# ABSTRACT

Title of Dissertation: HOW CAN (WHITE) TEACHERS DO RIGHT BY THEIR BLACK STUDENTS? GRAPPLING WITH WHITENESS IN THE MATH CLASSROOM

Hollie Young, Doctor of Philosophy, 2018

Dissertation directed by: Professor Clark, Department of Teaching and Learning, Policy and Leadership

This research is a collection of three studies that aim to better understand what it might mean for a White teacher to do right by her Black students in a mathematics classroom. By using a practitioner research design, I examine my own teaching in an all Black seventh grade low track mathematics class in an urban school. In the first study I illustrate how obligations to particular perspectives from stakeholders in the role of mathematics teacher can lead to conflicting aims, particularly when analyzing how a racialized lens influences the emergence and management of dilemmas. The second study involves a comparison of the intended and enacted curriculum in whole class discussions to examine students' opportunities to learn mathematical language and concepts. In this study I look at how I grappled with the ways in which Whiteness is assumed as a norm in the presentation of the tasks and suggestions for discussions in a reform-oriented curriculum and in my own commitment to creating access while foregoing precision. The third and final study is a case study with two students to illustrate how a teacher can mediate the relationship between students' perceptions of their mathematical ability and

their participation in discussions. This research serves as one example of how a teacher can interrupt the assumed reciprocal pathways from students' perceptions about their abilities and their engagement in whole class mathematics discussions.

From these three studies, I summarize several themes around what it might look like for White teachers to do right by Black students. By using the phrase do right by to re-conceptualize a traditional notion of equity, I conclude that White teachers can uphold a commitment to serving the best interests of their Black students by developing a racialized lens as they grapple with Whiteness, implement a balanced approach that draws on both reform-oriented and traditional approaches for teaching mathematics, and recognize that context matters when making decisions in a mathematics classroom.

# HOW CAN (WHITE) TEACHERS DO RIGHT BY THEIR BLACK STUDENTS? GRAPPLING WITH WHITENESS IN THE MATH CLASSROOM

by

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Dissertation submitted to the Faculty of the Graduate School of the University of Maryland, College Park in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
2018

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## Dedication

*To my former students, to my children, and to all Black children,*

*with a hope that teachers will try to do right by you*

**Acknowledgements**

First, I want to thank my former students and their families who agreed to let me conduct this research, for without their voluntary willingness to participate this would not have been possible. I would like to also thank Patricia Njenga, a colleague at Applegate, who helped me navigate the process for requesting approval to conduct research in this particular urban district.

Thank you to my committee members from the University of Maryland who graciously read and gave extremely helpful feedback. In particular, I would like to extend a special thank you to Lawrence Clark for stepping in to oversee my dissertation defense in a time of need. My deepest appreciation goes to my advisor, Dan Chazan, who has stood by me over the course of this project from early on when I first decided to return to the classroom to the conclusion of this work. Thank for all the extra time and energy you spent, coming to see me teach, weekly conversations over many years, and being on call when I needed you in the writing process. I cannot thank you enough, especially for pushing me to think and think and think some more.

I would also like to extend a thank you to my colleagues and friends who have helped me along this journey, particularly, Elizabeth Fleming, Dana Grosser-Clarkson, Anne Johnson, and Bedelia Richards. I also wish to thank my children's caregivers, Sarah, Mari, and Betsy, without whom this would not have been possible. In the final stretch, Betsy came through for me in a way that I will forever appreciate. She relieved all of my anxiety about childcare as my children absolutely loved being with her. I appreciate how much of her time she devoted to our family. I thank her from the bottom of my heart.

Last, but certainly not least, I would like to thank my family. A huge thank you to my mom and dad for financial, emotional, and physical support. In particular, I want to thank my mom for doing whatever it was that I needed. She was with me every step of the way. It means the world to me. I love you, mom and dad, to the moon and back. Finally, thank you to my husband for supporting our family, which made it possible for me to finish this program. Thank you for accepting me and loving me without judgment in my moments of being stressed out from this endeavor. And, thank you to my children for bringing me an immeasurable amount of joy each day and for reminding me what is most important to me in this life.

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### Chapter 4

## Chapter 0: An Evolution on Two Levels: Developing Consciousness About Race & Moving into the Role of Mathematics Teacher

"Color is not a human or a personal reality; it is a political reality."

