permitting a range of answers, even when non-mathematical, allowed for all of her students to participate. In her words: “I guess that's my way of, like, letting them start wherever they want and having them feel a level of competency with the content” (Interview, March 23, 2012). So when prompting the class

with instructions like “Create a statement that would result in one unique outcome,” (Observation, March 23,

So, there's a lot of very, you know, different entry points for me as a teacher to facilitate a discussion, but specifically with my first mod, I like doing a lot of open ended with them, because I know sometimes a few of them will struggle (Interview, March 26, 2012).

2012), Carmen indulged answers that ranged from students and skin color, to people and their personalities, to people and their finger prints. Carmen mentioned that she liked using questions that solicited a range of answers, because, as the teacher, she could choose where she wanted to start based on her students' responses.

Mathematics education literature often highlights the struggles that new teachers face trying to move from teacher-centered modes of instruction to more student-centered ways of teaching mathematics (Ma & Singer-Gabella, 2012; Swars, Smith, Smith, & Hart, 2009). Carmen, in contrast, enjoyed teaching in a more open, student-centered style. She credited the MST-Res methods courses with her desire to do so:

I want them to get the correct answer at the end, but through my courses, I noticed the importance of the process, you know, the thinking behind. . . . And like, the conceptual understanding behind coming up with a solution. Um, I don't know if I necessarily make space for that in my teaching. I mean I'm trying to. Like, for example, when I ask them for observations (Interview, March 26, 2012).

Carmen saw her observations as more than a way to attend to identity; she saw observations as a tool to push for conceptual understanding. In retrospect, I wish I had probed her more with regard to this statement, but I surmise that she viewed soliciting

observations from her students as a way to elicit student thinking. Not only did Carmen prefer to teach in a manner that emphasized conceptual understanding and privileged student thinking, she also found it easier to plan lessons for this type of instruction versus planning more traditional, teacher-centered instruction. She shared:

Once I get the hang of it, like in terms of what questions [I should pose], . . . and it is also helpful to talk to you about it in terms of like, "Ok, they did it, now what is an extension of it?" So I think it is a lot easier because the more traditional [way of teaching] is very step by step-by-step, and sometimes it feels like I am missing something. But if I do it like more open ended, I don't feel like I am missing anything because the kids will bring in whatever I am missing (Interview, March 23, 2012).

In addition to helping Carmen present mathematics in a more conceptual manner, she also noted that creating space for multiple entry points via observations allowed her to build relationships with her students. She noted, "If it is in the beginning of the year, to have a lesson that is already open ended without really knowing your students yet, then that lesson will help you know [your students] a lot better" (Interview, October 25, 2012). I take her use of the phrase "open-ended" in this sentence to mean allowing space for a wide range of answers and interpretations, both related and unrelated to mathematics. Her statement also points to her desire to know more about her students, a second tool that was prevalent across her corpus of data.

Tool: Consideration of students' lived experiences. A second tool that emerged as a strategy for attending to mathematics identity was Carmen's consideration of her students' lived experiences as salient to their mathematical ones. As noted in and

closely related to the tool highlighted in previous section, Carmen prioritized building relationships with her students.

Carmen taught at Booker T. Washington Middle School, one of the feeder schools for the high school where I used to teach. Upon learning this, Carmen began asking me questions about the high school where I taught and the surrounding community. Carmen also hosted lunches in her classroom, which became so popular, her students had to sign up to attend. During these lunches, Carmen spent time learning about her students' home and family lives. She later leveraged her personal relationships to motivate her students to persist while working on challenging mathematics tasks.

In an example of how Carmen leveraged student experience as a tool for learning and building identity, I witnessed Carmen build relationship with Guillermo, a student in her first-period class in the spring of 2012. When I began visiting Carmen's classroom, Guillermo was often out of his seat or yelling across the classroom and creating disturbances. Carmen, true to her laid back demeanor, calmly addressed his off-task behavior, but it rarely quelled him. Realizing that she had to focus Guillermo's energy toward something more mathematically productive, Carmen began meeting with him at lunch and building a relationship separate from the mathematics teacher-student relationship they were building in class. Over time, I observed Guillermo become a more active and productive participant during class. In our third interview where Carmen talked specifically about how she attended to mathematics identity, she attributed Guillermo's shift in disposition and behavior to building relationship and the nature of her tasks. In particular, she highlighted a task where students had to create a picture on a coordinate plane that represented something meaningful to them.

We were reviewing plotting points on a coordinate plane. And so the task was to draw a picture or create a picture by plotting points and the picture had to go to all four quadrants, and you had to label at least five [ordered pairs] in each quadrant, and then the picture had to be something that is important to you or that represented you, and you had to write about it. . . I noticed [Guillermo] was more involved, asking things like “Am I doing this right?” where, when he doesn’t care, he won’t even interact with me. . . . He needs a whole lot of hand-on things (Interview, May 3, 2012).

This excerpt supports Carmen’s assertion that her tasks would take care of other dimensions of mathematics identity. Carmen explained that Guillermo was motivated by a task where his personal experiences were valued, thus the nature of the mathematical task she selected addressed student motivation. I would also contend that the nature of her task also influenced the importance dimension, as Guillermo and his classmates aligned mathematics with their personal interests. Additionally, she noted that Guillermo’s understanding of plotting points on the coordinate plane also improved. While there is some deficit language regarding Guillermo not caring about his schoolwork, this quote does seem to point to Carmen’s acknowledgement that she played a role in his engagement via the types of tasks that she selected and facilitated.

In another instance of Carmen’s attention to her students’ lived experiences, from the beginning of the school year, she generally assigned warm-ups that asked her students to answer several mathematics questions along with a personal question. For instance, during the unit on data analysis, Carmen asked questions regarding measures of central tendency during warm-ups, but also included prompts such as, “Describe your dream

vacation, ” or “Summarize your weekend.” She later used this information to create contextual problems or as a way to start conversations at the beginning of class.

I had the pleasure of watching her honors students beam with pride when responding to the prompt, “Think of your favorite food, dish or recipe. Describe it in 4-5 sentences. Then, describe how it may be related to proportions” (observation, October 26, 2012). More than the recipes themselves, Carmen facilitated a conversation about how her students’ experiences with food connected to their families, ethnicities, and culinary talents. She shared a bit of her personal story about being a culinary teacher and also warned her students to take care of the cookbooks they were going to use for their task because her mother was sharing them with the class. As Carmen noted in the lesson planning questions on the mathematics identity template, “I feel this task considers my students out-of-school knowledge. Food and recipes may be linked to race, ethnicity, religion, culture, family and tradition – all social elements that may play a significant role in students’ out-of-school lives.” (Mathematics identity lesson plan prompt, October 26, 2012)

In this particular instance, Carmen pushed her students’ mathematical sense making. She encouraged them not only to share their recipes and stories but also to share how their recipes could be related to proportions. As always, the responses were varied, ranging from unit pricing for ingredients to the rate at which they could eat their dishes (“I can eat 2 bowls of macaroni in 2 minutes”), but they were much more mathematical in nature than I had noticed in her other classes. Carmen pushed their thinking by asking, “What if we were all coming over? How can you use proportions to help you?” (Classroom observation, October 15, 2012)

Carmen attributed her honors students' more mathematical responses to their status as honors students, which could have partly been true. However, what I found most interesting about this interaction was Carmen's push for them to connect their ideas back to the mathematical concept at hand, something that I had not witnessed in my other observations. Perhaps she did this because she felt these students were more academically prepared, thus supporting my assertion that Carmen's attention to identity was filtered through a lens of ability.

Tool: Creating tasks that explicitly addressed mathematics identity. As mentioned earlier, Carmen was the only teacher who explicitly addressed mathematics identity with her students. While I noted that Carmen's warm-ups often included a question about her students' lives outside of the classroom, I noticed that she also asked them questions about their affect with regard to mathematics. She sometimes asked questions reminiscent of the ones she posed to the student she interviewed for her life history assignment from the seminar. Sometimes the questions were reflective of ones that I asked her to answer as she wrote her own mathematics autobiography.

As I observed Carmen's class in the fall of 2012, I noticed a poster on the wall that I had not noticed in my other visits. The poster was entitled "What It Means to Be an Honors Math Student." The poster had lots of Post-it Notes with students' responses to the prompt. I made note of the poster and planned to ask Carmen about it in our debriefing interview. Below is an excerpt of our exchange about the poster and the activity that led to the Post-It notes on it.

Toya: So tell me a little bit about those Post-It Notes because I noticed [the title of the poster] said something about what it means to be an honors student.

Carmen: Mm-hmm. That was the very first week of school. Um, and then we talked about, well, I asked them to write it down, what it means, what they think it means to be in an honors class because one of the other teachers, Ms. Anderson, is always referring to them as “The Honors Class,” and using them as an example, not just for academics, but, like, how to behave in the hallway, how to respect your teachers, and stuff like that. So I just wanted to see how they felt.

Toya : Mmhm. And so what kinds of things did they share with you?

Carmen: A lot of it was mainly academic. (Quoting students) Like, “It means that you go above and beyond,” or “You’re above average,” or “You’re better than other kids in, like, math” “You do all your work.” Stuff like that.

Carmen’s students were conscious of the status that accompanied being an honors student. While she noted that most of them highlighted academic achievement, some of them also referred to exhibiting acceptable behavior like being respectful, following class rules, and doing one’s work. The most striking part of their responses was the idea that they believed they were “above average” and in some ways “better” than other students. As this is a study of teachers, not students, I wish I had pushed Carmen further in my questioning. I am interested in how she responded to their characterizations of

themselves as honors students and whether she saw her actions as supporting their notions of being better or above other students. As mentioned earlier, Carmen made distinctions between her honors students and those in her lower-tracked classes, so it would have been informative to know how she responded to her students during this activity.

I also questioned Carmen as to whether she did a similar activity with her other students. She responded that while she had not done anything comparable with her lower-tracked classes, she had tried a similar activity with her students who were enrolled in her AVID math course, a course intended to prep them for honors mathematics the following year. Carmen explained how her AVID students responded to the prompt “What It Means to Be an AVID Student”

Carmen: And then, with those responses, it was more like, “To be organized” because they’re more like about the binder and the notes, so I got a lot of “Be organized” and taking notes.

Toya: Mmhm, but noting around attitudes around math or anything like that? (Carmen shakes head no) Mm-mm. Ok. Alrighty,

Carmen’s AVID students responses were a bit shocking to me, not so much because of what they said, but what I interpreted their interpretations to mean. While AVID is a nationally recognized program that offers opportunities to students who show promise for success in advanced courses, I found their lack of attention to content specific messages to be surprising, in that this program is priming these students for honors-level work. I had anticipated answers similar to those of Carmen’s honors class.

While perhaps Carmen did not push students about their perceptions of themselves as honors or AVID students and perhaps she positioned her students in ways that maintained or exacerbated status issues, I still view her explicit attention to her students' mathematics identities via the activity described above as a promising practice. Keeping in mind that Carmen was a novice teacher, her attention to more affective issues related to mathematics was admirable. As we spent more time together, and Carmen began to explicitly think about issues of tracking as issues of status rather than ability. While she was still using ability-laden language at the end of our time together, she cited the mathematics identity planning template as bringing this issue of status versus ability to light in her teaching, as she had not consciously considered it before.

While Carmen did not do the aforementioned activity with her lower-tracked students, she noted that she had to directly attend to her struggling students' identities in different ways. Carmen cited several instances in which her struggling students in her lower-tracked refused to complete in-class mathematics tasks or became frustrated and stopped working on assessments. They commonly attributed giving up on mathematics assessments to their perceived inability to do mathematics. Carmen discussed the numerous occasions when she had to encourage her students to persist at mathematics tasks while also attending to their affective issues.

A lot of them feel like, and they've said 'I suck at math!' Some of them say, 'I quit!' and 'I don't want to do this!' especially during a test. Trenise, If she doesn't get it, she'll say 'I quit!' and stop testing (Interview, March 23, 2012).

Carmen went on to describe her response to this type of pushback:

I've talked to them about their attitudes . . . Well, with the ones that say, "I suck!" or "I quit!" and "I don't want to do this!" I usually ask them why first, or eventually I'll try to get them to the point to try to articulate like, why [they feel this way], because I feel like it's usually because they're not understanding. I try to get them to the point to say what they don't understand and then go from there. The past few weeks, I've been trying to answer them with like, "Well, when I come to you, you just can't say I don't understand. You have to tell me why." Like, what parts they don't understand. So, its' trying to get them to articulate what they don't understand because that's when I feel like that's when they want to quit, when they feel that they suck (Interview, March 23, 2012).

Carmen was cognizant that most of her students' negative self-perceptions were rooted in experiencing numerous instances of failure. She tried to remedy this by helping her students take more control of their learning. As a means of helping all of her students, but especially her struggling students see themselves as capable while doing mathematics, Carmen deliberated ways to give her students mathematical authority during mathematics instruction. One example of this was asking students to articulate their struggles and persist in lieu of giving up and labeling themselves as incapable.

Additionally, Carmen built her tasks in ways that provided opportunities for agency and mathematical authority for her students. The majority of Carmen's lessons, both recorded for this study and those not included in the corpus of data, positioned students to collaborate and to arrive at their own understanding of the material. Carmen rarely used a lecture format, and when she did, it tended to be at the end of class as a way to summarize the knowledge students constructed as they worked in pairs or small

groups. Whether using origami to teach proportions or asking students to use tiles to arrive at definitions for the terms square root and perfect square, Carmen usually found a way to foreground canonical mathematical ideas with her students' ways of knowing about the topic.

Contradictions in Carmen's Activity System

While the previous section highlighted how various elements of Carmen's activity system allowed her to engage in practices that supported mathematics identity, there were also contradictions that impeded her ability to do so. Carmen activity system includes contradictions between several elements of the system and the object of study. First, I will highlight contradictions between Carmen as the subject of system and the object. I contend that Carmen's personal experiences, at times, impeded her attention to her students' positive mathematics identity construction. Additionally, I will discuss how she struggled to determine the role of attending to mathematics identity in practice and to find instances of attention to mathematics identity in her own practice. I will also discuss how classroom management had a major influence on Carmen's system of activity as it created contradictions between (a) the rules and the object and (b) the division of labor and the object. Finally, Finally, I will conclude this section with a discussion of how Carmen's attention to mathematics identity was impeded by structural forces at the school and district levels.

Contradiction between the subject and the object. Carmen mentioned how others who made assumptions about her mathematics ability based on racial stereotypes partly shaped her mathematics identity. While Carmen pointed out instances of othering in her autobiography, she did not appear to be as cognizant of the ways that she

highlighted the differences between herself and her students and possibly othered her students, thus constraining their opportunities to learn.

As discussed when highlighting Carmen's salient biographical information, Carmen knew that her experiences were markedly different from her students. She framed them as "low income" and "at risk" during our interview, and cited her sense of responsibility and pride in working with students from these particular demographics. When discussing working with kids in her particular school district she shared the following:

Griffin County kids, like, I know all kids are different. Coming into teaching eighth grade, I was like, "Oh, how was I as an eighth grader? Oh, I'm going to see a bunch of eighth grade Carmens," and that wasn't it at all. So, and then, that's when I was reflecting like, "Why are these kids so different from me?" Because, when I was in eighth grade, I wasn't doing half the stuff that I see these kids doing. . . . And I, for some reason, I cared about what I was learning in math class in eighth grade. So, I would [tell prospective novice teachers] that how you experienced eighth grade or whatever grade you teach is probably going to be very different from the kids you teach are experiencing in middle school (Interview March 26, 2012).

I interpret this excerpt as struggling with her essentializing her students. She noted "all kids are different." Not only did she note it in this statement, but she tried to use student difference as a springboard for learning mathematics. However, implicit in her reflection about her eighth-grade mathematics experiences is the notion that her students did not care about what they were learning, a theme that I had heard from her in earlier

interviews and would hear throughout our time together. In the same vein, Carmen went on to say:

[Before teaching, I assumed], “Oh, I'm going to see a bunch of eighth-grade Carmens.” That wasn't it at all. So that's when I was reflecting like, “Why are these kids so different from me?” Because, when I was in eighth grade, I wasn't doing half the s[tuff] that I see the kids doing (Interview, March 23, 2012).

While Carmen struggled to make sense of her students' experiences, even as she tried to honor them in her classroom, I often wondered if Carmen's othering of her students limited the types of tasks she engaged in with her them. While Carmen was open to her students' unique ways of understanding, I sometimes witnessed her accept answers that were either incorrect or that needed more exploration and elaboration from students in her lower tracked classrooms. This became more apparent as I watched her with her honors students, the kinds of students she felt were more similar in achievement and background to her. She often pushed back on their responses in a way that I had not seen with her students in the lower-tracked classes. In fact, she lauded these students because they often pushed back at her about her mathematical reasoning. I often wondered if she accepted lower-quality responses from her students in lower-tracked classes based on her perception of them as different. Reflecting on Carmen's quotes brings to mind Ray Rist's (1970; 2000) classic study of teacher perception the dangers of educational self-fulfilling prophecies and Pygmalion effects, wherein teachers' narrow their students' academic opportunities based on student characteristics that are often unrelated to their academic potential. I would also argue that this perception of students' abilities also

negatively impacted one of Carmen's instructional tools – her desire to give her students mathematical authority and agency.

Contradiction between the tools and the object. As noted in an earlier section regarding Carmen's understanding of mathematics identity, I established that Carmen's notions of student ability overshadowed the other dimensions of mathematics identity, including her dimension of interest, the nature of the tasks that she assigned. One particular tool I highlighted above was Carmen's interest in allowing her students to have some mathematical authority over the lessons. While Carmen cited instances of agency and authority in her honors class' lessons, she acknowledged that she often purposely limited that amount of mathematical authority she offered to her lower-tracked classes. Carmen contrasted her approaches with higher- and lower-tracked students engaging them in open-ended tasks:

Toya: So what's the difference [in your approach with higher- and lower-tracked students]?

Carmen: With the low-performing classes, it's more of the "we do, you do." I've tried doing the student-centered stuff, and maybe they're not used to it, and maybe I haven't done it enough times with them, where they're not used to it. But, um, the first few times we did do it, I felt like it was a lot of, um, asking questions [they did not possess], like, enough stamina or perseverance to go through it on their own.

Toya: So they struggle to work independently?

Carmen: Yes, and this leads to them having a fit about something they can't do.

Because Carmen was already struggling with issues of classroom management, she explained that while she enjoyed teaching in a student-centered manner, she often found it difficult to control the fallout when her students in her lower-tracked classes became frustrated with a difficult task. Carmen opted instead to follow a more traditional “we do, you do” format, where she and her students worked on a task together, and then she assigned independent work, a more traditional lesson format reminiscent of using guided and independent practice. I observed this particular lesson format during each of my observations of Carmen's students in her lower-tracked spring 2012 class.

In total contrast, when watching Carmen facilitate tasks with her with honors students, I witnessed her take a much more hands-off approach. I never witnessed a lesson in the form of “we do, you do.” In fact, Carmen made it explicit that her honors students had a responsibility to themselves and to their classmates to not only make sense and struggle through the mathematics tasks, but also to communicate their ideas effectively and clearly.

In highlighting the contrast between Carmen's teaching styles, I am not offering a value judgment regarding her decision to limit the mathematical authority and agency she provided her lower-tracked students. Given Carmen's struggles with establishing norms, routines and procedures, it made sense that she did so to maintain some semblance of order in her classroom. However, the contradiction between this tool and the object highlights the salient role classroom management and norms played in Carmen's activity system.

Classroom management: Contradiction in Carmen's activity system. In introducing Carmen's case, I highlighted her laid-back teacher presence, which often led to off-task behavior and lessened her students' opportunities to engage in her creative and well-planned tasks. I contend that Carmen's laid-back approach to classroom management, meaning her struggles with managing student behavior and with negotiating classroom norms created contradictions in her system, specifically between the rule and the object as well as between the division of labor and the object.

Contradiction between the rules and the object. While the rules I chose to highlight in Jan's case were at the school and district levels, exploring Carmen's classroom rules and classroom norms, or lack thereof, provide interesting insight into how Carmen was limited in her ability to attend to her students' identities during her first year of teaching. Toward the end of spring 2012, Carmen made a powerful connection between her classroom management and mathematics identity She shared the following with me:

Carmen: Well, the thing that I found, and I guess I could connect this to math identity [and its relationship to] classroom management. There was a time this summer, where you were stressing the point about teaching procedures and then, for some reason, I really struggled with teaching procedures as a way of classroom management, but I see it now and I see that connecting to identity in terms of classroom management where I feel like if I don't have . . . Many times, I feel like I don't have control of the class. And

like, at the same time, I'm like, "Oh, I don't have any procedures to address any of these things."

Toya: So, you think next year you're going to try to build procedures?

Carmen: And routines. I feel like that affects their mathematical identity, because it's sort of just like them not knowing what I'm expecting [of them] (Interview, May 4, 2012).

In this exchange, Carmen acknowledged that her lack of class rules, routines, and procedures often hindered her in sending expectation messages to her students. In turn, she saw this as detrimental to helping her students develop positive mathematics identities. In her defense, I watched her try to establish classroom norms, rules, and procedures, but often her lack of follow through and laid-back presence did not yield her desired results.

During her first year, Carmen tried to establish some rules and procedures to gain her students' focus during mathematics instruction. Initially, she tried to refocus her students by using the verbal cue "Give me five," which meant that students should stop whatever they were doing and do five things, which included facing the front of the classroom and ceasing all side conversations. This proved to be ineffective, and by the final quarter of her first year of teaching, she had switched to using a chart to track classroom behavior, where students lost or gained points based on whether they met the behavior standards that were posted at the front of the room. Carmen rewarded her students for earning a certain number of positive days in a row. Even in light of this change, Carmen found it difficult to maintain her students' focus during mathematics instruction despite her thoughtful planning and engaging activities. As I listened to her

lessons during the data analysis phase of this study, I found her instruction frequently peppered with the statement “I’m waiting” as she tried to facilitate mathematical tasks. When listening to audio recordings of her classes, I began to code how often she had to reprimand students and attend to misbehavior because it lessened the amount of time dedicated to instruction, particularly during the Spring 2012 observations.

True to her vow to introduce procedures in her second year of teaching, I entered Carmen’s classroom in the fall of 2012, and much to my surprise, Carmen exuded a confident and in-control persona, which led to a significant amount of productive mathematical activity. She used strategies like stating “And a hush fell over my class,” and in response, her students came to order and responded, “Hush.” Carmen also used handclapping as a classroom management tool, asking students to “Clap 5 times if you can hear my voice. Clap four times, three times, twice, once. Ok, now I have your attention” (Classroom observation October 25, 2012). Sometimes she used this strategy when discussing mathematical ideas, such as “Clap two times if you agree with Megan’s statement. Okay, clap once if you disagree” (Observation October 15, 2012). As I observed Carmen’s class, I pulled her aside and said, “There’s a different vibe in here.” She responded, “Yeah, this is an honors class” (Observation October 15, 2012). Carmen conflation of her students’ behavior and their academic identities is reflective of a practice noted in educational literature (Hand, 2010; Oakes, 2005; Vareles, Martin, & Kane, 2013). While I did not have the opportunity to observe Carmen’s lower-tracked classrooms in the fall of 2012, I can attest that Carmen’s use of procedures and routines that allowed her to attend not only to the content but also to her mathematics identities in way that were not evident in the spring of 2012.

Contradiction between division of labor and the object. Carmen and her students negotiated classroom participation, but not as productively as Carmen had hoped. While Carmen believed in and expressed a desire to make her teaching student centered and inquiry based, her lack of classroom management and norms often inhibited learning and participation, particularly for students who were enrolled in her lower-tracked classroom in the spring of 2012. Often, Carmen could not get the class settled to explore the ideas that they put forth in class discussion, and as her mentor teacher I found myself intervening to provide support.

Drawing on an earlier quote, Carmen stated that her lower-tracked classes tended to “have fits” when they were met with a challenging mathematical task. Because Carmen was already struggling with issues of classroom management, she explained that while she enjoyed teaching in a student-centered manner, she often found it difficult to control the fallout when her students in her lower-tracked classes became frustrated with a difficult task. Carmen, however, was cognizant that some of the fallout and misbehavior was probably a result of her limiting their opportunities to engage in these types of tasks, phenomenon Hand (2010) coined as the co-construction of opposition in low-tracked mathematics classrooms. I would further assert that that Carmen’s students’ misbehavior was probably also rooted in her lack of establishing both social and sociomathematical norms. Because Carmen did not establish social and sociomathematical norms, she was often left with a highly disruptive class, which limited productive mathematical activity in her spring 2012 classes.

Contradiction between the rules at the state- and district-level and the object. While Carmen’s lack of attention to classroom rules and norms caused contradiction in

her system of activity, the school- and district-level forces (i.e., rule) did as well. Carmen worked at Booker T. Washington Middle School, a school that the State Department of Education had overtaken to ensure that it would improve its test performance and meet all requirements to be in compliance with No Child Left Behind legislation. As a result of the State's takeover, Carmen and her fellow mathematics teachers were required to participate in professional development and collaborative planning sessions run by State Department of Education representatives. Carmen, who was committed to a more open-ended and student centered way of teaching as a result of her methods classes, found the professional development and collaborative planning sessions to be unhelpful in that they did not support a teaching style that aligned with the type of teacher that she was trying to become.

Carmen: So, when we have collaborative planning with the State [Department of Education representatives]. I feel like they do help us make these lessons that I guess are more engaging. Like, they'll maybe draw kids in. But the problem that I have with collaborative planning is that in Dr. Hodge's classes we learned [about lesson] continuity. Like, [the lesson components] Before, During, and After are an extension of one thing.

Toya: Yeah, he likes to take a problem and launch it and move through it.

Carmen: Like, stretch it out. . . So I don't necessarily find that in what we do in collaborative planning. [The lessons we plan] just sort of jump around.

Toya: Okay, so you don't feel as if you're getting as much out of the tasks as you could?

Il: Yeah, I guess not. We're being asked to present [the tasks planned during collaborative planning] in a way that does not have the same level of continuity.

Toya: Level of continuity? Okay, so tell me more about level of continuity.

Carmen: Well, like in the Before, During, and After [components of the lesson] like in Dr. Hodge's class. They're all connected.

Carmen was referring to a lesson-planning format that required teachers to take a conceptually rich mathematics task and to think about planning activities and questions before, during and after the task. This was the lesson-planning format that Dr. Hodges, Carmen's summer mathematics methods teacher, required them to use as they wrote lesson plans. Carmen saw this lesson format as a way to provide continuity throughout the lesson. She felt that the lessons that she collaboratively planned with the State Department of Education and her colleagues were disjointed and did not allow for she and her students to get the most out of the mathematics tasks. Thus, the State's planning support and collaboration, while intended to help Carmen improve her lessons, felt stifling and counterintuitive to what Carmen felt was a more useful way to teach her students.

State-led collaborative planning and professional development were not the only provisions in place to move Washington Middle School out of turnaround status. School administrators tracked and monitored Carmen's students' test data, and she and her

fellow teachers participated in data meetings where they reviewed their students' performance on unit exams and benchmark tests given at each quarter in preparation for the high-stakes standardized assessment. In response to testing demands and related to her students' identities, Carmen shared how some of her students had become openly defiant about standardized testing. As shared earlier, she recalled instances of her students giving up on their assessments because they felt that they could not work through the mathematics items on the exam. Carmen also had to deal with her own feelings of anxiety with regard to standardized testing. She shared, "I kind of dread giving them unit tests that the county provides, even though I tweak it." She explained that even her tweaks were not enough to help some students persist during testing.

The labeling and sorting of students, as assigned by their test performance, also shaped Carmen's discourse about her students. As demonstrated in the excerpt above, Carmen commonly referred to her students and classes as "low performing" or "high-proficient." In listening to her interviews and coding her data, I noticed that Carmen began to use these descriptors with little or no awareness of the underlying and tacit assumptions embedded in them. In describing the varied mathematical abilities of her students, she shared:

Like, with AVID kids, they're supposed to be somewhere in the middle. And then with extra assistance they're, you know, more college bound. But then with the AVID kids, they're, um, they're very low performing in terms of math, at least. A lot of them struggle. When they come back from lunch, they notice that I changed the Math 7 assignment form my next class, because my other Math 7 class,

they're ahead. They're, like, the high, proficient class, I can just move them very quickly (Interview, October 25, 2012).

The excerpt above was taken from Carmen's last interview for this study. While Carmen had taken coursework across the MST-Res program that emphasized having an awareness of and aversion to deficit language, it seemed that Carmen's language reflected the prevalent, taken-for-granted understanding of ability and performance that permeates public schooling (Ellis, 2008). Carmen's statement above also highlights the common use of speed as an indicator of ability in mathematics (Horn, 2007).

While Carmen explained the challenges faced by she and her colleagues as a result of poor standardized test performance and Washington's turnaround status, she believed that her students were not aware of their school's turnaround status or the State-led takeover. Instead, Carmen believed that her students focused more on the negative social climate of the school than the academic climate. Carmen noted that there tended to be fights every week, and students are rarely reprimanded because of them. She also wondered if her students' perception of their school as a "poor school" influenced how they viewed the school's academic standing.

When asked whether the school sent messages of ability to the students, Carmen replied that she believed so. She noted that she had a co-teacher who worked with her. She attributed the co-teachers' support to the fact that she was a new teacher and had some of the lowest benchmark test scores. However, she also told me that some of her students perceived having a co-teacher as an indicator that they were "slow." Additionally, some of her Math 8 students noticed that they were not taking Algebra 1 like some of their peers, and they began to question Carmen about it. She shared:

More recently a lot of them have been asking me what kind of math class this is and what is the math class called. And I say, “Math 8.” [They ask] “Well, what’s Math 8?” And I say something like, “Well, its a mix of algebra, pre Algebra and geometry.” Today Tiffany she saw an algebra book and she was like, “Why aren’t we doing any work from the algebra book?” And I was like, “Well, we’re doing some algebra.” I was like, “Geometry stuff, you’re going to be doing this when you get to ninth grade, tenth grade.” The kids know that they’re in an honors class or a straight up algebra or geometry class.

So in addition to balancing the demands of being a novice teacher in a school that was experiencing sanctions based on test performance, Carmen also had to navigate her students’ identities in this milieu. She had to attend to their frustrations with regard to their performance on assessments as well as send ability messages to them that countered the message they were already receiving by being placed in a low-tracked mathematics class. I believe that these structural forces posed challenges to Carmen as she tried to enact practices to promote positive mathematics identity, and further, I see them as contradictions to her system of activity.

Summary of Carmen’s Case

Carmen Laureta’s case highlights the challenges of attending to mathematics identity while also struggling to meet the demands of teaching in a school being reconstituted by the State Department of Education. Carmen was intentional about using her students’ lived experiences in her teaching, often using cultural referents in her creation of mathematical tasks. Additionally, Carmen prioritized building positive relationships with her students and leveraged them in her instruction. While Carmen won

the admiration of her students, she often struggled to focus her students during mathematics instruction. She attributed this to not having established norms and expectations early in the school year. However, in her second year of teaching, she established norms and expectations, which generated more student participation.

I would characterize Carmen's instructional style as laid back and student-centered. Citing her own experiences as a mathematics learner as qualitatively different from her students, she sought to create a learning environment where she could implement more open-ended and inquiry-based lessons that reflected what she had learned in her mathematics methods courses. However, as Carmen was required to teach lessons created during the State-led planning sessions, she often found her instructional vision at odds with what was required.

Carmen's understanding of mathematics identity integrated all four dimensions of identity presented in this study. However, Carmen's focus on mathematical ability influenced how she attended to the other three dimensions. Similar to Jan, I contend that Carmen's emphasis on ability was informed by her history of academic success, family structure, and the prevalent accountability rhetoric she experienced as a new teacher in Griffin County Public Schools. Her prioritization of ability was pronounced when comparing her practice with her honors class in the fall of 2012 to her practice with a lower-tracked class in the spring of 2012.

Carmen's activity system was comprised of her experiences as the subject of her system as well as tools that helped her attend to mathematics identity in practice. Her tools included making sense of her students' thinking, bridging her students' ideas to more mathematical thinking, and creating activities that explicitly attended to

mathematics identity. These tools supported her as she endeavored to attend to mathematics identity in her practice. While Carmen utilized certain tools that supported her in attending to mathematics identity, I also posit that certain aspects of her personal and academic experiences, as well as her lack of well-established rules and procedures impeded her ability to attend to it at the level that she desired.

In the next chapter, I present Chris Andrew's case. Chris shares some similarities with Jan and Carmen with respect to his upbringing and high academic achievement. Additionally, Chris was teaching a course similar to Jan's test preparation course. In contrast to Jan and Carmen, Chris's experiences as an African-American man influenced his purposes for teaching and understanding of mathematics identity in ways that were vastly distinct from the other PNTs.

Chapter 6: Chris Andrews

Chris Andrews, a former financial advisor who became mathematics teacher via MST-Res, brought personal, professional, and academic experiences to the classroom that shaped his mathematics instruction, including his attention to mathematics identity. While all three teachers in the study connected their personal experiences to their teaching experiences, Chris, by far, expressed the most personal investment in teaching and attending to identity in his teaching. As a Black man teaching mathematics, Chris believed that it was his responsibility to use mathematics as a tool for community uplift. Chris was explicit about the sociopolitical nature of teaching mathematics (Nasir & McKinney de Royce, 2013), and I would assert that his experiences as a Black man in the United States and his racialized experiences as a high-achieving Black student shaped his perspective. Chris's case is one of complexities and tensions. Unlike Jan and Carmen, Chris shared similar cultural referents to his students. However, upon becoming teacher of record at Albert Einstein Middle School, he quickly learned that while shared racialized experiences have the potential to be tools for effective instruction and attending to mathematics identity, they do not supplant mathematics pedagogy or the importance of establishing norms and expectations.

Chris's case highlights the some of the unique perspectives and resources that Black mathematics teachers bring to the classroom and often leverage during instruction. Researchers have highlighted these resources as being beneficial to Black students (Clark et al., 2013a; Clark, Jones, & Davis, 2013b; Johnson, Nyamekye, Chazan, & Rosenthal, 2013; Martin, 2007). However, while Chris espoused many powerful ideas regarding the role of mathematics in community building, pervasive negative discourses about Black

students, and equity in education, he often could not translate his ideas into productive mathematical activity with his students. Chris was a teacher who prided himself on building relationship with his students, though I would contend that like Carmen, a lack of norms and expectations impeded his instruction and attention to mathematics identity.

I interpreted Chris's understanding of mathematics identity as a unique interplay between motivation and importance that was also influenced by his notions of ability. Chris stated that he wanted to improve motivation in his classes, yet when asked about his reasons for doing so, he provided reasons that aligned more with the importance dimension of identity. And for Chris, the importance of mathematics success lied in its ability to help Black students improve the quality of their lives and the lives of their families and communities. Similar to the other PNTs, Chris filtered his conception of mathematics identity through an ability lens. He believed that some people were predisposed to be successful in mathematics, and he considered himself to be one of them. From as early as the summer 2011 seminar, Chris asserted that people he considered to be "mathematics people" were naturally predisposed for mathematics success. Additionally, during his summer field experience, student teaching, and in his permanent teaching placement at Einstein Middle School, Chris grappled with the salience of race with regard to teaching mathematics.

Chris, like Jan, taught standardized test preparation courses at Einstein Middle School. He became teacher of record for his test preparation courses when another MST-Res teacher resigned from the program. I contend that the nature of these test preparation courses influenced his sociopolitical stance about the role of testing in shaping mathematics identity. Day in and day out for the first three months of his tenure at

Einstein, he was responsible for preparing his students for the state's high-stakes standardized exam. This meant analyzing data, predicting student success, and working with students who were quite oppositional as it came to preparing for tests. Chris often had students who rebelled during class and refused to work because they felt that they were misplaced in his class, though their standardized test scores required them to enroll.

I will highlight how Chris's notions of ability, attention to the nature of his tasks, issues of motivation, and how he conveyed the importance mathematics were highly influenced by school- and district-level accountability mandates.

Following a structure similar to the previous cases, Chris's case consists of three primary sections: (a) a description of Chris mathematics-teaching persona, (b) his understanding of mathematics identity at the time of this study, and (c) his attention to mathematics identity via his activity system. In the first section of this chapter, I introduce Chris and provide a brief classroom scenario that I believe encapsulates Chris's instructional style and his relationship with students. I also address Chris's practice in a more subject-specific manner, in that I discuss how he viewed the nature of mathematics and how he approaches mathematics instruction. In the second section I will examine how Chris conceptualized mathematics identity and how I would characterize her understanding of it in light of the mathematics identity framework presented in Chapter 1. In the final major section of this paper, I will examine Chris's attention to mathematics identity using Engeström's (1987, 1999, 2001) activity system. I will present data that serves as evidence as to how each element of Chris's activity system contributed to or constrained his attention to mathematics identity via his activity system.

Chris's Mathematics Teaching Persona

A Glimpse into Chris's Classroom

I visited Chris's classroom during second period in May 2012, about a month and a half before school ended. I wrote in my field notes that Chris's classroom was abuzz with talk, laughter, and lots of off-task behavior. While class began at 10:20, Mr. Andrews began facilitating the mathematics lesson at 10:30. He used the first 10 minutes of class to discuss his students' weekends. The excerpt below is from the first ten minutes of his class. Some students were still entering the classroom, and Chris was writing the itinerary and warm-up on the board.

Chris: Alright, good morning. (waiting for students to quiet themselves)
 Okay. Welcome back from the weekend. So what did we do this
 weekend? Any good stories? Any fun things you want to share?
 Sandy? You want to join us? You're first. Go ahead

Sandy: I had a bad weekend.

Chris: Okay,

Boy Student: Why?

Sandy: Because it was boring

Girl Student: I like weekends; I don't have to go to school

Jasmine: I saw Avengers

Chris: Avengers? I took my girls . . .

Girl Student: Girls? What girls?

Boy Student: He has girls? He's married. He can't have no other girls (laughter
 from the class)

Chris: So you went to see Avengers?

Student: You liked it?

Jasmine: Mmhm!

Chris: Mariah? Quiet weekend? Joe? Esperanza?

Esperanza: I went outside.

Chris: Lourdes?

Lourdes: I want to see my dad

Chris: Where's your dad?

Lourdes: Virginia.

Chris: Like, close in Virginia or far away?

Lourdes: Manassas

Chris: You gonna be able to get to him soon? Manassas, huh? (Chris looks to another student.) Daja? (She shakes her head.) Nothing? (Daja gives a muffled response.) Ah, you played PlayStation?

Alright guys. Welcome back (Classroom observation, May 7, 2012).

Relationship-building conversations like this are important in mathematics classrooms, and in fact, researchers who study culturally relevant pedagogy assert that interpersonal relationship building is a necessary condition for effective mathematics instruction with Black students (Bonner, 2009, Ladson-Billing, 1997). As highlighted in the last case, Carmen used her relationship-building activities and conversations as a means of bridging to the mathematics content she had to teach. While it is important to build relationship with students, it is equally important that relationship building not

usurp mathematics instruction (Gutierrez, 2009). I selected this exchange between Chris and his students because it highlighted what primarily stood out for me while coding his observational data. Chris's lessons were filled with relationship building conversations and positive affirmations, which he believed promoted positive mathematics identity, yet his lessons lacked productive mathematical activity.

Much of my time as Chris's mentor teacher was spent helping him strategize ways to regain a sense of order and structure to create a classroom climate conducive to meaningful and productive mathematics instruction. Because Chris cited his students' lack of motivation as the primary obstacle to his teaching success, we spent much of our time together thinking of ways to re-engage and motivate his students. Chris's casual approach to planning and teaching mathematics was in stark contrast to what I anticipated based on the conviction he expressed for educating Black children during our interviews. Unlike my experiences with the other PNTs, Chris and I did not have the opportunity to delve into the mathematics content he was teaching in the way that I had hoped, but we did spend a fair amount of time unraveling, challenging, and thinking through what it meant to be "smart," "successful," and "capable" in his mathematics classroom.

Chris's Approach to Teaching Mathematics

Chris expressed comfort and familiarity with the middle school content he was expected to teach; he exclaimed, "I could teach [the content] in my sleep!" (Interview, March 22, 2012) based on his self-proclaimed strong content knowledge and success with teaching children in a volunteer capacity. Over time, Chris learned that teaching mathematics required more than having a solid grasp of mathematical concepts. It required a level of pedagogical content knowledge and knowledge of students that Chris

did not embrace during his time in the MST-Res program, as evidenced by the lack of completion of his methods, diversity, and adolescent development courses and his failure to revise and resubmit his final teaching portfolio so that it would have all of the necessary components to pass. Chris was eventually dismissed from MST-Res at the end of the 2011-2012 school year.

Chris took a very laid back approach to teaching his students, but I use the descriptor “laid back” in a different sense than when I used it to describe Carmen’s approach to classroom management. Despite being strongly urged to plan his lessons, Chris primarily taught from one workbook. Because of this, most of his lessons consisted of he and his students working through workbook pages as a class with Chris leading the instruction. When I observed lessons where Chris tried to facilitate more conceptually rich tasks, his students’ off-task behavior usually led to little activity that was mathematical taking place. Again, I attribute some of the off-task behavior to Chris’s lack of planning, as he relied on the activities being fun and interesting without mapping out how he would facilitate the task. Additionally, while Chris considered his students’ interests and aspirations when selecting tasks, it seemed as if he did not consider their prior knowledge while planning his tasks, which often left him in a conundrum at the board, and often left me in a position to interject and clarify as I observed him teach.

As noted earlier, when coding Chris’s observational data, it was difficult to find instances of Chris using mathematics content and sound pedagogical strategies as tools to attend to his students’ collective mathematics identity. Instead, I mostly coded his observational data using the relationship building code, with occasional codes that

highlighted his attention to ability (i.e., “Let’s stretch your brains today!” (Classroom observation, March 22, 2012). During our interviews, Chris shared a student-centered vision for teaching mathematics, but his classes tended to be quite teacher centered. Based on my analysis, I contend that his lessons were teacher-centered due to a combination issues including a lack of well-established norms and expectations and limited attention to lesson planning. Attention to these elements may have allowed him to have more student-centered instruction that he described wanting to reach in his teaching.

I present Chris’s system of activity in the following section. I found Chris’s perspectives about mathematics identity coupled with his commitment to using mathematics as a tool for the economic and social advancement of Black people to run counter to the way he and his students negotiated participation in his class (i.e., the division of labor). In addition, I argue that Chris’s lack of attention to issues of identity in his practice are grounded in his lack of planning as well as his lack of well-established norms and expectations. In turn, these concerns became sources of contradiction in the system of activity.

Chris’s System of Activity

Chris’s attention to mathematics identity in practice will be examined via system of activity (Engeström, 1987, 1999, 2001). I present elements of Chris’s system of activity and how they supported or constrained his attention to mathematics identity based on his understanding of it. The elements of interest are: (a) Chris’s personal and academic experiences, including his understandings about the nature of mathematics and mathematics identity and his notions of smartness and success in mathematics (subject);

(b) his instructional moves, considerations during planning, and tasks (tools); (c) Chris and his students' negotiation of mathematical activity (division of labor); (d) and the classroom-, school-, and district-level forces rules that govern his classroom (rules). The contradictions (Engeström, 2001) between the elements of the system and the object are represented by breaks in the arrows. Figure 8 highlights the elements of the activity system that I will refer to in the following subsections.