- James Baldwin, *The Fire Next Time*

In this chapter, I attempt to do two things. I describe to the reader my perception of race and the realities of systemic racism, and some of the significant events and experiences in my life as a White, middle-class women that have shaped these views. This includes defining what I mean by Whiteness and how I have grappled with Whiteness in my life. I also present my mindset about teaching mathematics at the start of this dissertation and my evolution as a teacher of mathematics that brought me to this way of thinking. Both of these backdrops are intended to give information that can help the reader better understand my interpretations in this research that I conduct on my own mathematics teaching. Also my mindset and experiences inform the recommendations that I make, particularly for White educators and administrators.

I use an alternative dissertation format for this practitioner research project. Following this chapter, I provide an introductory chapter (Chapter 1) that gives an overview of a particular theme and body of literature that connects three standalone papers. These three papers are each separate chapters (Chapters 2, 3, and 4) and within each I address a separate set of research questions, all linked through a desire to understand ways to create access and empowering mathematics learning experiences for Black students. The final chapter (Chapter 5) is a discussion that brings together what I have come to understand through this research project about mathematics teaching in

relation to the experiences of Black students learning mathematics, as well as some of the relevant questions that have emerged as a result of this work.

Throughout this chapter I use short vignettes that highlight my experiences and my observations that have informed the ways in which I have come to make sense of mathematics teaching and the mathematical learning experiences of my students. These descriptions of particular episodes in my life and my understandings of particular phenomena are intended to help the reader construct a sense of some of lenses through which I am looking at Black students' experiences and mathematics teaching. For those who come to this work not accustomed to seeing through the racialized lens that I describe, I ask that you consider the development of this lens as one example of how a White person grapples with Whiteness and embraces empathy toward marginalized populations. The intent is not to suggest a pathway for how someone should develop a consciousness about race. I recognize that there are many different experiences and decisions that can lead a White teacher to look through a racialized lens. Also, in terms of my thinking around teaching mathematics, I describe in this chapter how I came to champion a particular approach, while in the upcoming chapters I share how I began to question if this particular approach is ideal for all students regardless of context. I ask that the readers keep an open mind, to possible ways of seeing mathematics teaching and to the idea that particular ways of teaching may or may not best serve particular groups of students.

## Developing Consciousness About Race

In this section, I tell the story of my upbringing and my experiences as an adult that are relevant to my development of a racialized lens, by which I mean how I came to

understand race as social categories from which White people in power have created a social hierarchy through systemic discrimination. I begin by talking about the role my mom played in shaping my social justice orientation and my self-reflection on particular experiences that opened my eyes to the salience of race and racism. Next, I share how I came to understand a concept of Whiteness, and what exactly I mean when I talk about grappling with Whiteness in the math classroom. I also describe how my family dynamics became multiracial and how from this I had support, particularly from my sister, in trying to be anti-racist and to be an ally. I present a particular challenge I faced in my friendships with White females and how I opted to protect my energy and emotional well-being as I worked hard to grapple with Whiteness. From here I provide an example in my teaching that opened my eyes to the negative psychological impact that Whiteness has on Black children. Then, from firsthand experiences of living in a particular neighborhood with my African American husband, I illustrate ways in which I saw the intersections of race, class, and gender. Lastly, I attend to ways that I continue to learn about the racialized experiences of Black children and adults from my friends and family.

**Experiences as a Child That Inform How I See Race and Racism**

I grew up in a predominantly White neighborhood with White parents. My dad was a police officer in the nearby downtown area. Both of my parents grew up in a city. They married before they were 20 and neither of them completed a college degree. In fact, none of my extended family members went to college, with the exception of my dad's sister and my two sisters. My mom stayed at home with us as young children and

when we went to school she worked mainly as a secretary for a church and oversaw the religious education program.

My mom instilled in me that judging others based on physical or material characteristics is wrong. She continuously sent a message that everyone is equal. For her this stemmed from her particular religious beliefs. She and my dad raised us in the Catholic Church, and her messaging was inclusivity, even though Catholicism and most other Christian denominations do not share the same sentiments. I gleaned from my mom's messages about religion that no matter what people's faith, Islam, Judaism, Buddhism Christianity, they are all worshipping the same God and a pathway is taken up depending on what feels best to a particular person. I cannot remember specific messages around race, but I know for me her words felt applicable to differences beyond religion. From my affinity for my mom and her words, I found myself at a young age drawn to people's messages about equity and inclusion, particularly, the words of Martin Luther King Jr.