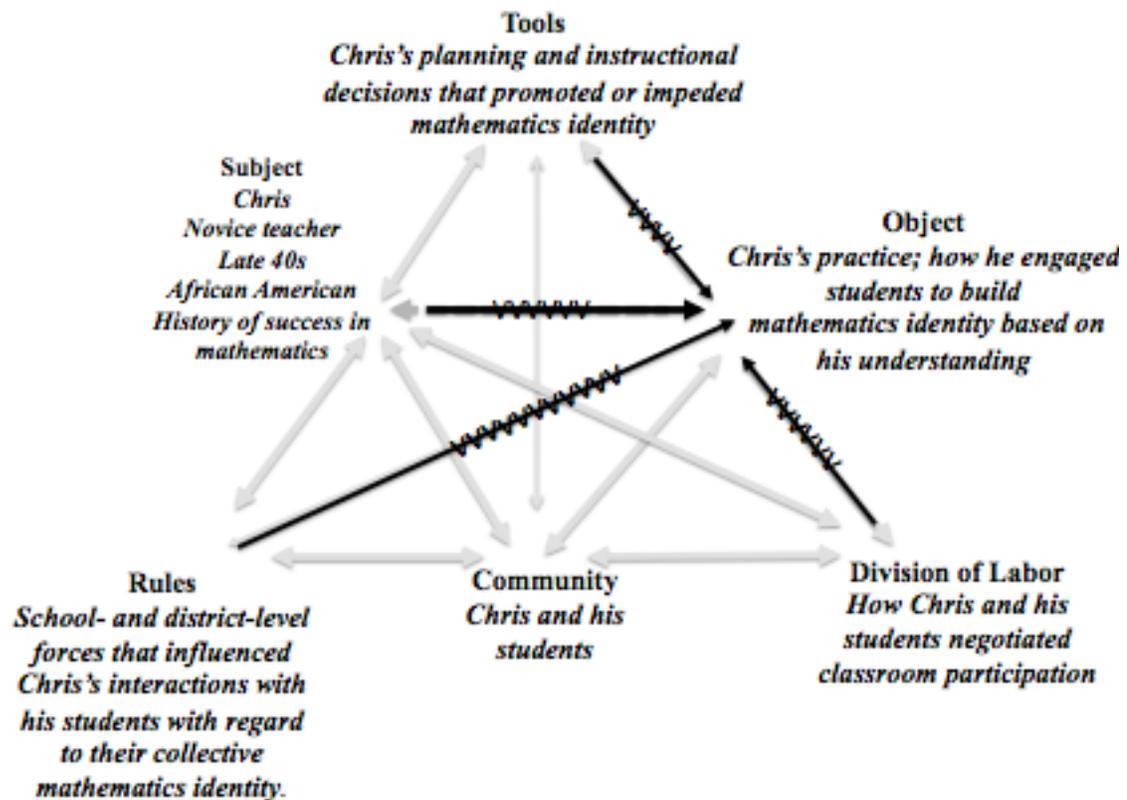


Figure 8. Chris's Activity System

Chris as the Subject of his Activity System

Salient personal and academic experiences. Chris grew up in a household with parents who were both college educated. He shared that they were “very clear and open about how they had both gotten schooling, and that was the general goal for [my brother

and me]” (Interview, March 22, 2012). Chris’s mother earned a degree in nursing, and his father attended an Ivy League university where he earned both his bachelor’s and master’s degrees. Throughout our first interview, Chris beamed with pride about the impressive educational history of his family, their “high level of intellectual capacity” (Interview, March 22, 2012) as he described it. Further, he shared that they were an anomaly among African-American families in their community at that time. His father and his aunts and uncles, all of whom earned graduate degrees, were known in their community for “having a reputation of being pretty high end, and I was always able to ask them for academic help” (Interview, March 22, 2012).

Chris began his early schooling in an urban center in the Mid Atlantic area, but his family, both immediate and extended, eventually settled in a small town in the Northeast. Chris recalled attending school with all of his cousins in a predominately White school district once they moved. To better prepare Chris for the rigors of college, his father transferred him to a private Catholic middle school, but then transferred him back to a public high school to “learn to deal with the real world” as Chris explained. Throughout their schooling, Chris, his brother, and their cousins faced harsh realities as the only Black students in a predominately White school district. Chris explained how his parents tried to prepare him for the racial backlash that they knew he’d face:

My father was explained to us, “Get ready, because it will be hard.” My mother really was concerned with how they were going to treat us, and she had been through some rough stuff growing up and she really warned us, “Don't let it hurt you! Don't let it hurt you! You just have to persevere.” And it did happen. We

were called names. We were mistreated. We were left out. We somehow didn't get resources (Interview March 22, 2012).

Chris admitted that the mistreatment he experienced probably hampered his academic performance.

There were times when we were singled out and accused of things we didn't do . . . We felt like they didn't really want us here, so I'm not going to really do my best, because I'm just tired. Yeah, I think they weren't really cheering us on, so I don't feel I was actually doing my best, so it hampered (Interview March 22, 2012).

Though he faced challenges, Chris attributed his parents' preparation for the harsh realities of racism to his ability to persevere and succeed academically, particularly in mathematics. Chris recalled how his mathematical ability allowed him to build relationships with students of other races and ethnicities, particularly with Asian students who similarly felt racially isolated at his school.

Because Chris excelled academically, he was excited about applying to college. He had numerous options available to him, including a large local state college, several HBCUs, and his father's Ivy League alma mater. Chris was accepted at his father's Ivy League alma mater, so he decided to attend school there and major in mechanical engineering. He recalled being amazed by students who he called "math geniuses" in his classes. He also noted that college was the first time he did not feel successful in mathematics and how race factored into this. He explained:

So, there weren't too many of us African Americans. [The White students] were nice enough people, but they didn't need to hang out with the Black smart guy, because there were plenty White smart guys, they didn't need to hangout with me

. . . You could tell somehow [they had] some extra connections going on with White professors (Interview March 22, 2012).

When I pressed Chris about what he meant by “connections,” he went on to say:

Well . . . the White students who generally associated with fraternities had old tests and files that their fathers and grandfathers purposely kept to give to them.

They could say, “Come over. We got two years’ worth of tests that we’re going to study, and Grandpop gave them to me when he was here.” Black people didn’t have that. So you couldn’t just [achieve] even though you could mathematically do the stuff. You had to be connected. (Interview, March 22, 2012).

In this passage, Chris asserted that he and his other Black classmates were academically astute, yet he realized that being astute was not enough to be successful in the engineering program at his university. Chris talked about the networks and social capital that the Black students at his school did not have; thus, they did not always succeed at the same levels as their “connected,” White counterparts.

Chris’s perception of himself as a “mathematics person.” When I asked Chris whether he saw himself as a math person, he quickly and resoundingly answered “Yes, very much” (Interview, March 26, 2012). He attributed both his home life and his K-12 teachers with helping him to develop this identity as a successful doer of mathematics.

Chris’s positive perception of himself as a successful doer and learner of mathematics began at home through interactions with his family, a common trend among high-achieving Black students in mathematics (McGee, 2013; Walker, 2012). Chris recalled that his father was good at mathematics, and the thing Chris remembered most about his at-home mathematics support was his fathers’ approach to helping him tackle

difficult mathematical concepts. He recalled going to his father for help with mathematics homework and being told, “‘Let's figure out how to set it up.’ [My father] was never, ‘I don't see a right answer.’ He always suggested, ‘Let's think it out. How can you figure it out?’ His approach was that way.” (Interview, March 22, 2012)

In addition to attributing his family with helping him develop a positive self-perception of his mathematical ability, Chris also shared several stories, from early elementary to high school, about how his teachers helped to shape his perception of himself as a mathematics person. One story in particular stood out as it also provided a glimpse as to how Chris viewed the nature of mathematics. He shared:

In second or third grade, a teacher gave us a math quiz. She gave us ten minutes to do a quiz that should take an hour and a half or so. All of us panicked, screamed and hollered, but we did what we could (Interview, March 22, 2012).

He then described how his teacher shared the following bit of advice with Chris and his classmates after the quiz:

She said, “So, let this be a lesson for you in life, when you're doing math or if for anything else – set it up. If you have it set up, then you know what you're doing, and I know what you're doing. Then going back and filling in is just a matter of time and effort. So, let that be a lesson to you in math and the rest of your life. Show people you know how to do a problem, even if you don't get time to finish it.” And I'll never forget that. That was early on. It was real early. That resonated with me . . . [I thought,] “Yeah, I could do that! I can set it up. I can show somebody.” I've actually done my math that way ever since, and very

seldom it would try to trick me when I did math that way (Interview, March 22, 2012).

In this excerpt, Chris alluded to the importance of exerting time and effort to being successful in mathematics, attributes that have been shown to lead to success in mathematics (Rattan, Good, & Dweck, 2012; Yeager & Dweck, 2012). On the other hand, within this quote lies a tacit understanding that mathematics is mostly procedural. Chris remembered setting up and filling in mathematics problems, a description of doing mathematics that is in alignment with those who have more procedural and incremental views of the discipline (Richland, Stigler, & Holyoak, 2012). Chris also referred to never being “tricked” when he did mathematics in a procedural manner. I believe when he talked about being tricked, perhaps he was referring to working non-routine problems that required a different type of thinking than problems that are typically done in a set-up-and-fill-in fashion.

Unlike Jan and Carmen, Chris’ racial identity was central to his identity as a mathematics learner. Despite his racial struggles at school, Chris’s perception of his mathematics ability was not diminished. In detailing his mathematical experiences in college, he noted:

Your first year [in mechanical engineering] is all math. So, we were taking all these math classes. I found the Black [students], and they were some sharp Blacks, top Blacks from the Black schools from across the country, but even still, there were some politics involved, too. You know you're smart and could do the work, but White students did not want to be bothered (Interview, March 22, 2012).

Again, Chris shared an experience of being racially isolated, a theme prevalent in both his K-12 and college experiences. I contend that Chris drew on these experiences as he taught in classrooms that were predominately Black in Griffin County Public Schools. As discussed later, I contend that Chris's awareness of the racial and sociopolitical nature of mathematics was a tool that guided how he understood and attended to mathematics identity.

Path to teaching mathematics. Post-college, Chris became an engineer, but in similar fashion to his educational experiences, he felt socially and professionally isolated due to the limited presence of African-American engineers. Becoming disillusioned with engineering after a few years in the profession, Chris applied to the business school at his undergraduate alma mater and was accepted. Chris explained that he found business school to be completely mathematical and full of “calculations with business words attached to them. Bonds, stocks, acquisition, depreciation. While they were all business words, they were mathematical concepts” (Interview, March 22, 2012).

Upon completion of graduate school, Chris chose a position in marketing, which was not directly related to his emphasis in graduate school, but allowed him the social interaction that he sought in his previous career. Eventually, Chris ended up at a technology start-up firm and became a stockbroker. In the early 2000's, the decline of the stock market and the crash of the dot-com industry left Chris unemployed. This was a turning point for Chris who would soon leave the business world altogether. In his time away from the business world, Chris developed an interest in education and equity, and his interests ignited his desire to become a teacher.

During his period of unemployment, Chris had an epiphany that he “could be helping a young Black person who’s not getting through the school system” (interview March 22, 2012). So in addition to volunteering with service organizations, he began teaching a mathematics course at his church. He was enjoying his teaching experiences and felt especially compelled to teach mathematics. He explained that as a former stockbroker and financial adviser, the number of Black people who struggled with basic mathematics concepts stunned him. He succinctly stated his reasons for teaching mathematics as this:

So, I kind of have a mission. I want to teach young people math, so they could just be strong mathematically. I want to teach African Americans math so they can become financially literate, and I want to get African Americans to understand “Don't let any of this stuff beat you down. Racism is out there, but we're going to push through it.”

Chris heard a radio advertisement that was soliciting applicants for MST-Res. He completed the application process and entered the field of teaching, which proved to be more of a challenge than he ever anticipated. In particular, prior to and during his year of teaching, he spent time trying to make sense of what it meant to be a high-achieving African-American man who was teaching mathematics to students of color, many of which had never experienced success in mathematics.

Chris’s understanding of mathematics identity. Based on the coding and analysis procedures outlined in Chapter 3, in this section I present quotes and classroom episodes that support my interpretation of how Chris understood mathematics identity at the time of this study. First, I will highlight how Chris described mathematics identity to

me. During our interview sessions, Chris described what he thought attending to mathematics identity in a practice should look like, strategies that teachers could employ to attend to it, and instances from his practice that he believed attended to the mathematics identities of her students. Then I will describe how I see Chris conceptualizing mathematics identity based on my analysis of his data. In this section, I will also highlight why Chris wanted motivation to be his dimension of interest.

Defining mathematics identity. As I shared earlier, I would describe Chris's notion of identity as interplay between students realizing the importance of mathematics in their lives and the role of motivation in getting students to succeed. I also noted that based on the way Chris talked about and wrestled with notions of ability, he, like Jan and Carmen, filtered his understanding of identity through the lens of ability. When reflecting on Chris's data, I did not see evidence of Chris thinking about mathematics identity as being embedded in the nature of his tasks as I did with Carmen and Jan. Figure 9 provides a representation of how I understood Chris's conception of mathematics identity. Using the gear metaphor, Chris's understanding of mathematics identity is driven by his prioritizing of the importance and motivation dimensions, thus they exert the most force on the system. However, it is important to note that in Chris's data set, ability was used almost as much as these two codes, but the nature of task code was used the least.

Chris was consistent across his interviews in terms of how he defined mathematics identity. He viewed it as something that was highly individualistic, meaning that he believed that as teachers attended to mathematics identity they should help each student use mathematics to reach their personal goals. He shared:

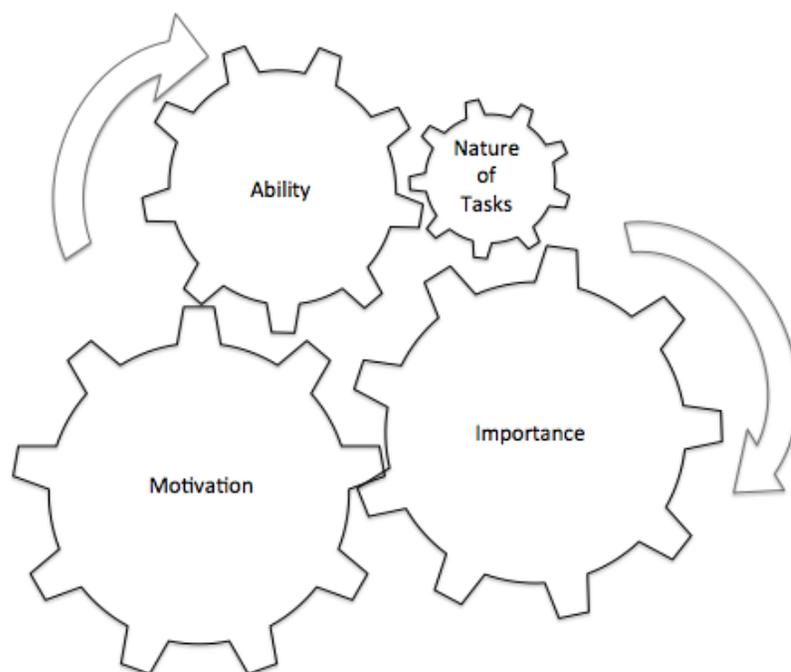


Figure 9: Chris' conception of mathematics identity

[Math learning] is personal. . . . You may be doing math to apply it to something. You may be doing it because you like doing it. Whatever you're trying to do, it's up to you, not for me to tell you what to do with it, but I'm here to help you be the best that you can be, doing what you want to do.

In the excerpt above, Chris noted that mathematics identity to him as a mathematics teacher involved helping his students reach a level of mathematics success that would empower them to reach their personal goals and aspirations. Thus, I assert that Chris is highlighting the importance dimension. In a follow-up interview Chris had this to say with regard to motivation:

Oh yeah, this is to help clarify, too. So you got a kid in class who is like, "I like math, I see math, but if you're just going to ask me to solve problems all day, I'm going to go crazy. If you can show me using statistics, I can become a casino

owner, I can run a casino, because now I have something to do with [my mathematical knowledge].” Versus, “I know I can solve the math problem. I already know the math problem. It all makes sense to me, but I’m not doing anything with it.”

In this quote, Chris again referred to the importance dimension of mathematics. Specifically, Chris noted that attending to mathematics identity for some students could mean tapping into their interests and aspirations beyond school. When asked how to do this, Chris said “So, first thing is finding their specific aspirations and goals. And second thing, giving them positive encouragement.”

During this same follow-up interview, Chris went on to say more about student motivation and their mathematics talents and abilities as it related to mathematics identity:

Chris: Some people can visualize [mathematics], and because they can visualize, they can do math. Some people can just logically think through equations and just do math. Other people can [work toward being good at mathematics. They think,] “If you show it to me, I can practice it, and I can work hard. Now I can do math.” So, the underlying strength they have is their identity, their math identity.

Toya: Okay, so math identity has to do with tapping into underlying strengths in order to be successful in math?

Chris: It’s strengths and motivations. It’s a combination (Interview March 22, 2012).

In this exchange, Chris acknowledged that in addition to be naturally talented at mathematics, students could also experience success through hard work. Chris explained that hard working students could attribute their success to tapping into what he would call their mathematics identities.

Chris's understanding of mathematics identity was intriguing but also somewhat confusing. I broached the subject of defining mathematics identity again in a later interview. Using a sports metaphor, he said:

Chris: In football, there are people who are natural athletes and there ones that worked hard. Obviously, both [types of athletes are considered] professional. They did something that got them to that point, and they're still in the same category. I kept thinking this was a much clearer way to describe this identity and all the angles [of it]. There's a million ways I could get the talent and coach the talent. But if I categorized all of them, their identities would still be professional football player and that to me helps clarify.

Toya: So, connect that to math identity and kids in the classroom.

Chris: So you have natural mathematicians. They can walk up and for some reason its all natural to them. I consider myself one of them. "Yeah, I see it. It makes sense. That's logical and I see why it doesn't work." It's just natural. And then, there's ones at times if I do it hundred times, I'll get it. . . . (April 2, 2012)

As in the earlier excerpt, Chris continues to highlight the ability dimension in this sports metaphor for mathematics identity. While acknowledging that some students are

good at mathematics via hard work, he still pointed out that some students are just inherently good at math. Further, he saw himself as one of those people who naturally excelled at the discipline.

Chris's notions of success in the mathematics classroom. Chris's utterances about mathematics identity, effort, and innate stood out in his data set because despite his acknowledgement that success in mathematics can be found through hard work and persistence, he was quite candid about how he privileged his students who he felt had natural ability. Like Chris and Carmen, Chris also succumbed to deficit notions of ability. He openly admitted that he was struggling to connect with his students who were struggling because of his positive personal experiences with mathematics. Often in class, he allowed misbehavior and confusion about the lesson to go unnoticed or unchecked, as he admitted in post-observation interviews that he was struggling with the proper course of action. He candidly shared that he'd "been caught in the bad mentality of 'Alright, let me find everybody who's smart like me and just deal with the smart people, and let the smart people be in charge'" (Interview March 22, 2012). He also acknowledged that this was his mindset both for teaching his classes and for participating in his methods classes with his cohort members. However, he also noted that this mindset was not proving to be beneficial and that he needed to shift his thinking.

When probed about what it meant to be successful in his class, Chris noted that a successful student in his classroom was "one who used his brain to mathematically solve problems" (Interview, March 22, 2012). Having worked with Chris over the summer and

during the school year and having knowledge of his strong beliefs about natural mathematics talent and ability, I pushed him:

Toya: Okay, so, I'm using my brain. I'm solving your math problems. I'm still getting every single one of them wrong (Chris laughs). Am I still successful in your class?

Chris: So, if you say it that way, no. I mean, eventually, I have to see some correct results coming out of your efforts, but very seldom, does that ever happen if you're mathematically using your brain and actually solving the problem. Very seldom is every problem wrong.

Toya: Ok, Let's say I get, like, half of them right.

Chris: Uh, I'm questioning if you're really putting effort into it. (March 22, 2012)

In this exchange, Chris noted that success in mathematics while effort-based also required some level of achievement, an honest admission that was not as easily admitted by Jan and Carmen. Though he initially responded that a successful student was one who was using her brain, he also shared that part of being successful in mathematics was working toward correct solutions, an aspect of mathematics success that was prioritized in the test-driven context where he taught. Further substantiating my claim is Chris's response to my scenario of working hard but still having mostly incorrect answers. Chris, reluctant to believe the scenario presented was believable, made a connection between effort and correctness, asserting that he would question my effort if I were not getting the majority of my problems correct.

Chris's dimension of interest: Motivation. Related to issues of effort and achievement, Chris believed that the best way to help his students put forth more effort to achieve in mathematics was to attend specifically to their perceived lack of motivation. From the beginning of this study, Chris shared that he was very interested in tackling what he believed to be his students' low motivation. When probed as to why he saw motivation as the most important dimension to attend to, he provided an explanation that was completely unexpected. He offered an explanation that was directly related to the racialized experiences of his students. He pointed to the tendency of Black people to demotivate one another, referencing what is sometimes called the "crabs-in-a-barrel" mentality. Taking a very familiar tone with me, Chris shared:

I think very, very frequently, we as a people, we always say it, "Crabs in a barrel." I mean (addressing me), I know you're familiar. Crabs in a barrel . . . [Black students say things to each other like], "Hey, man! Why you think you're getting out of here? You ain't no smarter than me!" The crabs in a barrel mentality. The number two thing is so many of our young people in our community never get the positive encouragement. [They need to hear] "Hey, you can do this and you did do this right and you did it, because you tried. You tried. You did it." (Interview, March 26, 2012)

I find Chris' crabs-in-a-barrel explanation to be one that is sadly familiar. While Chris used colloquial language to describing Black students' lack of motivation, ultimately, he cited apathy and Black students' antagonizing of one another as the primary reasons for demotivation. He posited that African-American children's perceived lack of motivation is due to African-Americans' tendencies to subscribe to the

“crabs-in-a-barrel” mentality, meaning that Black people, metaphorically, behave as crabs. That is, when they see one member of their community excelling and moving forward, they act as crabs at the bottom of a barrel and pull the successful person back to the bottom. Further elaborating, Chris provided another reason for why he believes Black students lack motivation:

Chris: I guess [crabs-in-a-barrel] mentality is probably reflex, reaction almost. Because of crab in a barrel [mentalities] and suppression by White authority we feel inferior. Not just mathematically; our people have lost their motivation

Toya: You mean overall as a people?

Chris: Right, as a people . . . Well, like I said, we've been told so many times, “You can't do this. You don't have this ability. You don't have this skill. Even if you actually have the ability, we don't want you here – at this job, at this school, at this place.” We've been so demotivated by others. (Interview, March 26, 20120

In this exchange, Chris referenced a more structural explanation for Black students' supposed lack of motivation. He discussed how, historically, Black students (and Black citizens more broadly) have been denied access to resources by virtue of being Black. This rationale for low motivation leads to Black students typically landing at the bottom of what Martin (2000, 2007, 2009) would call the mathematical hierarchy. This framing of Black students' mathematics success and failure, which is still a relatively young body of literature in mathematics education, eschews taking a deficit-oriented approach regarding the academic success and failure of African Americans.

We continued with his line of thinking about the relationship between Black students and motivation:

Toya: So, you're saying as Black people have been oppressed, they start to . . .

Chris: (Interrupting) Lose their motivation, and especially academic motivation. And clearly, if you say[to a Black student], "Here's a basketball, let's see if you could be the next Michael Jordan," all the sudden, then yeah, that's . . . (voice trails off, Interview, March 26, 2012)

Interjecting to clarify, I added:

Toya: So, it 's the bigger messages you think influence motivation?

Chris: Mm-hmm. Right. So yeah, if you say [to a Black student], "Here's a basketball. Here's a football. Here's a rap song, give it a shot." The whole world [affirms this, as if they're saying], "Yeah, I know you can rap, you're Black." But, if you say, "Here's an accounting book, let's see if you can open an accounting firm. All of a sudden, where's everybody helping you out? Nothing." (Interview, March 26, 2012)

Again, drawing on a social and structural explanation for low achievement and motivation among Black students, Chris pointed to one of the prevalent discourses that pervade discussions about Black children, and specifically Black boys. He highlighted the low academic expectations that are often accepted and sometimes promoted, stating that society believes in Black boys and their aspirations to play sports and rap, yet does

not support their aspirations to excel academically and professionally because of deficit thinking. It is interesting to think about the above exchange in light of the expectations messages that I believe Chris sent by virtue of his lack of planning and preparation.

These will later be highlighted as contradictions in Chris's system of classroom activity.

While Chris highlighted motivation as the most important dimension to address as a teacher of predominately Black students, I probed Chris about what he thought attending motivation in practice looked like.

Toya: So if you were to look into a teacher's mathematics classroom and you looked in and you said, "Wow, this teacher is really working on his or her kid's motivation," what would serve as evidence for you?

Chris: I would see some very thought out math problems . . . I observed Jan. She was doing data analysis. She thought of having [her students] do jumping jacks. She had a physical activity for them to do. One student would do [the jumping jacks], and the other would count. So, this was a very well thought out example of producing the data, collecting the data, and [the activity] pulled them into it, so they weren't just observers. So, whatever math problem it is... The problem is it can't be just them observing the teacher doing something. That's what it can't be (Interview, March 26, 2012).

Toya: So, if it's well thought out, connect that to motivation for me.

Chris: So, its something they can do, they're interested in doing, they're finding, excuse the word, "fun" doing.

Toya: Or, it's engaging?

Chris: Engaging! Right! [Laughs]...So, the math problem is not for the teacher. . . So, yes, so whatever the math problem is, you got to see the teacher involving the students in the math problem (March 26 2012).

Within this exchange, Chris acknowledged that the nature of mathematical tasks a teacher creates and facilitates has implications for engagement. He noted that if students are working on a task that they find meaningful and engaging, they are likely to be motivated to work. He cited one of Jan's lessons as one that attended to student motivation.

Because Jan and Chris were teaching in the same building, I often encouraged them to visit each other's classes. Jan had also completed her student teaching at Einstein, and I believed that her knowledge of the students and the school would be useful to Chris.

Additionally, I thought she would be a good model for Chris to observe a novice teacher engaging her students with the content while maintaining rules, norms, and routines.

Probing Chris further about what he thought motivation looked like, I continued the conversation:

Toya: Uh huh, so you would look in. You would see a teacher doing something along the lines of what Jan did. Creating thoughtful, engaging, and meaningful problems.

Chris: Exactly . . . Right, exactly. But, another thing that I would see is a teacher almost creating a debate, posing questions, and creating a debate. The kids teach each other very well. So, you throw a question out and one of them gives an answer. [They would be

answering questions like,] “Do you agree or do you disagree? Why or why not?” The teacher's got to be orchestrating a mathematical discussion, so that kids can hear other kids. There's such a connection when they hear another one of their own, work through it the same way and write the same initiative.

In analyzing this particular exchange, I recognize the influence of MST-Res's methods classes and seminar. Both in methods classes and seminar, we discussed the importance of student discourse, and the teacher's role in facilitating it. What this excerpt makes clear is that Chris had a specific vision as to what his classroom should look like.

Additionally, he was cognizant of what was expected of him as an MST-Res teacher, but as often true with novice teachers, it is difficult to enact practices that are presented and modeled in methods courses (Ma & Singer-Gabella, 2011). This was a concern that had been raised by MST-Res resident teachers.

Unpacking Chris's racialized experiences as the subject of his system. Chris, as the subject of his activity system, brought racialized experiences and perspectives quite different from Jan and Carmen. I assert that Chris's racialized experiences both supported and impeded his attention to mathematics identity in his classroom. Unlike the other teachers in this study, Chris explained that his decision to teach, and specifically his decision to teach mathematics, was grounded in conviction and a sense of racial responsibility, a documented theme among Black teachers' reasons for teaching (Foster, 1997; King, 1993). Chris believed that his knowledge and talents would be beneficial to students. Not only would he be able to help them improve their mathematical skills, but he would also be contributing at the community-wide level. He believed teaching

mathematics was a form of racial uplift, as he shared that being good at mathematics would help his Black students make sound financial decisions and improve the quality of life for their families.

Racialized experiences as a contradiction between the subject and the object.

Chris expressed a commitment to teach mathematics to Black students as a form of racial uplift. Chris's racialized experiences were complex, and at times, he expressed views about Black students that were not productive to positioning them as capable. In particular, Chris discussed the "crabs-in-a-barrel" mentality, a deficit-laden notion that assumes that Black people do not want to see each other succeed. Researchers have provided evidence that counters this notion. Perry's (2003) concept of "Education for freedom and freedom for education" was developed based on historical documentation that African Americans' educational achievements are inextricably linked to their reliance on one another. Anderson's (1988) historical analysis about the cooperation of African Americans who established schools during Reconstruction further corroborates Perry's assertions. In more contemporary contexts, Carter (2005) and Walker (2006; 2012) cited evidence that refutes the deficit-oriented notions that underlie the "crabs-in-a-barrel" mentality as it relates to education. In their studies of academically-successful Black student, they both noted that these students often draw on their peer networks to excel academically.

Chris's explanation for his students' lack of motivation lacked an awareness of his role in co-constructing demotivation. As noted in Carmen's case, misbehavior, and in this case, lack of motivation, is often co-constructed in mathematics classrooms (Hand, 2010; McFarland, 2001). Evidence from observations and interviews certainly suggests

that this was the case in Chris's classroom. In his summer portfolio, he noted: "As I reflect, I am realizing that I was a "victim" of teachers who were not committed to [me] 100%. As an African-American, I was expendable. Hence, I stand the chance of repeating this behavior" (Summer portfolio, August 2011). Based on my time with Chris, I doubt that he saw his students as expendable; however, I hypothesize that his lack of commitment to planning and preparation as well as a lack of well-established norms and expectations for classroom management limited his attention to his students' motivation and mathematics identity more broadly.

Academic experiences. Chris's K-12 academic success paved the way for him to access educational opportunities such as attending an elite postsecondary institution. I contend that being positioned as academically talented throughout his academic career influenced how Chris conceptualized success and smartness in mathematics, which, in turn, influenced how he conceptualized mathematics identity. Further, as Chris saw himself as academically and mathematically competent, this shaped his interactions with his students. He candidly admitted his struggles with reaching students who were struggling in his class.

Academic experiences: Contradiction between the subject and the object. In the excerpts that I shared, Chris's notion of success in mathematics included several references to people figuring out mathematics for themselves in an isolated fashion. Besides doing mathematics with his father, Chris described doing mathematics as an independent endeavor. As I looked for patterns in Chris's data, I found this notion was related to his teaching and planning practices, as Chris voiced some opposition to assigning collaborative work based on his opinion that it hindered his faster students.

Implicit in this opinion is an underlying assumption that doing mathematics quickly implies that a student is more mathematically capable than a student who works at a slower pace, a researched and documented occurrence in the discourse of secondary teachers (Boaler, 2002; Horn, 2007).

Chris's Tools

Chris's tools, like his role as subject of his activity of his system, both impede and support his attention to mathematics identity. While Chris attended to affective dimensions of teaching such as affirming his students during class and building interpersonal relationships, these tools did not align with how he attended to identity with respect to mathematics content and pedagogy. I will highlight several tools in Chris's system, explaining how they promoted and impeded his students' mathematics identity construction.

Tool: Openness to multiple solutions during instruction. Chris cited improving his students' motivation as a primary way to attend to mathematics identity and mathematics achievement. As a means of motivating his students, Chris worked to be open to nonstandard and novel problem solving strategies, making statements such as: "That's the thing with math. You may not get the perfect answer. You may think it's confusing, but try to figure out a pattern, a solution," (Classroom observation, May 3, 2012) and "That's your way. Diamond has another way. In math there's more than one way to do things." (Classroom observation, March 22, 2012). During a lesson on finding the area of composite figures, Chris verbally affirm his students' multiple problem-solving approaches and pushed them to look at the figure from another perspective.

We used strategy number one. We broke the figure into two figures and then we calculated using area formulas. I'm not letting this thing go. What is another way that we could have done this? You guys are going to think about this for a minute. You're gonna come up with some suggestions of another strategy that we could use. (Classroom observation March 22, 2012)

Chris tried to send the message that mathematics can be open, in the sense that multiple solutions pathways can all lead to an acceptable answer. In terms of Chris's tools, his acknowledgement of multiple solution paths was the most content-specific way that he addressed motivation and mathematics identity more broadly.

Tool: Use of verbal affirmation. In addition to being open to multiple solution strategies, Chris also verbally affirmed his students. During class, he reiterated that mathematics was doable. He praised a variety of student acts, including procedural ones such as turning in papers, affective ones such as reluctantly coming to the board to work a problem, and content-related ones such as correctly solving a problem or offering a solution strategy. When asked how he used affirmation as a way of promoting positive mathematics identity, he shared, "I can give them verbal credit and applause, and at the same time show other students, "This is a good thing. This can be done, getting things right and doing things right" (Interview, March 26, 2012). In this excerpt he explained that he viewed student affirmation as not only an identity building strategy for the individual student he praised, but it was also affirming for the other students who witnessed it. When analyzing the data, I made a connection between Chris's explanation for providing verbal affirmation and his earlier comments regarding how Black students rarely received affirming messages about their academic potential. Given Chris's

awareness of negative societal messages regarding Black students' academic achievement, he wanted to make his praise explicit. Thus, Chris used verbal affirmations as a tool for promoting positive motivation for all of his students.

Student affirmation as a source of contradiction. While I viewed Chris's use of verbal affirmations during class as a tool for building mathematics identity, I also observed that the nature of many of his affirmations also constrained his attention to it. His affirmations were usually in the order of or "See how Esperanza is putting something on her paper." (Classroom observation, May 3, 2012). In another example, Chris assigned his students the task of creating a menu for them to use during a lesson about combinations and permutations. When Chris circulated the room and observed his students' work, he praised the artwork on the menus and did not push his students to think about designing the menus with the mathematics content in mind.

Most of Chris's praise and verbal affirmations were related to behavior rather than mathematical thinking, which, in my opinion, communicated low expectation messages and lessened his students' opportunity for participation in productive mathematical activity. Again, returning to an earlier assertion, I conjecture that Chris's lack of planning as well as his lack of well-established norms and expectations created a sense of disorder in his classroom. Consequently, when students chose to engage in any manner, Chris praised them for "doing the right thing" (Interview, May 7, 2012), which could be something as simple as finding a pencil. Because so little productive mathematical activity took place, Chris was rarely able to affirm his students in terms of their mathematical thinking. Moreover, because Chris's positive affirmations tended to highlight student behavior, he consistently praised the same students, Eric and Esperanza.

Contradiction between tool and object. Chris's lack of planning and lessening of the rigor of the tasks he assigned created contradictions in his system. I assert that these contradictions limited his attention to mathematics identity.

Planning tasks. Given my yearlong collaboration and numerous visits to Chris's classroom, I can attest that he rarely planned his lessons beyond choosing worksheets from a workbook provided to him during his first week of teaching. It is important to note that because Chris taught standardized test preparation courses, and the test was administered in March, I observed several lessons in April and May where Chris was not required to teach any particular content. He had complete autonomy to create tasks that were not driven by state mandates and benchmarks; yet, he still relied on the workbook for activities. Chris's use of the workbook was not entirely problematic; it was the way in which he used it that was troubling. He used the tasks without considering how to organize them or how to tap into his students' prior knowledge, both things which he had stated were vital to attending to mathematics identity and, in particular, motivation. At the end of one of his lessons, Chris and I sat down to debrief what I had observed and what he had experienced teaching the lesson. We had a very candid conversation with regard to the planning and enactment of his tasks and how I believed his lack of planning was contributing to the disengagement and lack of participation that he perceived to be low motivation.

Toya: What do you think maybe is, is contributing to the lack of structure or the lack of participation?

Chris: Well, so I, I am I am even tired of using the paper myself.

Toya: Uh huh. What do you mean by paper?

Chris: Well, using handouts. Yes. I'm even at the point where I cringe
(Interview, May 4, 2012).

Knowing that he needed to make some planning and instructional changes, Chris decided to plan a series of lessons covering combinations and permutations that drew on his students' interests. The following excerpt picks up with us discussing his attempt at creating and facilitating more mathematically engaging task.

Chris: [Because I'm tired of worksheets] I guess is sort of why I came up
with the menu idea.

Toya: I think the task is a great task. I do. It is not the task [that's
bothering] me. It's the execution.

Chris: Ok. So, so reading standing up front reading... it is boring and dry
and uninteresting.

Toya: Let's think about some things you can do while planning to change
the way you facilitate [the tasks] (May 4, 2012).

Chris was cognizant that the worksheets were not getting at the level of engagement and motivation that he had hoped for, so he decided to build from one of the problems on a class worksheet and create a task based on it. He created a 3-day lesson that culminated with his students using their knowledge of combinations and permutations to create menus and answer a series of questions regarding combinatorics. I observed all of Chris's lessons for this topic. And though he was more thoughtful in selecting and creating this task, he still faced the same high levels of disruption and disengagement. As I shared with him in the excerpt above, my issues with the class I observed had less to do with the task and more to do with his facilitation of it. While the task garnered his

students' interest, it was poorly organized. Chris primarily gave verbal instructions. They were very loose in terms of what student should be trying to do. He introduced the task as follows:

Okay, so what I'm anticipating is that you make a four-page menu. The front will read the name of your restaurant. You can decorate it. We've got markers. So you ready? You can decorate this and make it look more colorful. It doesn't have to just be plain (Classroom observation, May 4, 2012).

Though Chris had not given all of the instructions, the students began leaving their seats for markers and paper. Some of them started to pair off, while others started working on homework for other classes. Chris continued the directions over the disruptions:

You might have appetizers. You might have main course. You might have drinks. You might have desserts. Does everybody understand what we're gonna do? You come up with your own restaurant or you can do one that you like. And obviously I'm going to ask you to calculate the number of permutations. So you don't want 50 items in your menu. You're going to do a lot of calculations. You don't want a big restaurant, four or five items. Four or five appetizers. Okay, you guys are gonna make it? Okay so markers, crayons ... Okay, do you understand what we're doing Jacob? Good, Esperanza is off and running. Okay so, this is the table that needs the most inspiration over here. You can get a lot of inspiration from watching her (May 4, 2012).

During the first day of this lesson, Chris allowed his students to spend the duration of class, about 30 minutes) working on their menus. To his dismay, most of his students did

not get as far along as he had hoped. Most of them spent their time trying to name their restaurants and working on the cover art. Very few listed any items on their menus.

In the hopes of seeing how this series of lessons culminated in the final activity, I visited Chris and his students to observe the lesson that preceded the one described above, Chris's students made very little progress in getting to the mathematics portion of the lesson, calculating permutations. They briefly reviewed how to calculate a permutation given five objects to arrange. They completed the rest of the packet on combinations and permutations they had begun as a whole-class activity. For the duration of class, about 40 minutes, most of the class finished decorating their menus and choosing menu items. During the last 15 minutes of the lesson Chris wrote the following on the board:

- 1) Exchange menu with partner
- 2) Look at 1 category (e.g., appetizer, main entrée) and determine the number of permutations. (Field notes May 7, 2012)

Chris's instructions to "determine the number of permutations," led some students to express confusion as to what Chris wanted them to do. Many opted not to work on the task, while some figured out what he wanted them to do and tried to solve. In my field notes, I wrote: "Chris called a volunteer to the board. She had listed 4 drinks on her menu. She said that she could have 16 different arrangements of soft drinks because 4 times 4 equals 16. Some students agreed. Some gave other incorrect responses. Chris reminded the students of the card activity from last week, and someone yelled out 24. Chris agreed with her and the bell rang before they could discuss other students' menus.

Chris collected the menus and told them they were for a grade” (Field notes, May 7, 2012)

Given the number of incorrect answers during the whole-group discussion at the end of class, Chris had not adequately planned to address his students’ misconceptions from last week. Additionally, the limited time spent on the actual mathematics of the activity suggests that Chris had not structured the lesson in a way to highlight the important mathematical ideas. When I shared my concerns during our debriefing of the lesson, he attributed his students’ disengagement and inattention to the mathematical portion of his lesson to it being the end of the school year. Chris also stated that the standardized test was over and that his students no longer wanted to learn.

While Chris’s reasons for his students’ disengagement and lack of motivation may have had some validity, I also contend that Chris’s lack of planning and preparation was partly responsible for his students disengagement as well. Chris had numerous resources available to him, including Jan who was teaching a similar course, numerous offers from me to get together to plan as I did with Carmen and Jan, and a department chair who also pushed him to work on improving his lessons and his classroom management. Chris rarely took advantage of the resources available to him. Instead, Chris relied on handouts and tasks that he thought would spark his students’ interests as ways to motivate. While the tasks themselves could have led to meaningful mathematical discourse and participation, Chris did not embed specific questions and instructional strategies within his lessons make this happen. Thus, Chris co-constructed disengagement and contributed to what he perceived as a lack of motivation. His lack of planning impeded his ability to effectively attend to his students’ mathematics identities.

Lessening the rigor of tasks. In addition to not making use of resources and adequately planning his lessons, Chris also had a tendency to lessen the rigor of his tasks, or as termed in mathematics education literature, he lessened the cognitive demand of his activities (Henningesen & Stein, 1997). This term refers to how factors, such as classroom norms shape the ways in which students reason through tasks. By lessening the rigor of his tasks, I argue that he denied his students of some of their agency and their mathematical authority as they worked through the task. Further, I assert that this sent messages to his students about their mathematics identities, particularly as it relates to the ability dimension. I will use examples from Chris's lessons on permutations and combinations to illustrate how his instructional approach limited his students' opportunities to engage with the content. On the first day of Chris's lesson series about combinations and permutations, he introduced the topic by having a student, Sandy, read the definitions on the worksheet aloud to the class:

(Reading handout) Combinations and permutations. There are two types of arrangements that you've studied. A permutation is an arrangement of numbers, in which the order is important. A combination is an arrangement in which the order does not matter (Classroom observation, May 4, 2012).

Believing that the definitions of the terms were central to his students being able to correctly compute solutions, he tried to reiterate the important ideas from the reading passage.

Chris: Okay, let's slow down on that part. So Eric, what did we learn in that passage about permutations?

- Eric: (reading directly from the paper) A permutation is an arrangement of objects or numbers in which the order is important.
- Chris: What one is that?
- John: Permutations.
- Chris: Permutation. All right, Sandy would you try it one more time so that everybody can get it. (Sandy reread the passage)
- Chris: Okay. That top paragraph is pretty key. If nothing else, you should follow the first paragraph.