None of us though, are immune from internalized racism. I remember in my dad's conversations on the telephone as he talked with his fellow police officer buddies from work, his use at times of the "N" word to refer to Black people who he believed were involved with stolen property he was trying to recover as a detective in the police force. My mom never spoke up to challenge him in his use of this racist language, but I knew it bothered her and I came to feel the same disgust as my mom. I too realize though that I did not somehow escape from negative stereotypes becoming implicit biases within me. Thinking back to a time when I went to sleep-away camp, I remember my favorite necklace going missing while at the camp. I immediately thought a girl whose name I

don't remember, but who I know was Black, took the necklace. Come to find out I had left the necklace at home and mistakenly thought I had worn it to the camp.

I remember reflecting on this situation in high school. At the time I was on an AAU basketball team and it was a somewhat diverse team. There were a few White teammates who would often shoplift and sneak alcohol from their parents' homes, but the African American girls on my team never engaged in such behaviors and were critical of the girls who did. From this experience I had a counterexample to the negative stereotypes that are perpetuated through media, particularly the news, and from the ways I have heard White people talk about Black people. In this reflective moment I remember having about my sleep-away camp accusations, I of course felt guilt and shame because I realized that it was based purely on bias toward the girl who was Black. This is the first moment I can remember in which I recognized in myself racism. From this point, I found myself more aware and more sensitive to the experiences of people of color, and more conscious of my own biases.

**Racialized Thinking in My Higher Education Experiences & Early Adulthood**

College was a big turning point for me in my journey of becoming more conscious of race and racism. Part of this was due to my experiences with the intersection of race and class. I came from a working class background, although I had friends who had much less than our family and whose parents struggled to make ends meet, so I always thought we were well-off until I went to college. As a student at Colgate, a private liberal arts predominantly White institution (PWI), I began to see examples all around me of extreme wealth among White students. Because of the disparities I saw in the material things that students had, their lifestyles, and their experiences, compared to me, I began

feeling like I didn't belong there. I was accepted into Colgate because I played basketball and I was very good at it. Even with graduating at the top of my high school class, the type of schools from which Colgate admits students were not like the mediocre public high school I attended in a suburb of Western New York. Basketball was my ticket to Colgate. With class differences making me feel a level of discomfort with many of my peers and my social justice mindset that I had from my mother's lessons, I made friends with students of color who had class backgrounds more similar to mine. Also, sports paved the way at Colgate for initiating these friendships across racial lines.

After receiving my undergraduate degree, I was part of many social circles and situations in which I was the only White person. Specifically, these opportunities came from continuing to play basketball after college and engaging in social activities with Black friends. Truthfully, I did not always feel completely comfortable in situations in which I was the only White person, but I knew having these experiences were good for me in the sense that it gave me insights into what it feels like to be seen as different than others. Also, in these spaces, I could listen and learn about the difficult experiences that people of color have daily in this country because of racism. By me putting myself in these situations I continued to increase my awareness of and sensitivity to race and racism. I also was motivated to read about African American history and specifically to learn more of the truth that is not taught in schools, at least not in the schools that I attended. From this reading I gained insights into the collective experiences of a population of people, and I learned how the overt forms of racism that were prevalent at one time shifted somewhat to become more covert, subtle racist acts that are not only from individuals, but part of systems and organizations.

I found in me a passion for addressing inequalities, particularly related to the experiences of Black people in the United States. I began to develop an interest in understanding racial identity, and how these socially constructed categories are taken up and how people can transition in their ways of thinking about race and racism given particular experiences and messaging. I returned to school, earning a master's degree in psychology, working closely with my advisor who conducted research on the racialized experiences of African American students in higher education. During this time, I attended several conferences that focused on race, and how White people, in particular, can work to help address the institutionalization of Whiteness. By Whiteness I am referring to a socially constructed category that gets taken up, often subconsciously, by White people. Whiteness is informed by a particular ideology that is based on the social construction of racial superiority to justify discrimination against particular populations of people, in order to give advantages to White people.

I began to learn how White people can bring a critical lens to Whiteness, including recognizing how White privilege creates advantages, and the various types of policies that can support people of color who would not otherwise have the same opportunities as White people. For me, to grapple with Whiteness means to struggle against a belief that certain perspectives and norms are assumed to apply to and be in the best interest of everyone. With White people holding the majority of dominant positions in this country and a history of a social hierarchy that was created to favor White people, Whiteness carries with it a negative connotation. There might be certain perspectives or norms that White people have that are not inherently bad, but it is in the way in which

these norms and perspectives have become part of systems and used to discriminate against non-White people that is the problem.