This was the extent to which Chris probed his students' for their understanding of combinations and permutations. It is important to note that they had discussed this topic in Chris's class in preparation for the standardized tes as well as in their regular mathematics classes. Chris knew that they had seen the material before. Rather than engaging his students in conversation about their knowledge of the topic, he relied on the worksheet to be instructive, as he told his students that when working they should "follow that first paragraph." Looking across Chris's lessons, the selected example is reflective of how Chris typically engaged in tasks with his students. Chris often struggled to create meaningful dialogue, so he ended up teaching in a manner that was teacher-centered and that limited students' opportunities to share their ideas and make meaning of the content beyond what was on the worksheets.

When working individually with students, Chris would typically tell students how to resolve issues they were grappling with, thus lessening the cognitive demand of tasks for his students. For example, when one of his students, Sandy, called Chris over for help with getting started on a permutation problem. Instead of probing her for what she knew

or asking her to articulate why she was struggling, he immediately responded, “You understand what we’re trying to do, right? Just use scratch paper and calculate like the one on the board. You can draw a diagram. You can make a list.” (Observation May 3, 2012)

In this same lesson, Chris posed the following question: “Given four letters, A, B, C, D. How many different ways can you arrange the four letters?” (Observation May 4, 2012) Students worked independently and in pairs to find the answer. As they worked, Chris went around the room and set the problem up for several students, showing them how to rearrange the letters to look for a pattern, though he had done a comparable problem on the board at the onset of the lesson.

Some students told Chris that they would try a tree diagram, and Chris complimented them for using an alternative strategy. When Chris called the class together to discuss their answers, students provided the following answers: 16 (because arranging 4 letters in 4 positions made them inclined to multiply 4 times 4), 96, 24 (the correct solution), 11, 13 (student wrote out the arrangements and could only find 13), 17, and 256. Chris listed all of their answers on the board. The conversation regarding the correct solution to the problem was as follows. Chris selected Asia, the student who stated the correct answer, to explain her solution:

Asia: ADBC ACBD. . . (lists the other arrangements for when the letter
A is first in the arrangement)

Chris: Okay, does that make sense, the strategy there? She started with A.

Eric: I did that too!

Chris: You did that too? Okay. So she did the first set. So if you repeat this for B, right? How many would you get for B?

Jamison: Four.

Chris: How many would you get for B, Kevin?

Kevin: Four. (Student laughter in the background)

Macy: Six.

Chris: Right. You get six for B.

In this excerpt, Asia provided a viable solution strategy for finding the number of arrangements when A is the first letter. However, Jamison, stated the answer to an equally popular solution. He stated 4, which several other students had gotten as well. This counting misstep was the source of many of Chris's students stating that 16 was the correct solution for the problem. Instead of addressing the common counting misconception in the room and allowing space for mathematical argumentation, Chris moved the lesson forward.

Chris: Randy, if you repeated it for C how many would you get for C?

Randy: Six.

Chris: Six, right. Six arrangements for four letters, so what do we get?

Class: 24.

Chris: 24. Good. So the final answer is 24. Okay. All right, so we've got two more questions to answer. I know I said you could make a tree diagram, but you guys all get it. You don't need to make a tree diagram. Number eight. Esperanza, would you read number eight for me?

Chris stated that all of his students understood the solution despite several of them providing an incorrect solution. While Chris had pointed out that creating debate among students was a feature of attending to mathematics identity, I believe that Chris saw his assistance and emphasis of the correct answers as a way to help struggling students, something he admitted to not doing well. However, in his effort to help them, he often ended up telling them the correct answers, glossing over their confusion, or tackling the most cognitively demanding part of the task – finding a viable solution strategy.

I contend that Chris's tendency to highlight correct solutions and minimize discourse and argumentation not only lessened the cognitive demand of his tasks, but also stripped students of their agency, meaning that students' opportunities to express their mathematical thinking and press their peers' mathematical ideas through the sharing of ideas and argumentation was limited. Additionally, Chris's habit of immediately providing his students with solution strategies limited their opportunities to take ownership of their ideas, i.e., the opportunity to exercise mathematical authority. Thus, in limiting his students' agency and authority, the lessened cognitive demand of his tasks constrained his attention to mathematics identity. Chris and I spent an extensive amount of time after his lessons on permutations and combinations breaking down his instructional moves, how they impacted his students mathematics identity, and steps he could take to create opportunities for more mathematical agency and authority.

Classroom Management as a Source of Contradictions.

Like Carmen, Chris's lack of norms and expectations, which I refer to as classroom management, impeded his ability to address mathematics identity. While Carmen's classroom management issues complicated her instruction, Carmen's

thoughtful planning and selection of tasks helped her maintain some order and mathematical activity. I would argue that Chris's lack of management coupled with the lack of planning and preparation I detailed in the earlier section severely impacted Chris's ability to attend to mathematics instruction. Specifically, his lack of classroom management and norms created contradictions between the division of labor in his classroom, the rules, and his attention to mathematics identity. During a classroom observation, I wrote the following in my field notes:

After asking students about their weekends, he wrote the warm-up on the board. Very few students began to work. I noted one student passing out the menus the class had begun creating the week before. Others were out of their seats talking and horseplaying. Others looked for markers to complete another assignment (Field notes, May 7, 2012).

Later in the lesson:

A student . . . passed out the packets that the students began working on last week. Mr. Andrews wanted students to work aloud as a group to complete the worksheet packet about combinations and permutations. At this point, many of the students appeared to be off task. Two were sitting at Mr. Andrews's computer playing music. Others were playing with the markers. Two were at the back of the room pretending to fence with yardsticks. Students were supposed to be completing a table in their packet, but it appeared that very few of them were completing the task (Field notes, May 7, 2012).

The type of extreme off-task behavior emphasized above was commonplace during *every* class I observed in Chris's class, including lessons that I did not record and the times that

Chris and I co-taught. Chris was cognizant of the seriousness of his classroom management problems, but it seemed as if he was resistant to do anything about it. During our last interview, Chris spent some time reflecting on his classroom management.

Chris: Right. Yeah, so, one thing is – Well, I guess I did get a chance, but I didn't do it. However you want to say it. Like, we never did the set up the rules and expectations. I mean Christen was here.

Christen was a MST-Res teacher who resigned from the program. Chris assumed her teaching position about 3 weeks into the teachers' placements. When he became the teacher of Christen's courses, I encouraged him to start over. I suggested that during the first week of class, he spend time establishing his rules, norms and expectations as though it were the first week of class. Chris admitted that while he could have taken time to establish rules and expectations, he did not do it.

Toya: Right, so remember we talked about just stopping and taking the time, restarting?

Chris: Right.

Toya: So what do you think? I think it is easier when a teacher, or I think it is more helpful - rather than me running down a listing of things. I think it is helpful to just take a moment and reflect on your own teaching. What do you think? Just, let's just take just today's lesson.

In Chris's reflective moment, he pointed out that the nature of his tasks, i.e., the handouts, were probably part of why he could not get his students to focus. As I shared

in an earlier excerpt, he admitted that he had also grown tired of using worksheets. He also cited a lack of technology as another reason that his students were demotivated. I felt that Chris was headed down a path of citing external reasons for student misbehavior and demotivation, so I stepped out of my interviewer role and responded to him as his mentor teacher:

Toya: What if we start with some really simple things like the 7 [disruptive students sitting at one table]? So, I am going to switch hats now and give you a mentor's perspective. I was hoping that when I came in today, you were going to put some people over here (pointing to a table that was empty during class). We discussed that last week.

Chris: Gotcha. (A student interrupts to ask for a pencil. He finds one for her; she thanks him. (To the student) You are welcome. Stay out of trouble, sweetie! (Turns attention back to me) Yes.

Toya: So something just as simple as breaking them up and changing seats. Kevin sits with his back to you the entire time.

Chris: Breaking them up. Right. (Chris begins jotting down notes.)

(Interview, May, 7, 201)

Further addressing Chris' concern with using worksheets:

Toya: There are a lot of students; there is one of you. They are going to get paper. It's how you organize class sometimes. Teachers use handouts. So, for me [what's more important is] *what's on the paper* and what you *do* with your students (Italics added for

emphasis). How you facilitate the work . . . I think that most of what got done today, was that they made menus. That's it. You put the [mathematical questions they should answer] on the board, and not that I love worksheets, but where were they supposed to record their responses . . . They needed to be able to show evidence of their thinking and their work. Because you are struggling with motivating them to work, you have to put things in place to make things clear and to keep them working.

Chris: Right (Interview, May 7, 2012).

As I had shared with Chris before, the mathematics tasks about permutations and combinations were not as problematic as he thought; my primary concern was his enactment of the tasks and all of the missed opportunities for productive mathematics activity. Connecting this issue of management to mathematics identity:

Toya: Let's just think in terms of, like, identity. What messages being sent [to your students] when seven of them can sit [at the table and horseplay], two of them can have their backs turned to you, and when you are talking, they are talking over you.

Chris: Right.

Toya: Because honestly, I think that the mathematics was lost (May 7, 2012).

When reflecting on this interview, I wish that I had allowed more space for Chris to respond to me; however, I remember feeling that in that moment, Chris's was in need of intervention. This exchange represents a shift where the interview went from

collaborative to instructive. Further, when I asked Chris about possible reasons as to why his students were unproductive, he started listing factors that I believed were not in his control at that moment. I believed his classroom management practices and mathematical tasks were things that he had the agency and autonomy to change, so I wanted to focus on those things. As I talked with him, he took copious notes. Later in the interview, we brainstormed management tools that would help him engage his students in more mathematically productive activities.

Contradiction between the rules and object. Teachers typically create or negotiate classroom rules as a way to be explicit about the behavioral expectations they hold for their students. From an activity theory lens, these rules, along with prevalent school- and district-level rules govern the system of activity in a classroom. I observed Chris's lack of classroom and posit that it created contradictions in his system, thus impeding his engagement in activities that promoted positive mathematics identity development.

Chris had very strong opinions about classroom management. In his summer portfolio, he shared:

My goal is for the students to self-manage and self-regulate. I do **not** believe in a dictatorial style. In fact, I am almost for a democracy, except that they are children. . . . I believe that we should establish rules jointly. There should be student "buy-in." As we discussed in class (and I have seen proven over and over in my life), if you allow students (people) to participate in creating their own rules and regulations, they are psychologically more committed to those rules and regulations (Summer portfolio, August 2011).

While the benefits of a democratic mathematics classroom are numerous (Skovsmose & Valero, 2001:), I often wondered if Chris used “democratic” and “free-for-all” as synonymous. I shared this excerpt with Chris during our second interview, and he stated that he still wholeheartedly agreed with it, but he admitted to not helping students create rules and regulations (“We never did the set up of rules and expectations”). Chris’s students’ inappropriate behaviors often went unnoticed or unaddressed. Chris opted to befriend his students as his primary tool of classroom management. As an example of this, he regularly passed out candy at the end of most of the classes that I observed.

When I asked about the candy, he explained:

My kids, maybe they trained me, but I found it only took a little bit, the least amount and they're so grateful you gave them one piece of chocolate. So, I always tie [giving candy] to [responses to questions like], “Are you doing well in school? The MSA is here. Are you going to prepare for the [standardized exam]? Here's a piece of chocolate.” . . . So I have been clearly been tying it to staying out of trouble, doing your homework, paying attention in class, doing your classwork, doing your work.” So, I tied it to doing academic stuff. . . . (Interview, March 26, 2012)

While he claimed that passing out candy was tied to academic expectations, yet I observed classes where the room was in chaos, but in the last two minutes of class, Chris would pass out candy and tell his students to be good and stay out of trouble. Chris continued:

I mean, some of them won't even put their name on their paper. So, I'm like, look, I say this to them, “You want a piece of candy and I can't get a name on the

paper?” I say, “You think I’m going to give you a piece of candy?” So then, now I noticed I get papers with names on them. So, each one is in a different place, but constantly linking it all to their performing better . . . (Interview, March 26, 2012)

While I understood that Chris wanted to develop a positive rapport with his students, he often tried to do so at the expense of being respected by them. I had witnessed the students grab the basket from Chris’s closet and help themselves, regardless of their behavior. His students recognized that he would give them candy for performing the most menial of tasks, and thus, they used this knowledge to their advantage. In the exchange above, Chris is tying doing simple, expected tasks like putting one’s name on a paper to an extrinsic reward. Further, Chris viewed handing out candy as a tool for motivation and relationship building, but I contend that the tacit message of low expectations was communicated more than expectations of academic success.

Contradiction between the division of labor and object. Chris and his students negotiated mathematical activity in his classroom, and more often than not, this meant that he and his students co-constructed off-task behavior, which limited productive mathematical participation. Because Chris had not established routines, procedures, or expectations, I contend that he adopted an instructional style that was teacher centered, in that he was the person who primarily engaged in the content, which left his students open to off-task behavior, behavior that often led to harsh, ability-laden discourse among them. I often noted phrases like, “Shut up, dummy!” or “Why do you even bother Kevin?” or “You’re so stupid.” peppered throughout the lessons. Chris hardly ever addressed these types of comments, nor did he address obscenities, racial slurs, or generally rude, hurtful

comments. I would argue that Chris's lack of classroom management opened up space for his students to participate in ways that were harmful to other students, and in could have potentially influenced his students' mathematical identities in negative ways.

School and District Forces: Contradictions between the Rules and the Object

As the teacher of a test preparation course, Chris was highly aware of how accountability mandates and structures at the school- and district-level, i.e., rules of the activity system, sent messages to students with regard to their mathematics identities, and specifically motivation. Chris was certain that the school impeded students' motivation. Specifically he cited other teachers' low expectations and negative perceptions of the students at Einstein.

Chris: The general answer is yes, it impedes. . . . I've watched a few teachers that, basically, were very discouraging, and I was there, so they only said so much.

Toya: About the potential of the kids?

Chris: Right, they [talk as if the students] have no potential. All they talk about is the negative. Just like the media. Here's everything negative about the kids. And I'm thinking "There's something positive about these kids we're talking about." . . . I know, and probably because it frequently happened to me when I was that age. Well, they could have said something about me being good in math; that never came up, but let me do something slightly different out of line. Oh, [they could] talk about that all day!

(Interview, March 26, 2012)

Chris expressed incredible displeasure with the language other teacher's used to describe the students at Einstein. Chris drew on his personal experiences and likened his experiences as a student to the students that he taught. Further, he acknowledged that the prevalent and negative media depictions of Black students and their potential probably also played some role in how his fellow teachers viewed their Black students. However, in Chris's desire to see the best in his students, I feel like he sometimes set his bar too low and rewarded behaviors that did not warrant praise.

Besides the ways that his colleagues' perceptions negatively affected students' motivation, Chris was quite candid about how he believed the accountability structures also still referring to teachers and their low expectations he lamented:

[There's] very few teachers or anybody who tell a kid, "Let me just stretch your brain, for the sake of stretching your brain. [Instead, we tell them], "You got to get A's on a test, you got to pass the [standardized exam], you got to find a job and make widgets." And we all tell these kids this. . . It's all about the standardized tests and so . . . Because, historically, it's been teacher-led instruction. I teach you. You regurgitate, you put it on a test, and I put on a score. So, the system seems to be like generally the same way that no one is attaching particularly their career interest, their motivations, their intrinsic interest. It's, "How are you doing on some standard tests?" (Interview, March 22, 2012)

True to Chris's tendency to highlight the importance and motivation dimensions of mathematics identity, he noted that the school and district level testing mandates negatively impacted student identity, in that school leaders rarely took student interest

into account. Additionally, in a really powerful moment, Chris captured what I believe the response to testing and accountability mandates across all three PNTs. They all found testing to be a hindrance to their teaching, and in Chris's case, the messages sent to students about their career and future course-taking trajectories was incredibly limited.

Summary of Chris's Case

Chris Andrews's case is illustrative of how drawing on cultural referents and espousing a commitment to equity are necessary but not sufficient to attend to mathematics identity in practice. While Chris had the clearest vision of what it meant to attend to mathematics identity in practice, he had the least success with enacting practices. This, I argued, was rooted in his lack of well-established norms and expectations for his students. Chris struggled to focus his students during mathematics instruction. He, like Carmen, attributed this to not having established norms and expectations early in the school year.

Chris's understanding of mathematics identity integrated all four dimensions of identity presented in this study. For Chris, adequately attending to mathematics identity, and specifically to motivation, meant tapping into his students' interests and motivation. Additionally, he believed that helping students develop positive mathematics identities was especially important for Black students, as prevalent discourses frame them as having limited potential to succeed academically. In a similar fashion to Jan and Carmen, Chris's notions of ability also permeated how he attended to mathematics identity.

Chris's activity system was comprised of his experiences as the subject of his system as well as tools that helped her attend to mathematics identity in practice. His tools included affirming his students and being open to multiple solution paths. While

Chris employed these tools to him in attending to mathematics identity, his activity system was rife with contradictions, most of which originated from his lack of well-established rules and procedures.

In the next chapter, I present a cross-case analysis. I present an activity system that encapsulates salient themes across all three teachers in the study. Further, I discuss common contradictions I observed across all three cases.

Chapter 7: Cross-Case Analysis

This study of three novice middle-school mathematics teachers sought to answer the following research questions:

- How do novice middle-school mathematics teachers conceptualize mathematics identity?
- In what ways do the teachers in this study attend to the dimensions of mathematics identity in their planning and practice?
- What forces appear to influence these teachers' attention to these dimensions of mathematics identity in their practice?

While addressing these questions in Chapters 4, 5, and 6 via each PNT's system of activity, in this chapter, I will address these questions through cross-case analysis.

Each case in this study is unique to the others; however, when taken together, these cases, share common themes that I will highlight in this chapter. I will highlight these common themes across the PNTs via an activity system that encompasses salient experiences of the subjects as well as tools, rules, and how each PNT's division of labor influenced how they took up issues of mathematics identity in their practice. Figure 10 represents this broad system of activity that I will unpack. As with each teacher's individual system of activity, tensions in the system will be considered contradictions in the system and are represented by the breaks in the arrows connecting the various elements of the system to the object.

PNTs as the Subjects of Their Activity Systems

John Graham's often-used quote "We teach who we are" is relevant to the centrality of the subjects of the activity systems presented in this study. Each teacher's personal narrative provided the perspective from which I explored his or her activity system. In the cases presented, Jan, Carmen, and Chris shared personal and academic

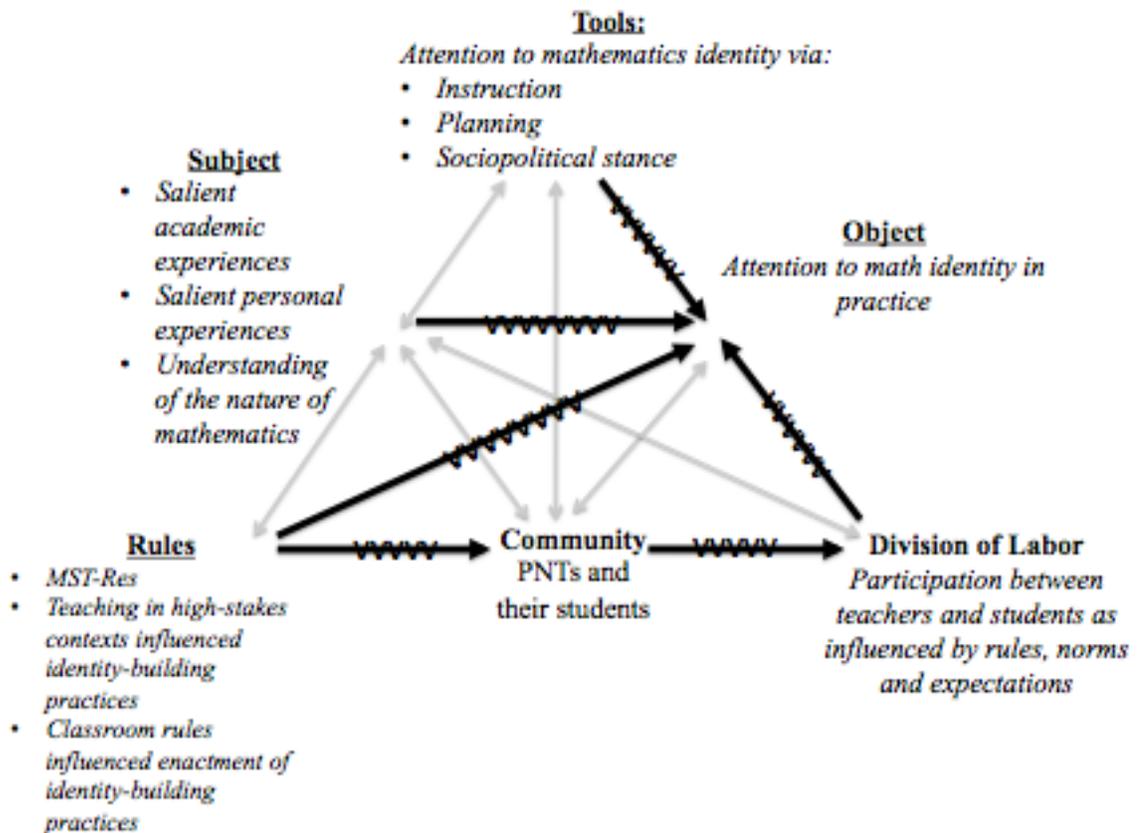


Figure 10. Activity System Across all three PNTs

experiences that were influential to them as learners of mathematics. Further, they made connections between their personal narratives and their classroom practice. In essence, the salience of the teachers' lived experiences as the subject of their activity system, coupled with dominant social and institutional discourses shaped the teachers' perceptions of their students and "structured ways of thinking and acting in relation to mathematics, teaching, and learning" (Neumayer-Depiper, 2013), including how they attend to their students' collective mathematics identity.