I looked at my own experiences as a White person in contrast to what I was learning about the experiences of people of color, and from this found sympathy and passion to address the disparity in people's experiences and outcomes along racial lines. I realized that White people have to challenge each other to see what has been happening with systemic inequities that result from a history of racism. For so long it has been assumed by White people that everyone regardless of color has equitable chances and opportunities, but this is not the case. In a talk from an African American psychologist, Dr. Parham, speaking about how he saw the role of White people in addressing the negative effects of Whiteness, I remember him saying, "Never lose hope in the power to change the human spirit." This belief gave me motivation to want to challenge others and myself to recognize the ways in which we might be taking up and acting on the negative aspects of Whiteness. For instance, in my personal life I remember questioning my dad and his language. Over time I saw in my dad exactly what Dr. Parham described, that is, a shift in his mindset and in his actions.

**My Multiracial Family**

Another huge shift occurred in my family becoming multiracial over time. Shortly after I graduated from college (twenty years ago), my White cousin had two biracial children with her African American partner at the time. Nine years ago, my White sister adopted a 6 month-old Ethiopian girl. Further, just two years ago one of my cousin's sons married an African American woman with whom he has two children. Also, my marriage

to an African American man and our two biracial children shifted the racial composition of my family.

In terms of what some of these shifts in my family did for me in developing race consciousness, I share some of my sister Heather's experiences and how this has influenced me. My sister Heather is very similar to me in her desire for more equity in the world, her awareness of racial bias, and her attempts to be inclusive of others. I am sure this stemmed from our upbringing, particularly from my mom. I know she too has developed close friendships with people of color, particularly her best friend after graduate school who is African American. My sister is also the godmother of her best friend's firstborn child. Fast forward to my sister's pursuit of international adoption from Ethiopia. In this journey, she read countless books, particularly about cross-racial adoptions. We often talked about what she was reading and what it would be like to raise a Black child as a White mom in the United States. She also did not want to strip her daughter of her Ethiopian heritage. My sister spent three months in Ethiopia and has returned several times, working hard to foster her daughter, Sophia's, Ethiopian heritage and a connection to her daughter's family in Ethiopia. She also recognizes that in the U.S., Sophia is Black and with this she knows that a strategic effort is important for Sophia to develop a positive Black racial identity, including decisions around school, church, extracurricular activities, etc.

Race and racism is something that my sister and I talk about quite frequently. It is something that we reflect on daily in terms of our experiences, particularly as White people who are aware of how Whiteness gets taken up and is used to marginalize people of color. Our discussions are often about our concerns for people of color, particularly

our families, in a society in which Whiteness is perpetuated through the institutionalization of racism.

**Exercising Agency in My Journey to Maintain My Well-Being**

Having my sister in my journey to become more race conscious has been helpful because there were many times when I strategically decided to shift my friendships with White women because of their mindsets about race, and particularly about Black people. I do believe in the words of Dr. Parham that I mentioned previously, yet I find that for people who are not yet at a place in which they can grapple with Whiteness, there is much time and energy needed to help raise peoples' awareness. Friendships already require a certain level of time and energy, and this adds another layer, along with an emotional component, that at times can feel overwhelming. Therefore, I have done a lot of "shifting" of my friendships to minimal contact except as a critical voice that may help others become aware of how they are taking up and perpetuating Whiteness.

Here are two example of how this shift has occurred. First, I can remember a close White female friend from college telling me shortly after we graduated that she gets so tired of hearing me talk about race. She wondered why I connect everything to race and racialized experiences, and often felt that I was too sensitive. After this conversation we both initiated some distance with only brief comments back and forth through social media. Also, there was a situation with a White friend from graduate school that led me to shift our friendship. In this instance her fiancé made a racist statement while the three of us were driving in his car and my friend looked at me and said nothing. I cannot remember what he said, but I know that I was upset and confronted him. I asked my friend why she did not speak up and she felt it just was not a big deal. Again, after this

situation there was distance between us, except brief comments or posts through social media outlets. Strategically shifting my friendships has been something I felt I needed in order for me to continue to grapple with Whiteness without letting anger get the best of me, and specifically to continue to make sense of how it gets taken up and what I can do to contribute to the ideal of dismantling this ideology.

Over the years, I have learned more about how I can have conversations about race and racism with White people who have not yet begun recognizing how they are implicated in perpetuating Whiteness. An African American acquaintance of mine told me "Hollie, you are rare," and gave me the book The Fire Next Time by James Baldwin, in which he wrote, "It is people like you who will help to protect us from the fire next time." I am not sharing this for accolades. I humbly share this so that the reader knows I situate myself in a struggle for equality. I am trying to be an ally, which includes grappling with how I act given the ways I take up Whiteness, often subconsciously. I feel this is my daily work, trying to make change for a more just society. Often taking the form of me trying to unpack the biases in me, as well as confronting others when I hear or see what appears to me to be prejudice or discrimination that people are taking up and acting on, and that shape policies and organizational procedures.

**The Effects of Whiteness on Black Children**

There are countless ways in which Whiteness can negatively impact Black children. In one example that I share here, I illustrate the negative psychological effect on a Black child from a White superiority complex that shape Black children's experiences. Specifically, while at my second school, which I refer to as Applegate, a Black boy in the sixth grade asked me "Are White teachers smarter than Black teachers?" The student

demographics at this charter school were typical of the schools in this city, that is, most schools have an all-Black or predominantly Black student body. This student body represents a situation of segregation that bares similarities to a separate and unequal schooling pre-Brown versus Board of Education; however, now infusing White teachers. In this new public charter school only two of the eight teachers were Black and the remaining six were White.

The troubling question rattled me. He went on to say, "Because everyone tells me this is a good school and we have more White teachers here than I've ever had in school, so does that mean they're smarter. Is that what makes it a good school?" I felt sick. I was so deeply saddened and concerned by this student's question. I knew that this student's candid question and commentary was evidence of how deep negative stereotypes, discrimination, and degrading racialized experiences undermine self-confidence and self-worth. Hoping to counter his view, I went on to share names and stories of the lives of incredibly smart Black teachers (much smarter than me) that I know, some of whom were teaching at private schools so their children could attend tuition-free.

Even though race has always been in the forefront of my mind, my student's question sent me into a whirlwind of deep reflection around poverty and race as it relates to schooling, and what it means for *me,* a White woman, to teach Black students. This brought me back to Morrison's (1970) *The Bluest Eye,* in which she shares with the reader the tremendous amount of pain and suffering that people endure when faced with racial injustice and relegated to economically dire situations. Morrison (1970) reminds us of the internalized pain associated with such inequalities, oppression, and the resulting self-hate that can emerge. As I relate this to the schooling experiences of my students, I

recognize that inequalities are complex and vast. Such realities cannot be thought of just in terms of teachers and administrators decisions, or simply funding disparities. Yes, there is an educational debt that needs to be addressed, but the racism leading to inequalities is pervasive; it is found in all arenas of life in the United States. Thus, the particular ways of experiencing mathematics education come from the racialized ways in which opportunities for housing, jobs, childcare, schools, and even transportation play out in this country (see Gaber, 2017 for further commentary), along with the ways in which school staff and students, as well as authority figures in all arenas of life, view and treat Black children (Delpit, 2012).

It is certainly not an equal playing field for Black students. As I mentioned previously, the intersection of poverty adds another layer that drastically impacts Black students' racialized experiences in particular settings. For instance, Black students in poverty, and particularly those living in urban environments, not only face institutional and individual level racism, but also endure the harsh realities of concentrated poverty, specifically, food deserts, inadequate health and dental care, noise and air pollution, the ramifications of an illegal drug economy that brings heightened levels of violence, and a police force and justice system that can be unjust. I also recognize that the intersection of race and poverty leads to my students' limited experiences engaging in intimate positive interactions with other Black people in power positions, such as doctors, lawyers, private company and government agency executives, engineers, school administrators, etc. In particular, having someone of this status as a family member, a neighbor, or close family friend helps students see that they too could have this occupation and they learn through time how to interact confidently with folks in these roles.

This makes me think of Lareau's (2003) research on class, having found that middle and upper class families tend to have more comfort interacting with people in authority roles because of their exposure. For Black children growing up in concentrated poverty, experiences with a culture of power are limited. While Lareau (2003) primarily focused on the ways in which White parents raise their children and did not attend to dynamics of race, I contend that this lack of exposure is due, in part, to the geographical, organizational, and institutional boundaries that quite literally keep people out, particularly Black people from limited means.

The idea that the United States is a meritocracy is quite a fallacy, at least for particular populations. For my student to ask me this question certainly means he likely is not exposed to Black people in power positions whom he looks up to and sees as "smart." But even more so, he has likely experienced or witnessed racism that has permeated his thinking about who can be smart, and he assigns race as a designation related to smartness in deciding who is smarter than whom. This interaction with my student has had a profound impact on me, helping me to realize the depths of the impact of Whiteness on Black children, particularly its negative psychological effects.