While Jan, Carmen, and Chris had unique personal and academic experiences, I found commonalities across the three. All of the PNTs described being othered (academically and socially). Additionally, All three PNTs noted that their upbringings

were vastly different from their students; thus, they made clear distinctions between themselves and their students. Some of these distinctions prompted them to teach in more open and conceptual ways, while other distinctions create contradictions in this broad activity system, specifically as all three participated in the process of “othering” their students based on academic and social differences (Borrero et al., 20012; Kumashiro, 2000). In addition to othering their students, Jan, Carmen, and Chris each shared similar comments with regard to how their perceptions of what it meant to do and teach mathematics teaching were shifting as a result of participating in methods classes and their newfound teaching experiences.

Being Seen As and Framing Students as “Other”

The PNTs, shaped by their own personal narratives, negotiated participation within the activity systems of their classrooms. Each of these teacher’s narratives included some element of othering, meaning those who privileged more commonly accepted ways of knowing and being marginalized them (Kumashiro, 2000). While Carmen and Chris described being marginalized based on their experiences as students of color in predominately White academic spaces, Jan shared how her language differences as an ELL student left her feeling marginalized at times. While feeling othered by their peers, all three PNTs grew up in middle- to upper-middle-class communities and felt academically supported by their families. I observed that all three of the PNTs made clear class distinctions between themselves and their students; thus, while being othered in their own lives, they, in turn, othered their students, both consciously and unconsciously. I contend that the PNTs’ personal and academic experiences both fostered and constrained their efforts to attend to mathematics identity.

Being seen as “other.” Both Carmen and Chris noted how they felt othered based on their racial and ethnic identities. Carmen briefly noted how her peers’ perceptions of her as an Asian American made her feel the need to excel academically, especially in mathematics. While Carmen shared that she felt as if she were experiencing stereotype threat (Steele, 2003), I argue that Carmen was likely feeling the weight of being considered a model minority (Lee, 2009) based on the perceptions of Asian and Asian American students as academically superior to their peers. Chris provided a more candid reflection of his racialized experiences as a high-achieving Black student in predominately White academic settings. Chris was more explicit about the mistreatment he experienced as a Black student from elementary grades through graduate school. He described feeling overlooked and somewhat invisible, as many of his academic achievements went unnoticed. Slightly different from Carmen and Chris, Jan described feeling isolated and othered based on her ELL status. She was the first ELL student in her school, prompting administration to hire an ELL teacher. She explained that while she felt competent with computational mathematics, she experienced isolation from her peers when self-contained in an ELL support course and experienced frustration when trying to read and solve word problems in English during mathematics class.

Being othered as a source of instructional improvement. Contemporary research in mathematics education has begun to explore how personal and academic experiences influence mathematical practice of teachers of color (e.g., Birky et al., 2013). In their study of highly-respected Black Algebra 1 teachers, Birky and his colleagues made connections between Madison Morgan’s mathematics teaching practice and her lived experiences. They surmised “a part of what allows her to pursue her goals and

create the instruction she creates are her beliefs about students' capabilities, which appear to stem from her own experience as an African American student." Building on this literature, I endeavored to make connections between each PNT's personal and academic narratives and their instructional practices. All three PNTs cited their experiences of being othered and treated differently as a part of their rationale for desiring to teach mathematics in ways that were different from the rigid and rote ways that they learned it. Additionally, all three expressed that feeling marginalized made them particularly sensitive to student differences and used this knowledge to drive their instruction. As Carmen put it, "If I try to teach [in a rote] way to these kids, it's just not possible" (interview, March 23, 2012). Thus, they were all receptive to more student-centered and inquiry-based approaches to teaching. Further, as demonstrated by Jan, they were open to conversations around race and difference in their mathematics classrooms; conversations that Jan claimed improved students' mathematical participation during mathematics instruction because they had strengthened their bonds with one another. In Chris's case, he cited his racialized experiences as a part of his rationale for wanting to adopt a classroom structure that was democratic and conducive to productive dialogue and mathematical argumentation. He wanted to provide his students with a type of instruction that he had not experienced, as he viewed his mathematics instruction as rigid and his teachers as somewhat neglectful because he was one of the few Black students in his classes.

Framing students as other. Just as each of the teachers experienced being othered, either because of language in Jan's case or race in the cases of Carmen and Chris, I contend that the PNTs also shared other commonalities. They all experienced

academic success, particularly in mathematics. They also described commonalities in their upbringings. All three PNTs grew up in middle- or upper-middle class communities and had parents who they described as actively involved in their education. I assert that the PNTs' positioning of their students as different, other, and, in some instances, deficient was related to how they juxtaposed their students' lived experiences with their own. The PNTs drew distinctions between their students and themselves in terms of culture, class, academic achievement or some combination of the three.

Adopting a “those kids” perspective. While recognizing the instances of othering in the PNTs' narratives, it is ironic to note the ways in which they othered their students. In several instances, the PNTs took a “those kids” stance (Zirkel et al., 2011) to understanding their students' lived experiences and academic performance based on these experiences. For instance, they attributed their students' limited academic success to issues such as lack of parental support, low socioeconomic status, and a sense of apathy among Black students. In other words, the PNTs framed their students' experiences as unfamiliar (and possibly subordinate) to their own personal experiences, similar to how Delpit described teachers' experiences when working with “other people's children” (1995/2006).

Throughout Carmen and Jan's interviews, they used language like “high needs,” “low income,” “those kids,” and “at risk” to describe their students. This language use is common within educational discourse and used without cognizance of how words shape our perceptions (Ellis, 2008). Further, both of them shared that their students and their parents did not care. They highlighted concerns like students' lack of participation in class and parents' perceived disinterest in their children's education as evidence of not

caring. In one instance, when discussing how she supported her students and accounted for their lived experiences in her teaching, Jan reflected on her upbringing and the high expectations that her parents placed upon her. She believed that her students lacked this type of support and accountability from their parents. In thinking of ways to support her students, she noted that she had to be mindful of what she asked her students to do for homework because she did not believe her students had much at-home academic support, a stark contrast from her own upbringing. Now whether the PNTs' claims are true is debatable, but what is more striking is the PNTs' broad labeling of all of her students as having parents who are ambivalent about their students' educations, a theme all too familiar in the literature regarding parent-teacher relationships in underserved schools (Delpit, 1995/2006; Fine, 1993).

Ellis (2008), in his study of prevalent deficit-oriented discourses in mathematics accountability systems, argued that assigning the labels of "at risk" or "low-income" without fully considering the loaded meanings and connotations that these labels carry could prove detrimental to how students are positioned for future opportunities in mathematics. In this study, I would contend that while Carmen and Jan both consciously worked to push back against deficit-oriented discourse regarding their students, their personal experiences sometimes attributed to their use deficit-oriented practices and language, which ultimately limited their ability to positively attend to mathematics identity in practice.

Chris distanced himself from his students in similar yet distinct ways than Jan and Carmen. He was forthright about his commitment to teaching Black students and noted that teaching Black students felt like a moral responsibility, a familiar theme that is

prevalent in the literature on Black teachers teaching Black children (Foster, 1997; King, 1993; Milner, 2012; Siddle-Walker, 1996, 2000). However, Chris's case demonstrates that even when Black teachers and Black students share similar cultural referents, Black teachers are not immune to deficit-oriented theories with regard to the history of low achievement of Black students. When Chris was asked why he felt his students were demotivated, he stated, "You know how we [Black people] are," and went on to describe the tendency of Black students to exhibit a crabs-in-a-barrel mentality. As stated in Chris's case, I found this explanation to be simplistic and deficit-oriented at its core. This line of thinking is reminiscent of theories such as Ogbu's (1986) involuntary minority status theory regarding Black Americans and their aversion to academic participation and success. While I understood Chris's perception, it lacked awareness of educational structures, such as tracking, labeling, and sorting, which position some Black students for limited success. In spite of Chris's initial crabs-in-a-barrel explanation, he did acknowledge how the media inundates society with discourses about the inadequacy of Black children. Research in contemporary mathematics education literature (Walker, 2012) highlighted the profound effect of the media's influence on discourses about Black student achievement. While Chris drew on his experiences as a Black person and a mathematics student to understand academic success and failure, he inadvertently othered his Black students, offering an explanation for limited success that I assert impeded his attention to enacting practices that would help his students build positive mathematics identity.

All three PNTs described themselves as mathematically successful. Carmen was less definitive about her identity as a mathematics person as compared to Jan and Chris.

Moreover, she acknowledged that her mathematics identity was malleable and depended upon the company that she kept. On the other hand, Jan and Chris firmly saw themselves as mathematics people. Further, they shared similar conceptions of the nature of mathematics. Jan appreciated the “straightforwardness” of the content (Jan, Interview, May 7, 2012) of mathematics, while Chris appreciated mathematics problems that allowed him to “break them down into steps” (Chris, March 19, 2012) to arrive at correct solutions. While the PNTs recognized that they were successful at mathematics taught in a teacher-centered, rote fashion and strived to do something different for their students, I contend that they all struggled not to let their personal experiences as successful mathematics students cloud their perceptions of their students’ abilities. In particular, Chris openly acknowledged his desire to work with students who were “smart” in mathematics like him as well as his frustration with trying to bring his struggling students along (Interview, March 19, 2012). As the spring 2012 semester progressed, he shared that this line of thinking had been unfruitful to his teaching, yet he struggled to break free of this static and fixed way of thinking about intelligence and wrestled with ideas of smartness all semester.

Preservice and novice teachers’ reliance on their success in mathematics through rote, teacher instruction and the mismatch between this reliance and their students’ needs has been highlighted in mathematics education literature. Rodriguez & Kitchen (2005) noted how secondary mathematics teachers’ salient academic experiences influence their approaches to teaching mathematics, often leading to teacher-centered instruction void of consideration for students’ needs or the sociopolitical climates in which they teach. Further, many secondary mathematics teachers, having had success in their mathematics

careers, often demonstrate what Nathan and Petrosino (2003) coined as an expert blind spot, that is when “educators with advanced subject-matter knowledge . . . tend to use the . . . formalisms and methods of analysis . . . of that discipline as guiding principles for their students’ conceptual development and instruction, rather than being guided by knowledge of the learning needs . . .” (p. 3). I contend that all three PNTs, at various points during the data collection period, unconsciously drew on their experiences of being successful in mathematics and engaged in practices that limited their ability to help their students develop positive mathematics identities, thus creating a contradiction between the subject and object in the activity system. Further, when reflecting on the research questions, the PNTs’ experiences and perspectives were not only a contradiction in the activity system, but I also a force that impeded their attention to mathematics identity in practice. Moreover, their experiences and perceptions shaped the ways they conceptualized mathematics identity, especially their notions of ability and the nature of the tasks they assigned based upon their perceptions.

Tools Related to Mathematics Identity

The tools in the activity system presented in this chapter are comprised of the in- and out-of-school practices and attitudes that the PNTs drew upon to influence their students’ collective mathematics identity. In relation to the research questions, the tools of the activity system represent the ways the PNTs attended to mathematics identity in practice. This study builds on Clark et al’s, (2013a) earlier work regarding two teachers, Madison and Floyd, and the socialization practices they used during instruction to build their students’ mathematics identities. In their work, Clark and his colleagues asserted that the some of strategies teachers employ to attend to mathematics identity appeared to

be non-mathematical in nature, or as Ladson-Billings (1997) described “unmathlike” (p. 705); however, they posited that the acknowledgement of these tools represented the “widening of the lens’ through which we observed mathematics practice” (p. 6).

Further, Clark and his colleagues asserted these non-mathematical practices serve “as implicit supports for students’ mathematics learning, yet may resist classification when viewed through existing mathematics ‘best practice’ instructional frameworks” (p. 6).

In this study, the PNTs demonstrated use of tools that I consider both mathematical and non-mathematical in nature. I will organize the use of these tools into three broad categories: (a) attention to mathematics identity via instructional moves, (b) attention to mathematics identity via planning, and (c) attention to mathematics identity via an emergent sociopolitical stance. While all three teachers exhibited attention to mathematics identity across all three categories, each of the PNT’s cases will serve as an illustrative example of attending to mathematics identity in one the categories. Thus, I will discuss how: (a) Jan is illustrative of a teacher attending to mathematics identity through student-teacher discourse and instructional moves, (b) Carmen’s case is illustrative of attending to mathematics identity while planning lessons and creating mathematical tasks, and (c) how Chris’s perspective illustrates an emerging understanding of the sociopolitical forces that influenced mathematics identity, and in turn, he had a vision for how he wanted to attend to it. Further, I will share relevant literature that is related to each category.

Attention to Mathematics Identity via Instruction

As all three PNTs identified and tried to implement practices that helped their students develop positive mathematics identity, Jan’s teaching practices serve as the most

illustrative example. As noted in her case, I attributed her ability to enact practices that promoted positive mathematics identity partly to her negotiation and establishment of norms, rules, and procedures with her students at the beginning of her tenure. Jan's case is one of tensions and complexities, particularly as it relates to the ability dimension of mathematics identity. While Jan's language during interviews included language that could be considered deficit-oriented, when teaching, Jan consistently tried to send positive messages to her students about their ability.

As noted in her case, Jan employed several strategies that promoted the development of positive collective mathematics identity. These strategies included: shifting mathematical authority during instruction, setting a tone for collaboration, and offering more qualitative feedback on assignments. Shifting mathematical authority and creating collaboration in mathematics classrooms in middle school classrooms that serve students of color is essential, as it helps to build communities of mathematical practice (Lave & Wenger, 1991; Zollman et al., 2011), which position students to see themselves as mathematically competent (Keck-Staley, 2010). Further, these strategies demonstrate to students that they have the capacity to create mathematical knowledge (Boaler 2000). Additionally, when teachers shift mathematical authority and create a classroom climate conducive to collaboration, it highlights the importance of prioritizing student struggle and inquiry in the learning of mathematics (Hiebert & Grouws, 2007; Keck-Staley, 2010; Stein & Lane, 1996). In all, these strategies have been shown to have tremendous positive influence in increasing student participation, shaping the ways in which students participate and see themselves and others as competent, and thus, contributing to their development of positive mathematics identities (Boaler, 2002; Gutierrez, 1996; Horn,

2008). In their study of middle school teachers and students building mathematical competency, Gresalfi et al. (2009) highlighted multiple ways that teachers and students negotiate competency. The strategies used included: negotiating mathematical meaning, considering the sensibility of mathematical decisions, validating each other's ideas, clearing up confusion, and revising work. These elements were present or emergent in Jan's practice, and as such, competency in her classroom was not assigned solely by Jan. Instead, it was distributed across all members of the classroom community. Students positioned themselves and each other as agentic members who were tasked with the responsibility of actively participating, thus demonstrating competency.

Jan and her colleagues credited their summer methods course with their newfound discovery of teaching mathematics in a conceptually rich and student-centered fashion. In particular, Jan highlighted how the instructor of her summer methods course as sparked her desire to evolve from teacher-centered, didactic instruction to a more open, student-centered style of teaching. In mathematics education literature, researchers highlight the role mathematics teacher educators play in not only helping preservice and novice middle-school teachers shift their pedagogical practices via problem-based methods courses, but they also how their methods classes helped preservice teachers shift their beliefs and develop identities as learners who made sense of mathematics, pursued multiple solutions to problems, and made connections within and beyond the discipline (e.g., Crespo and Nicol, 2006; Ma & Singer-Gabella, 2011). In turn, the preservice teachers in these studies aspired to become teachers who could promote similar activity in their classrooms. After analyzing the data, I conclude that Jan and her colleagues followed a similar trajectory.

Attention to Mathematics Identity via Planning

While Jan's case is most illustrative of attention to mathematics identity during mathematics instruction, Carmen's case best illustrates how teachers attend to mathematics identity in an out-of-class fashion, through planning and creating tasks that are both mathematically challenging and relevant to students' lived experiences.

Carmen's attention to mathematics identity is reflective of some of the non-mathematical practices related to attending to mathematics identity that Clark et al. (2013) discussed in their study. Her planning strategies included using cultural referents that accounted for her students' lived experiences as well as modifying curricular materials to meet her students' needs. While Carmen used these tools to positively attend to mathematics identity, her notions of ability sometimes influenced her to plan lessons that minimized her lower-tracked students' opportunities to learn.

Inclusion of cultural referents. In attending to her students' mathematics identity, Carmen deliberately sought to learn about her students' experiences. She sprinkled personal questions throughout her warm ups. She spent time with her students getting to know them and building relationships at lunch. She questioned me about my experiences as a high school teacher who taught at Washington Middle School's feeder high school. Using the information about her students that she gleaned from the activities described above, she made use of her students' lived experiences in her mathematical tasks, as she often drew on contexts important to them as she wrote word problems. She also leveraged her strong interpersonal relationships with her students to increase participation in her classes, as evidenced by her student Guillermo's growth over the spring 2012 semester. Carmen's use of interpersonal relationships and cultural referents

in her instruction are reminiscent of Clark et al.'s (2013) observations of Floyd Lee, a twenty-something mathematics teacher who drew on his experiences in and knowledge of Black youth culture to draw his students into his mathematics instruction. While Carmen did not share similar cultural experiences as her students, she tried to honor what was important to them in her instruction. Thus, through privileging her students' lived experiences, Carmen not only facilitated mathematics instruction that could be considered culturally relevant (Bonner, 2009; Emdin, 2010; Ladson-Billings, 1995, 1997) she also attended to mathematics identity via the nature of her tasks.

Modifying curriculum. Carmen's honoring of her students' lives also showed up in other ways in her planning. Carmen was cognizant that many of her students had not experienced success in mathematics, so she strove to design mathematical tasks that honored their sense making as well as provided them with multiple entry points to the tasks. Carmen included space in her tasks for her students to make observations about what they were observing as they worked. I presented the he function example at the beginning of her case to illuminate how Carmen's students often provided novel and unexpected responses. Carmen struggled with how to respond their ideas, often trying to bridge to more mathematical understandings. Ladson-Billings (1997), discussed the everyday understandings of mathematics that students bring to their mathematics classrooms and how teachers. She highlighted the work of Smith and Stiff (1993), wherein the researchers used storytelling as a means of introducing algebraic concepts.

Despite constraints presented by the State's takeover of Washington Middle School, Carmen tried to tailor her lessons in ways that were conceptual in nature honored and that her students' ideas. As a part of the State takeover, Carmen was required to

attend collaborative planning meetings with fellow mathematics teachers and state representatives. She found the lessons that she and her colleagues planned to be out of alignment with what she had come to value as important to mathematics instruction through her methods classes. Because of this, Carmen modified her lessons to meet her students' needs.

There is evidence that sustained collaboration among mathematics teachers has the potential to “support students’ learning and advancement . . .and provide more resources for students to develop identities of mathematical competence” (Horn, 2008, p. 203). Clark et al. (2013) highlighted the tensions of attending to mathematics identity via the nature of mathematical tasks in low-performing schools. They note that teachers often find pacing guides and required curriculum as “constraining, and [teachers] feel that they must move through content prematurely despite inclinations to broaden the nature of mathematical activity” (p. 20). Carmen expressed a similar concern as we talked about how her collaboration with her colleagues limited her opportunities to explore the mathematical tasks with the depth that Carmen desired. Thus, Carmen found herself tweaking her tasks in ways that were more reflective of strategies she had adopted from her methods courses. This further supports the influential role of methods courses and their potential of shaping preservice and novice teachers’ perceptions about the nature of mathematics and pedagogy.

Attention to Identity via an Emergent Sociopolitical Stance

Chris was, by far, the most limited in his attention to mathematics via his practice; however, he expressed the clearest vision of what it would look like for a teacher to attend to mathematics identity as well as why it was important to attend to in practice.

While I have highlighted some of the more challenging portions of Chris's interviews with regard to Black students and academic success, he was the only teacher in the study who thought about mathematics identity as being shaped by dominant social discourses outside of school. I refer to Chris's awareness of the social and political discourses surrounding mathematics identity and student success as his emergent sociopolitical stance, drawing on Nasir and McKinney de Royston's (2013) framework of adopting sociopolitical perspectives in mathematics education.

Chris recognized the influences that dominant social discourse has on the perception of Black children. In particular, he noted how the media promotes images of young Black people as rappers and athletes with little or no attention to their academic potential. He cited the prevalence of these narrowly defined images of success as detrimental to Black student motivation. In addition to dominant social discourses, he also pointed to the structural effects of racism that he believed made Black students feel inferior, which ultimately led to demotivation and self-perceptions of inability to do mathematics.

Martin (2007b), in the midst of debate regarding what it means to be a highly qualified teacher, posed the provocative question, "Who should teach mathematics to African-American children?" He posed this question, seeking an answer that was not steeped in traditional achievement gap rhetoric or the negative construction of Black children as deficient. He further asserted:

Neither strong mathematical content knowledge nor strong pedagogical skill alone is sufficient . . . Teacher dispositions, racial competence, and commitment to anti-oppressive and anti-racist teaching are just as important as knowledge of

subject matter; a teacher who is truly qualified must demonstrate competence in all of these (p. 10).

While Chris expressed some deficit-oriented perspectives with regard to Black students, he also espoused a commitment to using mathematics as a tool for Black social mobility. Some of Chris's motivations for teaching mathematics were rooted in thinking that has been referred to as liberatory pedagogy in mathematics (Frankenstein & Powell, 1994; Martin, 2009b; Price & Ball, 1998), that is, mathematics education that places "power at the center of its pedagogy and the cultural lives of its students at the heart of mathematics knowledge production" (Price & Ball, 1998, p. 257).