**Becoming More Aware of the Race, Class, and Gender Intersections**

In my atypical interracial marriage and daily experiences, I am constantly reminded of the ways in which race, class and gender intersect and result in layers of injustices. My awareness is in part from books and from experiences of friends and family, but also it comes from having seen firsthand such realities living with my African American husband and two biracial children in a predominantly Black, lower-income neighborhood next to vacant houses in the city in which this research was conducted. The

absence of police when it came to issues with the vacant homes next door, such as, prostitution and drug using, and yet the presence of police when my husband's brake light was out has reminded me of the ways in which communities of color, and particularly Black men within these communities, are targeted and denied fair treatment. Specifically, calling the police in regards to the illicit activities next door, often resulted in police showing up at a much later time in the day after the activities had ended; whereas, my husband was pulled over with three cop cars surrounding him for a brake light that had just gone out (he had fixed it the night before). I drove his car the remainder of the week until we could get it into the mechanic on the weekend and was never pulled over for the light being out.

The intersection of race and poverty in the urban environment in which we lived brought also noise pollution and a food desert. I can remember nights when my children as infants were waking up to the fire trucks at the station across the street or the police cars zooming by in the night, sirens blaring. The options for food were limited too in the immediate surroundings, specifically a lack of good quality produce or restaurants that offered healthy options. For instance, in an affluent neighborhood in the city I had lived in previously, I could walk two blocks to find restaurants that offered salads, fresh fruit, and an assortment of produce options at a small grocery store. In the lower-income Black neighborhood where we lived, the closest grocery store with fresh produce was a five minute drive for us, but for people without a car and who did not live as close, it could be a 20 to 30 minute walk, particularly because there were no buses that went down the smaller residential side streets, like ours.

**Further Understaning Racialized Experiences From My Friends and Family**

There is much too that I have learned from the countless stories that my husband and I have shared about the prejudice and discrimination that our Black family members and friends have endured, a combination of systemic and individual acts of racism. For instance, my husband, an alum of the University of North Carolina at Chapel Hill, talked about his father's dream to attend UNC, which he felt was denied due to race. UNC did not admit Black undergraduate students until 1955, and even still in that year only three Black students were admitted. Further, he shared the hostile experiences that his mother and her Black peers endured while attending a predominantly white graduate school in Virginia, which eventually led her to transfer. Granted, these instances occurred fifty years ago, but still today I know firsthand that racism persists.

My sister just recently shared how a White adult in her Black daughter's life stated, "I just cannot believe how smart she is." While this sounds benign, this is someone who readily brags of her (White) children's achievements, and in this instance for my sister it felt like she was surprised by my niece's intelligence because of her racial background. Further, my best friend, a professor, shared how a colleague in the Sociology department at an elite university, a woman who later went on to become the chair of the department and, therefore, someone integral in people's evaluation for tenure, told her that her braids were unprofessional. Also, a good friend of mine, a Black male, was pulled over and pinned to the ground with five police officers pointing guns at him in a case of mistaken identity. With a fear of Black men that police officers, in particular, often demonstrate, he is lucky that he was only knocked to the ground and did not face a

more tragic scenario. The list goes on and on, as it does for most, if not all Black families in this country.

Also in the times my husband and I have talked about what we want for our children, we recognize that with each decision we make for caregivers, schooling, church, dance, music classes, etc., we make them taking into account whether or not there will be people who look like them and folks in charge who we trust to treat our children fairly, something that parents of White children rarely have to think about. I know that this matters for their positive racial identity development and for their feelings of confidence and self-worth, so they can grow and thrive without being subjugated to the psychological impact of feeling othered or judged based on the color of their skin. I also realize that we can't avoid this forever, that they will experience some form of racism in their lives. It is inevitable given the realities in this country.

By sharing my particular experiences that have shaped the development of my racialized lens I am not trying to suggest that these are the sorts of things one must do to become more race conscious. I recognize that each person's experiences are different and the decisions I made are not a prescription of what one must do to develop a racialized lens. However, I do hope to convey that some of my pursuits were strategic, such as, coursework and conferences that attend to the experiences of marginalized populations, reading about the history of race and racism in the United States, and putting myself in situations in which I have opportunities to know what it is like to be the one person who is different in some way and in this same space be able to listen and really hear the voices of people who so often are made to feel uncomfortable and singled out for their differences. I also sought out resources and a support system because grappling with

Whiteness and standing up against systemic racism can be challenging. I shift now to details about my journey in becoming a mathematics teacher and the influence of a racialized lens on this path and in my research.