Consistent with Chris's desire for his mathematics instruction to be liberatory in nature, his emergent sociopolitical stance also consisted of a desire to teach mathematics in a way that respected and honored his their aspirations and interests, i.e., instruction that made his students' lives central to instruction of his instruction (Ladson-Billings, 1997; Martin, 2009b; Price & Ball, 1998). He prioritized the importance dimension of mathematics identity, stating that his students' career interests and inspirations should drive mathematics instruction. In other words, he believed that for mathematics to be meaningful to his students, it should be purposeful in their lives, and when possible, situated in contexts that would generate their interest. Nasir, Hand, and Taylor (2008) highlighted the importance of mathematics being purposeful in the lives of students.

They stated:

Students who take their role as learners to be purposeful, integral and active to the collective enterprise may be more engaged in knowledge building activities

than individuals who simply do what is necessary to succeed (or to not get caught failing) (p. 192).

When making distinctions among his students, he noted that some of his students would be successful no matter how instruction was delivered. At the same time, he also shared that some of his students needed the extra motivation to be successful, and for him, providing extra motivation meant helping them to see mathematics as purposeful and relevant.

Taken together, Jan, Carmen, and Chris provide examples of mathematics identity in practice in unique and varied ways. The in- and out-of class practices presented in this section highlight the diverse ways in which mathematics teachers can attend to mathematics identity in practice. Further, the examples selected point to how some practices that would typically be considered as non-mathematical are actually mathematical in nature, in that they influenced the classroom interaction and participation in the PNTs' middle-school mathematics classrooms (Bonner, 2009; Clark et al., 2013; Ladson-Billings, 2009). It is important to note that the tools highlighted in this section did not happen absent of context. These contextual factors, which I consider rules in the activity system, will be discussed in the following section.

The Role of Rules in Attending to Mathematics Identity

As explained in earlier chapters, the rules of an activity system establish the norms in which activity occurs. Rules at multiple levels governed the PNTs' activity systems in this study. In relation to the research questions, I interpreted these rules as forces that the PNTs participated in the MST-Res program, which had a unique set of expectations and commitments to equitable mathematics instruction that influenced

instruction. The PNTs found themselves trying to balance the expectations and commitments of MST-Res while also meeting mandates as established by Griffin County Public Schools and their respective schools. At a micro level, the PNTs also negotiated rules, norms and expectations in their classrooms that influenced their attention to mathematics identity. Each PNT's classrooms was governed by its own set of classroom rules, which I argue impeded or promoted their attention to mathematics identity.

MST-Res and Its Influence on Attention to Mathematics Identity

MST-Res faculty and staff established the program an alternative route to certification for mathematics and science teachers that was unique in its commitment to diversifying the teaching force. In addition, MST-Res had a commitment to developing a cadre of teachers who were dedicated to equitable practice in mathematics and science in underserved schools. MST-Res's programmatic design was purposeful and guided by the tenets of Ladson-Billings' (2006) call for teacher education programs with critical commitments. Ladson-Billings (1994, 2006) noted that many new teachers attribute urban students' misbehavior and low performance to a loosely defined conception of cultural deficit that is often espoused in mainstream society. As such, the MST-Res staff sought to address the unfamiliarity of urban classrooms and the prevalence of new mathematics teachers' deficit perceptions of urban communities, as these teachers have been cited as having incredible rates turnover when compared to other new teachers (Liu, Rosenstein, Swan, & Khail, 2008; Sowder 2007).

Research contends that it is difficult for teachers to critique practices and institutions where they have had success (deFreitas, 2008), thus the philosophical underpinnings of MST-Res served as a force to disrupt the line of deficit-oriented

thinking that has been highlighted among new teachers in urban schools and is an obstacle to developing positive mathematics identity. Courses such as the summer seminar and mathematics methods sought to disrupt what students understood about the nature of mathematics, effective pedagogy, and the sociopolitical nature of the content. All three teachers referred to the influence of MST-Res's stance regarding equity and coursework on their practice. Jan and Carmen cited summer seminar as pushing their thinking about equity and affective dimensions of mathematics instruction. All three teachers cited mathematics methods as being influential to their teaching, especially because they were all accustomed to more rote and teacher-centered methods of teaching.

While MST-Res was an influential force in these teachers' attention to mathematics identity, these teachers were soon faced with the pressures of teaching in a high-stakes accountability context. In the next section, I will discuss how accountability mandates affected how teachers attended to mathematics identity, in particular to the ability and nature of task dimensions.

School and District Influences on Mathematics Identity

National mandates like No Child Left Behind and Race to the Top reshaped the accountability landscape for public schools, teachers and students. The testing mandates put forth by NCLB are intended to “ensure that all children have a fair, equal, and significant opportunity to obtain a high-quality education and reach, at a minimum, proficiency on challenging State academic achievement standards and state academic assessments” (retrieved from <http://www2.ed.gov/policy/elsec/leg/esea02/pg1.html>).

While this legislation has brought the needs of traditionally underserved to the forefront, many argue that this intention has gone awry (Sloan, 2007). Disaggregation of data and

the assignment of labels such as *proficient*, *advanced*, and *basic* to students as a result of their assessment performance have done little to dismantle the educational hierarchy that implies which groups of students can or cannot do mathematics (Ellis, 2008). Instead, labeling practices reinforce these hierarchies and often limit students' academic trajectories and impede their possibilities for constructing positive mathematics identities. Further, the labeling practices prompted by accountability mandates shape teachers' perceptions of their students and inform their practice and planning, often changing the nature of their mathematical tasks based on how their students are labeled.

Influence on the ability dimension. In this study, all three PNTs cited school and district policies regarding standardized testing, a feature of the accountability movement, as forces that hindered their attention to mathematics identity. Jan explained how adherence to test-driven curriculum limited her ability to teach in a fashion that she knew was most effective for her students. Carmen discussed the challenges of teaching in reform-oriented ways as her curriculum was heavily influenced by the State Department of Education and the end-of-year high-stakes assessment. Chris, in a moment of frustration summarized his the influence of standardized testing as an act in producing students who would become widget makers (Interview, March 19, 2012). In our interviews, he mentioned how he felt teachers no longer had the space to “stretch kids' brains” (Interview, March 19, 2012) due to the overshadowing of meaningful mathematics teaching learning with test-taking strategies and test-driven instruction, or what Apple (1999a) would call the “de-skilling” of teaching to meet the demands of high-stakes testing.

While the PNTs acknowledge that school and district forces were challenges to their ability to attend to mathematics identity in practice, all of them tacitly used deficit-laden ability discourse when talking about their students. In every audio-recorded interview, they referred to their students using ability labels. I raise this issue not to condemn these PNTs, but rather to highlight the influence of labels formally assigned via school districts (e.g., advanced, basic, English language learner [ELL], eligible for free and reduced meals [FARMS]) these labels reinforce or disrupt the tacit assumptions that underlie the informal labels like “fast kids” and “lazy kids. (Ellis, 2008; Horn, 2007). Students, as active participants of the classroom, resist or conform to their positioning.

Influence on the nature of task dimension. In addition to the state-required lesson plans being a contradiction to her system, the PNTs’ perceptions about her students’ abilities also influenced the nature of the tasks that she planned. Carmen and Jan described major distinctions between their honors and regular-tracked students, both along academic and social dimensions. With these differences in mind, they explained that they often changed the nature of their tasks and instruction according to which classes they were teaching.

Both shared that their lessons with lower-tracked students were more teacher-directed, while they allowed more space for discourse, questions, and argumentation in their more advanced classes. Jan’s and Carmen’s lesson planning decisions highlight the curricular and instructional decisions teachers make when influenced by tacit and unexamined assumptions about ability (Ellis, 2008; Horn, 2007; Oakes, 2005; Sloan, 2007). Further, research has shown that teachers, influenced by labels such as *basic* and *below-grade-level* often make instructional and curricular decisions based on their

personal theories or beliefs of what these students can do based on how they are negatively constructed (Horn, 2007; Sloan, 2007; Zohar et al., 2001). Conversely, students labeled as *gifted and talented*, *advanced*, or designated to attend *magnet* programs are often provided with qualitatively different experiences (Oakes, 2005), as they often participate in the types of rigorous, problem-based instruction that researchers in education find desirable for all students (Schoenfeld 2002). As Watanabe (2008) explained, notions of ability “serve to reinforce not only teachers’ belief in a linear progression of skills, but also supports their enactment of bifurcated curricula” (p. 518).

All three PNTs taught classes under the pressures of high-stakes testing. Jan taught test preparation courses in the spring of 2012, and Carmen’s school was under state-mandated sanctions as a result of test performance. Diamond and Spillane (2002) noted that schools’ responses to accountability measures were directly related to the schools’ statuses, i.e., how the schools were labeled. Schools marked as probation schools organized themselves around the threat of state takeover. Those deemed as high performing were organized around incentives rather than sanctions. Being organized around sanctions instead of rewards had major implications for the probation school in Diamond and Spillane’s study. The researchers concluded that a focus on curricular improvement and instructional effectiveness was replaced with emphasis on “superficial changes” (e.g., getting a certain percentage of students to pass the test, appearing on-task when visitors came to the school) designed to impress external observers who held the fate of the school in their hands, practices which all three PNTs attested to taking part in at their schools.

Classroom Management Attention to Mathematics Identity

Just as MST-Res and school and district policies created rules that governed each PNT's activity system, at a micro level, each PNT's establishment of rules, norms and expectations, which I call classroom management for the sake of brevity, also influenced each teacher's attention to mathematics identity. Both Carmen and Chris admitted that their lack of rules, norms, and expectations limited their abilities to engage their students in productive mathematical activity and to attend to mathematics identity. In contrast, I argue that because Jan had strong classroom management, she was able to attend to mathematics identity in practice in ways that Carmen and Chris could not. It is important to note that while I observed overt and active resistance (i.e., students refusing to cooperate or disrupting lessons), I also acknowledge that more passive forms of resistance were also evident (i.e., quietly disengaging) and are equally as concerning. Passive forms of resistance, in which students display subtle defiance, are also impactful to the classroom culture (McFarland, 2004). As students exercise agency, they can actively choose to withhold participation (Gresalfi et al., 2009; Hand 2010).

When discussing classroom management and student behavior all three PNTs primarily cited apathy as the primary source of student misbehavior. While I believed that there was some merit to their claims, I wanted to push their thinking about their role in their students' lack of engagement. After extensive conversation, both Carmen and Chris acquiesced to their lack of classroom management as a source of disengagement and opposition. Chris also acknowledged that his reliance upon worksheets also contributed to the disengagement and misbehavior in his classroom.

I assert that these teachers co-constructed the misbehavior and disengagement in their classrooms, that is, the construction of opposition is often the result of participation structures, negotiated by a teacher and her students, that either afford or limit students' the opportunity to participate (Hand, 2010; McFarland, 2004). In a study of a low-tracked Algebra 1 class, Hand chronicled the evolving nature of classroom participation. She studied how students were framed as "oppositional" and as such, students performed as the teacher positioned them. Viewing student misbehavior from a participation lens also highlights the salience of meaningful mathematical engagement to behavior. Defining competence as a process of interaction, students who are deemed as oppositional in one instance are able to negotiate the classroom structure and participate in ways that frame them as competent in other situations.

Division of Labor and Mathematics Identity

Across the three cases, I observed that the rules, norms, and expectations at the classroom level that governed the activity system also influenced the division of labor in the classroom, or how students negotiated mathematical participation. Because Jan had the most clearly established rules, norms, and expectations, she and her students were able to negotiate classroom participation that was more evenly distributed. Conversely, Chris's lack of rules, norms, and expectations resulted in a classroom that was quite teacher-centered, as he was always trying to maintain some sense of order during instruction. Carmen had similar issues with negotiating participation in her classes; however having the opportunity to watch her over time, I observed her implement rules, norms, and expectations in her second year of teaching which led to the division of labor in her class being distributed more equitably across her and her students.

Summary

The PNT's personal and academic experiences and roles at district-, school-, and classroom-levels were extremely salient to both the individual and general activity systems presented in Chapters 4 through 7. What stood out the most across the data is the tension between teachers' well-meaning intentions and their practices as influenced by policy. Each PNT espoused a commitment and dedication to mathematics identity; however, these commitments were not enough to counter the ever-present demands of accountability and the notions of ability that are a result of them. The PNTs in this study were not just influenced by lay culture norms (Tatto, 1996) about mathematics ability and students of color, they taught in a school district that built policies around them.

The power of policy leads me to rethink the role of teacher education as it relates to preparing teachers for schools identified as "high-needs" schools. While I anticipated school- and district-level forces to be influential in each PNT's activity system, I did not expect them to permeate my findings at the magnitude that they did. Though the MST-Res staff, including myself, made our stance about equity and building positive mathematics identity explicit, ultimately, the day-to-day realities of classroom proved to be nearly insurmountable challenges to building mathematics identity, especially to countering fixed notions of ability.

Additionally, looking across the data, it is important to highlight that these teachers were novice teachers at the time of this study. I often wondered if we, meaning MST-Res staff, equipped PNTs with tools to meet the demands of accountability while also being productively subversive (deFreitas, 2004), meaning I wondered if we as instructors and mentor teachers helped the PNTs figure out how to meet the demands of

accountability while countering negative messages of mathematics ability and students of color in high-needs schools. Pushing students to pass high-stakes exams is par for the course when one decides to teach public school. In fact, given the rudimentary nature of the content on standardized mathematics exams, I doubt that anyone would argue that students should not be able to pass them. However, due to a multitude of reasons, students in underserved schools have a history of low performance on these exams, which has created an emphasis on instruction that is test-driven, lacking in rigor, and limited in conceptual understanding (Schoenfeld, 2002).

Looking across these three teachers leads me to think about how introducing mathematics identity to preservice and practicing teachers in high-needs schools should probably be foregrounded with the sociopolitical nature of mathematics teaching in an accountability era. In the next chapter, I will suggest specific implications with regard to my findings and analysis across these cases.

Chapter 8: Implications and Conclusion

While researchers have done extensive work to conceptualize and refine theories of mathematics identity, work on this topic remains primarily theoretical. This study was designed to bridge theory to practice, and thus, I provide implications related to mathematics teacher education and theoretical considerations. In this chapter, I provide a brief overview of the study and key findings. In light of the findings of this study, I also present implications that may inform how mathematics educators approach mathematics identity with preservice and practicing teachers and think methodologically and theoretically about furthering mathematics identity research. I also offer future directions for research related to this study.

Synthesis of the Study

I conducted this study of novice middle-school mathematics teachers' attention to mathematics identity with three primary reasons in mind. First, I was interested in understanding how they were conceptualizing mathematics identity given their prior engagement in summer seminar and their novice teaching experiences. Second, I wanted to investigate how they attended to what they understood to be mathematics identity in their practice. Third, I wanted to glean an understanding of the forces that PNTs saw as influential to their attention to mathematics identity.

I used qualitative methods (interviews, observations, and artifact analysis) and a case study and cross-case research design to highlight the experiences, perspectives, and practices of three novice teachers, who participated in the MST-Res program. MST-Res was an alternative certification program that prepared career changers to teach mathematics and science in schools in Griffin County Public Schools, a predominately-

Black school district with a growing number of Latino students. Griffin County Public Schools had a long, documented history of low performance and struggled with mounting test-driven (Valli et al., 2008) pressures. I presented case studies for three MST-Res practicing novice teachers (PNTs), Jan, Carmen, and Chris, all of whom were my mentees during the 2011-2012 school year.

I investigated how the PNTs conceptualized mathematics identity. Specifically, I explored how these teachers conceptualized mathematics identity along four dimensions: ability, importance, motivation, and the nature of mathematical tasks. I used a metaphor of interlocking gears to represent how these four dimensions were interrelated and interconnected when attended to in practice. While each of the PNTs conceptualized mathematics identity differently, they all viewed it through an ability lens, meaning that the nature of their tasks, their strategies for motivation, and how they saw mathematics as important to their students' future aspirations were predicated upon how they positioned the students as mathematically competent or incompetent.

I used Engeström's (1987; 1999, 2000) activity theory to as an analytical lens to explore each PNT's attention to mathematics identity in his or her classroom, which was the object of each system of activity. Activity theory takes into account the complex, and interconnected nature of social interaction. In the case of each teacher, the PNT of interest was the subject of his or her system of activity. I made connections between each teacher's salient academic personal experiences and their attention to mathematics identity. Rules, both imposed on them by school- and district-level policies and negotiated by the teacher and his or her students, governed each PNT's classroom. I identified the strategies and practices that teachers utilized to attend to mathematics

identity as the tools of their activity systems. Within their classroom communities, PNTs attended to the division of the labor in their classrooms, meaning how participation was negotiated based on the rules, norms, and expectations of the class. All of these elements taken in concert comprised each PNT's activity system.

The elements of the teachers' activity systems promoted or impeded the PNTs' attention to mathematics identity, the object. While I addressed each teacher's system of activity in detail in each case, I also observed salient themes across all of the activity systems, which I addressed in a cross-case analysis chapter. The salience of each teacher's personal narrative emerged across all three PNTs. Specifically, as the PNTs in this study are all teachers of color, they all noted instances of being othered in their educational experiences, and such, they all expressed some sensitivity for their students' differences and tried to make accommodations for those differences in their practices. All of the PNTs also experienced success in mathematics, which, while highly desirable in new teacher candidates, sometimes impeded their ability to effectively attend to mathematics identity in practice.

The teachers in the study attended to mathematics in their practice various ways, which I called tools in the activity system. I categorized these tools in three ways: attention to mathematics identity via (a) instruction, (b) planning, and (c) an emergent sociopolitical stance. Further, I used each teacher's case to provide illustrative examples of what attending to mathematics identity in each category looked like in action. I used Jan's case to illustrate attending to mathematics identity via instruction. Some of Jan's instructional practices included setting a collaborative tone, shifting mathematical authority, and offering more qualitative form of feedback on assignments. Carmen's case

was the most demonstrative of attending to mathematics identity in practice. Carmen's strategies included using students' lived experiences to contextualize mathematics tasks, leveraging her strong relationships in class to direct students toward productive mathematical activity, and making sense of her students' everyday understandings and trying to bridge them to more mathematical ones. Chris's case was illustrative of a teacher attending to identity while adopting a sociopolitical stance about teaching mathematics. Chris's experiences as a Black student in predominately White academic institutions influenced his stance toward mathematics identity that was reminiscent of Frankenstein and Powell's (1994) description of mathematics for liberatory purposes. Chris was aware of the political and social implications of teaching mathematics, thus his attention to mathematics identity included an element of social uplift for Black students and particular attention to mathematics being relevant to the interests and aspirations of his students.

Across all of the PNTs, the rules at multiple levels that governed their activity systems were similar in nature. All three of them taught mathematics in what Valli et al. (2008) characterized as test-driven milieus. Both Chris and Jan taught test preparation courses, while Carmen was assigned to a school being reconstituted by the State Department of Education. These test-driven contexts shaped the PNTs' instructional and planning decisions as well as their discourse, as each of them described students using deficit-oriented language associated with testing and accountability mandates. At the classroom level, classroom management, or the rules, norms, and expectations negotiated with each PNT and his or her students also proved to be a force that either supported or constricted their attention to mathematics identity in practice. Additionally, their

classroom-level rules also influenced how they negotiated mathematical participation, or the division of labor in their activity systems.

Implications

Given the findings of this study, I present several implications across several related areas related to mathematics identity. Given that this study primarily relied on teacher-generated data, I offer suggestions for that may inform how we approach mathematics identity with preservice and practicing teachers. Next, I discuss how this study informed my thinking with regard to conceptualizing mathematics identity. Finally, I reflect on the use of activity theory in exploring mathematics identity.

Implications for Teacher Education

In this section, I present implications related to teacher education and professional development based on the findings of this study. They include the highlighting the role of personal reflection in teachers' practice, encouraging mathematics teachers acknowledged the influence of external forces and to exercise their agency, and assisting teachers in identifying and implementing practices that help shape positive mathematics identity.

Role of teacher reflection. Each PNT's personal narrative was central to how he or she attended to mathematics identity in practice. Their personal stories of academic success influenced how they viewed mathematical success and smartness, their positionings of their students as mathematically competent or incompetent, and their perceptions of parental involvement. In the summer before their first year of teaching, the PNTs wrote and reflected on their mathematics autobiographies, which encouraged them to recognize instances of privilege or oppression that were salient not only to their

experiences as learners and doers of mathematics, but that would also be important to their mathematics instruction.

While the summer course was intentionally designed to promote reflection and to introduce sociocultural and sociopolitical concerns in mathematics education, this work could also be done in mathematics methods courses, as it has been done in other instances. The role of personal reflection is especially important to prospective secondary mathematics teachers who have had success with traditional modes of mathematics instruction in school contexts vastly different than the ones where they will teach (Rodriguez & Kitchen, 2005). Helping preservice and practicing teachers be reflective about their academic and personal experiences helps them to become aware of personal biases about mathematics content, teaching, and learning (deFreitas, 2004, 2008) as well as the sociopolitical nature of teaching mathematics (Crockett & Buckley, 2009; Weisglass, 1994, 1997). Equally important to writing and reflecting on one's own mathematical experiences is the importance of sharing and reflecting on personal narratives with other prospective mathematics teachers. As each person brings unique experiences to teaching, the sharing of personal narratives has the potential to make prospective teachers aware of alternate perspectives and experiences that they had not considered. Zevenbergen (2003) suggested that preservice and practicing mathematics teacher education programs incorporate ideological critiques as parts of the mathematics education curriculum and that mathematics education courses become spaces to challenge the tacit belief systems that appear to hinder the development of critical consciousness necessary for the current public school milieu.

Awareness of external forces and teacher agency. As Michael Apple

eloquently stated, attempts to reform teacher education will “founder on the rocks of the daily life of teachers” (Apple, 1999b, p. 102), if these reforms fail to address the structural forces that establish and sustain specific dynamics of institutional power. As highlighted in this work, contextual factors, or the rules of the activity system, had major implications for how teachers enacted practices to attend to mathematics identity. The high stakes contexts where the PNTs taught mathematics influenced how the PNTs perceived their students’ abilities, the nature of the tasks they created, and how they facilitated tasks. As prospective mathematics teachers prepare to enter schools in similar test-driven contexts, it is important that mathematics teacher educators assist them in raising their awareness of the role of context and its potential to influence how they help shape their students’ mathematics identities.

Related to making prospective teachers aware of the external forces that influence their attention to mathematics identities, mathematics education programs should give explicit attention to how public discourses about who can do mathematics and labeling practices that permeate mathematics classrooms shape mathematics identity. Accountability and achievement gap discourse permeates districts like Griffin County Public Schools, thus, making teachers aware of these prevalent discourses, and in particular how these discourses can negatively influence teachers’ attention to mathematics identity in practice, has promise for unpacking tacit conceptions about mathematics identity and teaching practice (deFreitas, 2008). Raising awareness of the external forces that influence mathematics practice and attention to mathematics identity also creates space for conversations of equitable practice and the political nature of mathematics. Many prospective and novice teachers enter the profession with the

misnomer that learning mathematics is apolitical and neutral (deFreitas, 2004) and should be an individualistic endeavor (Gresalfi, 2009). Discussing mathematics instruction and identity in context opens up room for dialogue about these assumptions and other tacit assumptions regarding ability, race, gender, class, language and the trends of achievement and participation associated with them.

In addition to being aware of deficit-oriented discourse, mathematics educators must highlight the role of teacher agency. As stated in Chapter 7, I questioned my own role in helping the PNTs recognize that they were agentic and that meeting accountability demands was not mutually exclusive to promoting positive mathematics identity. Mathematics teachers educators have to help teachers realize that countering deficit-oriented notions of students in low-performing schools happens in every classroom interaction. Helping prospective and novice teachers identify tools for building identity in test driven contexts is equally as important as raising their awareness about the challenges they will face as they enter the classroom.

Awareness of the varying nature of mathematics identity. The PNTs in this study attended to mathematics identity in varied ways. Each teacher, bringing a unique set of experiences to the classroom, employed practices that looked vastly different, yet contributed to attending positively influencing their students' collective mathematics identity. This study illuminated numerous ways to do so, some more mathematical in nature than others. Given the numerous possibilities for attending to identity in practice, it is important that mathematics educators make visible the ways that teachers can attend to it or are already attending to it in practice.

While the PNTs in this study attended to mathematics identity in various ways, they had trouble identifying instances of it in their practice. Mid-study, I made the decision to create the mathematics identity lesson planning prompts for the PNTs to answer while planning and after their lessons for the very purpose of helping the PNTs think about the ways mathematics identity shows up in practice so that they would learn to recognize these practices in their teaching over time. So, in addition to making teachers aware of the numerous ways to attend to mathematics identity in practice, mathematics teacher educators should also assist prospective and novice mathematics teachers with highlighting instances of attention to mathematics identity in their practices as well as in the practices in other teachers.

Connecting identity to mathematics content and pedagogy. The mathematics identity lesson planning prompts also addressed another concern that arose during our collaboration. I wanted the PNTs to be very clear that attention to mathematics identity could and should be integrated with mathematics content. Through conversation and collaboration, the PNTs discovered that attention to mathematics identity was not an add-on to mathematics instruction; it is a viable and essential component.

In this study Jan attended to mathematics identity through strategies that were not just salient to building mathematics identity, but that were also considered pedagogically sound. By highlighting a strategy such as setting a collaborative tone, teacher educators can help teachers unpack the pedagogical merits of the strategy as well as the strategy attends to mathematics identity, as it promotes mathematical authority and agency. Getting secondary mathematics teachers to attend to more affective elements of mathematics instruction has proven to be difficult, as sometimes these domains of

teaching are seen as additive and not directly related to teaching mathematics (Crockett & Buckley, 2009; Gutierrez, 2012; Skovosmose & Valero, 2001; Sleeter, 1997; Weisglass, 1994, 1997), so for some of them, beginning with something that is of interest to them, i.e., mathematics content, and introducing mathematics identity through it may be the best way to leverage their interest, rather than viewing their disinterest in equitable or affective mathematical practices from a deficit perspective (Lowenstein, 2009).

Rethinking Mathematics Identity

In Chapters 1 and 2, I presented the sociocultural underpinnings that guide most research regarding mathematics identity, primarily originating from Lave and Wenger's (1991) seminal theoretical work regarding situated cognition and legitimate participation. Additionally, I also presented several authors who, in addition to addressing mathematics identity from a sociocultural perspective, have also started to think about it through a sociopolitical lens (e.g., deFreitas, 2004; Martin, 2009; Nasir & McKinney de Royce, 2013). Upon reflection of my findings and analysis, I assert that simultaneously using these theoretical frames has promise for furthering mathematics identity research. While sociocultural and situative perspectives lead us to consider how people come to legitimate participation in communities, sociopolitical perspectives highlight the fact that sometimes the opportunity legitimate participation seems inaccessible based on issues of power and privilege.

The contextual factors that influenced the PNTs' attention to mathematics identity are my impetus for suggesting the power of considering the dual frames of sociocultural and sociopolitical perspectives. Race, language, and ability shaped my data in ways that I had not anticipated, both in the narratives of the PNTs and in their instructional

decisions. Unpacking the influence of these forces in light of sociocultural perspectives is warranted. Additionally, treating issues of race, language, gender, and ability as discrete also lessen the complexities of sociocultural forces. With this in mind, I argue that drawing on theories of intersectionality (Crenshaw, 1991; Hill Collins, 1990; Tate, 1997) highlight the complex nature of students' becoming legitimate participants in while negotiating multiple positionings in mathematics classrooms.

While the gear metaphor for operationalizing particular dimensions of mathematics identity was useful, I did not include a fifth dimension that was highlighted in the mathematics identity literature, attribution, or the people and institutions that students see as influential to their mathematics success or failure (Anderson, 2007; Clark, 2009, Martin, 2000). After some reflection, I think that delving more into how teachers attended to students' attributions for success or failure would strengthen future studies, given the nature of my findings. Each PNT alluded to what attributed to students' success and failure (e.g., lack of parental support and negative images in the media), and a deeper exploration of attribution in the light of the other dimensions could have further informed how the dimensions worked together as the PNTs conceptualized mathematics identity.

Further, in rethinking how I conceptualized the dimensions of mathematics identity, I would have highlighted the role that context plays, especially as it relates to how teachers attend to ability. The ways that the PNTs in this study discussed and attended to ability were inextricably related to their teaching context. Given this finding, I wonder how teachers in other teaching contexts would prioritize ability. I hypothesize that mathematics ability, regardless of whether students are high achieving or failing, is

probably the most prominent dimension of identity, as it sets the tone for how teachers discuss the importance of mathematics, how they design their tasks, and how they choose to motivate their students. Thus I conceptualize ability as the “driving gear” of the metaphorical gear system presented throughout this study. As researchers conduct research to build the mathematics identity literature base, the role of context and its influence on ability must be adequately addressed.

Theoretical Implications of Activity Theory

Activity theory was a useful and productive theoretical frame to use given the nature of this study. It allowed me a way to organize classroom activity in meaningful ways, while thinking about it from cultural and historical perspectives. It also allowed me to look at the relationships between the object of study and influential factors.

Activity theory was useful theoretical frame for studying classroom activity, yet on its own, it still required a theoretical perspective to guide what I highlighted in the activity system. While I used a sociocultural lens for studying classroom activity, I believe that the flexible nature of activity theory allows for future studies adopting sociopolitical approaches (Gutierrez, 2013a; Nasir & McKinney de Royce, 2013) to explore identity within the context of classroom activity. Further, while I opted to examine each teacher’s activity system separately, activity theory allows researchers to look at the relationships between systems of activity. Thus this theoretical framework has potential for studying groups of teachers within schools or school districts.

Data Collection Tools and Procedures

As stated in Chapter 3, I believe that the presence of student voice would have strengthened this study. My claims about the practices that supported or impeded

mathematics identity development were grounded in what I observed and what is available in this particular body of literature. Researchers claim that teachers influence students' mathematics identities in substantial ways (e.g., Gutierrez, 1996, 2013a; Horn, 2007, 2008, Martin, 2007b). By incorporating students' voices in studies of this nature could further inform researchers as to the role and relevance of mathematics teachers in shaping their students mathematics identities.

Another methodological implication arose when considering the importance of student voice in this kind of research. While this study was qualitative, the use of quantitative methods could allow for more large-scale studies of student mathematics identity. Survey data holds promise for corroborating, disconfirming, and informing the pioneering qualitative work in mathematics identity such as student counternarratives (e.g., Martin, 2000, McGee, 2012). As highlighted by the work of Clark et al. (in press), quantitative studies of teacher belief systems about mathematics teaching and learning and their awareness of students' mathematical dispositions further inform the theoretical development mathematics identity as well as teaching practices that attend to it.

Future Research

While conducting this study was been an incredible learning experience, I am left with queries for future result as a result of my findings. Given that research on mathematics identity is relatively contemporary, numerous domains of this work, both theoretical and practical, remain understudied.

A direction for future includes conducting research of this nature with seasoned teachers. The teachers in this study were novices who were still learning their school contexts, middle-school mathematics content, and pedagogy. Given my findings, more

research regarding how more experienced and veteran teachers understand mathematics identity would be informative. Further, how their professional experiences factor into how they approach mathematics instruction and shaping identities in their classrooms could further inform the role of teacher experience and its relationship to students' mathematics identity development.

While race has been highlighted as salient to understanding the mathematics identities of students, very little research exists that examines how teachers' racialized identities influence mathematics instruction and how they attend to mathematics identity in their practice. Researchers have noted the importance and usefulness of considering race and ethnicity as salient factors to mathematics teaching in recent research (e.g., Dee, 2005, Johnson, Nyamekye, Chazan, & Rosenthal, 2013), yet more research is needed as studies, including this one, have noted that teachers' racialized experiences inform the resources that they draw upon while teaching mathematics. Some of these resources include using shared cultural referents while teaching and prioritizing sociopolitical commitments in their mathematics teaching (Clark, et al., 2013a).

The test-driven contexts of the schools in this study influenced how teachers attended to mathematics identity in practice. Given my assertion that district, school, and classroom contexts are central to conceptualizing mathematics identity, more work is warranted in classroom spaces different from the ones in this study. For instance, one query for further inquiry is how teachers would teachers conceptualize mathematics identities in schools that are considered high performing.

Given the implications of this study, future research directions, and the fact that mathematics identity is a relatively new body of literature in mathematics education, I am

encouraged to further pursue this line of research. There are theoretical and pragmatics issues within this body of literature that are ripe for research.

Conclusion

It is my hope that this study highlights that the work of attending to mathematics identity happens in classroom interactions, even in the ones considered minor or non-mathematical. While research has outlined *what* is important to attend to with respect to mathematics identity, this work investigated *how* teachers do it. From spending time in these PNTs' classrooms, I surmise that teachers' potential to positively influence mathematics identity occurs in every teacher-student interaction, every question posed, and every mathematics task assigned. It occurs whether students and teachers are cognizant of it. Further, it is influenced by teachers' experiences and perceptions.

In this study, while exploring mathematics identity from the purview of novice teachers, I aimed to do so in a way that highlighted its role in promoting equitable practice. As noted in Chapter 1, considering mathematics identity as a viable domain of the mathematics teacher knowledge base has implications for equity. Gutierrez (2009) summarizes the tensions of that arise when teaching mathematics and researching it from an equity perspective as follows:

Teachers who are committed to equity cannot concern themselves with their students' self-esteem and negotiated identities to the exclusion of the mathematics that the students will be held responsible for in later years. In answer to which of the two foci are important (teaching students or teaching mathematics), I would answer "neither and both." It is in embracing the tension

(not choosing between the two) that allows teachers to develop their own authentic practices and political clarity around issues of equity. (p. 10)

Drawing from multiple perspectives representing the “social turn” in mathematics education (Lerman, 2000), I conclude that work regarding mathematics identity embraces the tension of attending to mathematics teaching while also attending to equity.

Embracing this tension pushes the boundaries of mathematics knowledge necessary to increase participation for all students, particularly those who have been underserved.

While a sociopolitical perspective of mathematics identity encourages educators to tackle issues of discrimination and power, sociocultural perspectives also remind educators that how teachers and students negotiate participation in classrooms in light of dominant social structures is important. Considering this domain of teacher knowledge moves us closer to the expansive and ambitious pedagogy called for both outside of and within mathematics education (Ladson-Billings, 1995; Lampert et al, 2013). Being an identity worker (Gutierrez, 2013b) opens up opportunities for students change their mathematical trajectories and to have opportunities beyond making widgets.

Appendix A: Sample Interview 1 Protocol

Thank you so much for agreeing to participate in my study. As I've mentioned before, the goal of my study is to explore what it means to teachers to attend to mathematics identity in practice. This is the first of a series of 4-5 interviews. All of the subsequent interviews will follow classroom observations. Today's interview serves as an initial introductory interview. During this time, I'd like to discuss your mathematical experiences and how you believe they have influenced your practice. I expect our interview to last between 30-45 minutes.

Before we begin, however, I'd like to share the informed consent form for this study. Hopefully you've had time to read and review it. Feel free to ask any questions or express any concerns. Also know that you are free to quit this study at any time. Any questions/concerns? (Review form and get signature)

Past experiences as a mathematics learner

- Tell me about your upbringing. Where did you grow up? Where did you go to school? What kind of community did you and your family belong to?
- Tell me a little bit about your own history with mathematics? Did you see yourself as a good/poor student? What do you think made you good/poor student?
- Describe what it was like to learn math as a younger (K-12) student. Was it easy or difficult? Why?
- Who did you look to for support in your math classes?
- Describe an experience where you felt successful in math class. Describe another where you did not feel successful.

Current experiences as a mathematics learner

- Tell me a little bit about your mathematical experiences before deciding to become a teacher.
 - Were you using math in your previous career? If so, how?
 - Tell me about how you decided to teach mathematics as a new career.
- Do you think that your previous career experiences influence how you teach mathematics? If so, how?
- What has been your experience with learning mathematics as a returning student? Has it been easy or difficult? Why?
- Do you like to participate in math/math methods classes? Why or why not?
- Who do you look to for support in your math/math methods classes?
- Describe an experience where you felt successful in math class. Describe another where you did not feel successful.

Mathematics experiences as a teacher

- Describe what a “successful” mathematics student in your class is like. What makes them successful?
- Based on your experiences in the classroom this school year, do you believe that some of your students are just “math people?” Why or why not?
- Do you consider yourself a “math person?” Why or why not?

Mathematics identity in the classroom

- How would you describe mathematics identity? What do you believe it would look like for a teacher to attend to mathematics identity in their classroom?
- Do you feel like there are barriers that prevent you from attending to issues of math identity in your classroom?
- Do you think your students receive messages of ability in the school? In your classroom? What are the messages? How do you reinforce positive or counter negative messages?
- What role should mathematics teachers play in shaping their students’ mathematics identities?
- Do you have explicit conversations or do facilitate activities that address issues of ability, stereotypes, or achievement (gap) issues in class? Do you see this as your responsibility as a mathematics teacher?

Thank you so much for agreeing to participate. I understand that your time is valuable. I hope that as we engage in these conversations, you will find this meaningful to your practice.

Appendix B: Sample Interview 2 Protocol (Carmen)

Reflection on Summer Course

Here's an excerpt from your portfolio that you completed over the summer. I'll give you a few minutes to read.

In third grade, my major goal was to successfully pass the timed division test (correctly answer 100 division problems in 90 seconds) in order to be first in my grade to complete all four timed operations tests. In this specific goal-oriented situation, I engaged with mathematics in a manner that helped me acknowledge that I was capable of learning mathematics. As Anderson states, "Students who adopt the practice of quickly getting correct answers may view themselves as capable mathematics learners" (8). This goal-and-achievement situation greatly shaped my identity as a proficient and competent mathematics student as I went on to successfully complete higher-level mathematics courses in subsequent years.

1. What is your initial reaction to your reflection?
2. (Follow-up, if needed) Do you believe this experience shapes your teaching practice? How so?

Now take a moment to read excerpt #2 (excerpt from math life history interview with student at community center).

Conducting [a math life history interview with a student] has reinforced the notion that students do want to be challenged, and also come to the classroom with a wealth of knowledge. For example, when I developed lesson plans in Methods class, one of the reflection questions regarding the lesson prompted me to think about what I would do for students who found the content overly simple – how would I scaffold for these particular students? Thinking about this important aspect of lesson planning did not immediately cross my mind, at first. I felt planning this aspect would be an extreme, just-in-case situation, and its validity and usefulness would not actually be tested. However, after interviewing Hydeiah and hearing her requests for more challenging work, it solidified the importance of this key aspect of planning – students do want to be challenged and are extremely active learners.

3. What is your initial reaction to your reflection?
4. Would you make any modifications after being in the classroom? Do you still agree with your summer reflection? Why or why not?
5. Reflect on the work we did this summer around mathematics identity if you can. What do you remember? Do you see any aspects of it as relevant to your current work in the classroom?
6. If you could share a few things with the teacher who wrote these reflections over the summer, what would you share with her?

Nature of Mathematical Tasks

1. How do you believe addressing the nature of your tasks will influence a student's mathematics identity?
2. With respect to the other facets of identity (ability, motivation, and importance), why do you think the nature of your tasks is the most important to address?
3. What do you believe it looks like for teachers to think about student identity as they create mathematics tasks?
4. What actions do you take to think about student identity as you create mathematics tasks?
5. What actions/structures (either yours of the school's) do you believe impede your work around student identity?
6. In the lesson that I observed last week, how do you believe you attended to issues of identity through the tasks you chose to introduce functions to your students?

Appendix C: Sample Interview Protocol (Jan Interview 5)

Autobiographical

1. Why teach math instead of science?
2. You mentioned the issues you've been having with ELL students this year. How do your experiences as a former ELL student influence the way you perceive these students and/or what they need to be successful?

Identity in Practice

1. Reflect on teaching the test preparation classes last year. How do you think they influenced how you see student ability?
2. How does doing the same math tasks from last year compare to doing them with your students from last year?
3. Based on last year's work around identity in practice, did it shape the way you approached your students this year?
4. Motivation was an issue when working with your students last year. Are you having similar concerns this year? What do you think is the same/different?

Questions about the Lessons

1. When I observed you the other day, you said things such as:
"I don't remember. I can't help you."
"I don't know the answers. All I do is teach you."
"You all need to check. Get your papers out!"
 What was the purpose behind making these types of statements?
2. *"Do we get what he's saying? Cause I don't get what he's saying?"*
 What was the purpose behind making these types of statements?
3. "Testing" students on their memory of perfect squares. Tell me more about this practice.
4. You said the group I observed was "ready" for discussion and inquiry assignments.
 - a) What made them ready?
 - b) Do you feel like you had a role in their readiness?
 - c) If so, what did you do to prepare them?

Appendix D: Mathematics Identity Lesson Planning Prompts

Questions to consider pre-lesson

1. Does this lesson give my students agency? How?
2. Who maintains the mathematical authority in this task? How do I know?
3. Does the task allow for multiple entry points and perspectives?
4. Does this task consider my students' out-of-school knowledge and perspectives?
5. How does this task encourage students to talk to each other?
6. What would constitute success or successful completion of this mathematical task?

Questions to consider in post-lesson

1. Whose ideas were viewed as important during the task?
 - a. Which students were positioned as “knowledgeable?”
 - b. Which students were positioned as “not knowledgeable?”
2. Did the lesson provide openness for multiple entry points, diverse problem solving strategies? What serves as evidence?
3. How did students that I would consider “high status” respond to the task? Low-status students?
4. Were my students successful (according to how I defined success in the pre-lesson prompts) on this mathematical task?
5. When the task was enacted, was conceptual knowledge prioritized and highlighted? Procedural knowledge?
6. Upon reflection, how would I modify this lesson to better support students in building positive mathematics identities?

Appendix E: Coding Schemes

Biographical Interview and Mathematics Autobiography Data Codes	Interviews 2-6 Data Codes	Observational/Math Identity Lesson Planning Prompts Data Codes
<ul style="list-style-type: none"> • Biographical/Demographic <ul style="list-style-type: none"> ○ Otherness – indicating being othered based on race, language, etc. • Personal mathematics experiences <ul style="list-style-type: none"> ○ Success ○ Failure • Intrinsic success –positioning oneself as success or failure • Extrinsic success – positioned as success/failure via others • Personal motivation to teach <ul style="list-style-type: none"> ○ Factors attributing to teaching ○ Desire to teach • Nature of mathematics • Identity conceptions 	<p>Identity Codes</p> <ul style="list-style-type: none"> • Ability <ul style="list-style-type: none"> ○ Labeling – teacher’s use of deficit-oriented language ○ Othering – teachers positioning students as other • Importance • Nature of Task • Motivation <p>Attention codes</p> <ul style="list-style-type: none"> • Strategies – how teacher attended to Identity <ul style="list-style-type: none"> ○ Relationship building <p>Forces Codes</p> <ul style="list-style-type: none"> • Dilemmas • School/structural 	<p>Identity Codes</p> <ul style="list-style-type: none"> • Ability • Importance • Nature of Task • Motivation <p>Means of addressing identity</p> <ul style="list-style-type: none"> • Teacher discourse • Instructional move <p>Contextual factors</p> <ul style="list-style-type: none"> • Addressing misbehavior • School/structural <p>Influence codes</p> <ul style="list-style-type: none"> • Promote • Impede

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