## Becoming a Mathematics Teacher and the Intersection of Race and Teaching

In this section I summarize what brought me to teach in a particular context, specifically, an urban school district that serves a large population of low income students of color. I give relevant background information about the two schools at which I taught and what these experiences were like. In these descriptions I share how race is salient and how this informed my thinking about curriculum and pedagogy. Further, graduate school is an important part of my learning experiences and I share how this informed my view on an ideal approach for teaching mathematics in the particular context in which I carry out this research. I also unpack my journey in grappling with a White savior complex that is very common for White teachers teaching in low-income urban America. Finally, I share why race is at the forefront of this dissertation in my quest to better understand how White teachers can do right by Black students.

### On Becoming a Teacher in a Particular Context

So, why become a teacher and why in a large urban district in the mid Atlantic? This decision was based on my desire to work in a practitioner role and with a student body whom I care deeply about (i.e., Black students living in areas of concentrated poverty). Again, this stemmed from my upbringing. My mom's messaging around everyone being created equal and her commitment to helping others as part of her religious beliefs, both of which instilled in me a desire to serve marginalized

communities. From other experiences too, particularly through friendships and relationships, courses, research experiences in graduate school for my master's degree, and life experiences more generally, I felt compelled to work with Black students in low-income urban areas.

I went through an alternative certification program in a mid-Atlantic urban school district to become a secondary mathematics teacher, with a middle school endorsement. The goal of the program was to transition people without an education degree into the field of teaching as career changers. I was selected to teach mathematics having some college-level math coursework and an affinity for mathematics. I was required to attend a math immersion program for those without undergraduate degrees in mathematics. I moved into a sixth grade mathematics teaching position at a public charter school.

**My First Teaching Job: Direct Instruction and Racially Hostile Environment**

My first school, which I refer to as Harvest, used a curriculum called DI, which stood for Direct Instruction. This particular curriculum required me to read from the script and students were to answer in unison response when I snapped and said "Now everyone." This approach was not too different from the lecture style, teacher-modeling and lecturing that I had experienced as a young person learning mathematics. In my second year, the school moved to a teacher-produced curriculum that came from the district. It was organized around the skills that students would encounter on the state test. The state standards drove the state assessment, which in turn dictated the content in the district's curriculum. I followed the curriculum, using the recommended "I do, we do, you do" approach.

The student body at Harvest was uniquely diverse for this district, but not the case for the teachers. The demographics for students was approximately 50% White, 30% Black, and 20% Hispanic, whereas the teachers were mostly White. There were tensions around race at this school as the population was shifting, which I came to understand from the veteran White teachers was due to more Black students coming to the school each year, something that a few of them explicitly complained about. The office referrals were overwhelmingly for Black students, which the same teachers used as evidence to support their complaints. I found the White administration was not proactive in addressing what to me seemed to be issues of biases toward Black students that led to disparities in the way they were labeled and treated by many of the teachers. The prejudice from teachers that was creating a negative schooling experience for Black children drove me to work with several families to help them relocate their children to different schools. The following year, I purposefully changed schools due to the lack of support from the White administrators in addressing these issues. I was told several times that I was the one creating these "racial problems" at the school; hence making this a disturbing place to work.

**My Second Teaching Job: A White Teacher in an All Black School**

I moved to a newly established public charter middle school, which I refer to as Applegate. In my first year at Applegate I was the only math teacher. I taught 120 sixth grade students, 30 per class. This new school had a much higher rate of poverty (85% Free and Reduced Lunch) and special needs status (21% of students with IEPs as compared to a national average of 7%) than my previous school. Also, Applegate brought a new dynamic around race – a White teacher teaching all Black students.

Moving to this school after a summer experience at a private school with my former students, I was motivated to shift my teaching to what I now know as reform-oriented teaching. As I began trying this out it initially felt impossible to engage students meaningfully in problem-solving in the ways that I had hoped, given the sheer number of students within each class and the vast array of students' math readiness. Also, I was inexperienced with this different way of teaching that involved reasoning, and I did not know how to overcome students' push back. Finally, there were tremendous demands on the teachers as they played an integral role in developing this new school. I generally resorted to the "I do, we do, you do" model and an IRE (initiate-respond-evaluate) questioning approach. It was not until leaving teaching to attend graduate school and returning to the classroom that I finally felt some confidence in implementing a reform-oriented curriculum and pedagogical approach.

**An Eye Opening Experience: A Pedagogical Approach For Teaching Mathematics**

Many of my fifth and sixth grade students at Harvest seemed to enjoy the DI method, maybe because it felt familiar, given that they had experienced this method since Kindergarten. I noticed though that students who seemed to struggle with mathematics often put their heads down and tuned out. My students did poorly on the state test that first year, maybe because I was a first-year teacher or maybe it was the curriculum and pedagogical approach. In my second year, when I followed the state curriculum with modeling, guided support, and then independent practice, almost all of my students scored proficient on the state assessment with some students scoring advanced. Essentially, I was teaching to the test and it did bring results that were much better than the previous year with only 50% of these same students scoring proficient in fifth grade.

Based on these results, half of my 60 students were selected to attend a summer program that brings together public and private schools to share experiences, expertise and facilities, and to provide enrichment opportunities for public school "inner-city" (their term) students.

As my students rode from the dilapidated neighborhoods in which they lived to the posh setting of one private school, with a campus resembling that of a college, I was faced with a profound awakening. It began in their math class, taught for the first two weeks by my private school colleague. I observed as my students struggled to make sense of mathematical problems that required reasoning and number sense. This teacher pulled from a curriculum called Investigations produced by TERC and from the Connected Math Program (CMP). The task that they encountered on the first day was determining how to fairly distribute five cookies among six people, and how much each child would receive. Not only were my students stumped, but even more unsettling was their tendency to give up or to diligently try to push the teacher to tell them what to do. I also noticed as soon as they came up with an approach for solving the problem, they wanted the teacher to tell them if they were right or wrong. Sometimes they would beg for affirmation. These were my students who had scored proficient or advanced on the state test, who clearly knew, at least for the test, the 45 math skills defined in the state standards for sixth graders. Yet, they struggled to engage in reasoning and problem-solving on what might be considered simple, yet cognitively demanding tasks, some of which were from a K-5 curriculum. I blamed myself. I felt I had done a disservice to my students. I knew I could not go back to teaching the way that I had been.

**Graduate School as a Piece in my Teaching Puzzle**

I entered graduate school part time in hopes of focusing on how to better serve Black students in urban education and in wanting to better understand the research on teaching and learning mathematics. Here I encountered information and ways of thinking that were new to me. I had the opportunity to experience being a student in a mathematics class that prioritized problem-based tasks, student exploration, and discussions about the mathematics. From this class I was reminded of the affective aspects of learning mathematics, particularly as it relates to how one is positioned or positions themselves in the classroom. Through this class and other coursework I learned how I might enact and engage students in cognitively demanding mathematical experiences that build on students' intuitive knowledge, while also helping them develop an understanding of the established conventions and rules of the discipline of mathematics without just lecturing. I also learned about fostering productive mathematics identities, and particularly as this relates to Black students' racialized schooling experiences.

Another Aha! Moment in graduate school came when I learned about using discussions in math class and what these can afford students. Prior to beginning my teaching career, I had never associated discussions with teaching and learning mathematics. I had always experienced lecture style math classrooms, in which the teacher models how to solve a problem and then the students practice the same type of process with a set of similar problems. Students rarely asked why. In fact, if they indicated they were confused, the teacher usually just re-stated the procedures or gave another example. From graduate studies, I saw how a teacher can use students' ideas to drive a lesson through classroom discussions about the math. How empowering this

could be, particularly for Black students who too often are invisible or silenced in a classroom (Delpit, 2012; Martin, 2006).

Further, I continued to reflect on race and poverty, specifically looking at research in mathematics education that considers what is possible (e.g., Ladson-Billings, 2005; Perry, Steele, & Hilliard, 2003), while also thinking about the ways in which a teacher might both enable and constrain students' opportunities to learn in the content and pedagogical decisions that they make. For Black students who are unjustly stereotyped as deficient, I wanted to implement pedagogy and curriculum positions them as capable. After two years of graduate school, I returned to teaching, drawing on what I had learned about reform-oriented teaching. I discuss what reform mathematics teaching entails in the next chapter. Essentially this way of teaching, in an ideal form, makes central students' thinking, offers high cognitive demand problems that are based in seemingly real-world contexts, and gives students opportunities to reason and construct mathematical understandings. Applegate welcomed me back to teach sixth and seventh grade with a reform curriculum called the Connected Math Program (CMP). I taught sixth and seventh grade lower-track mathematics classes. As part of the CMP curriculum and with resources in my tool belt from graduate school, I focused a lot of my attention on facilitating whole class discussions about the math in which students could be active participants.

I went into these two years of teaching and conducting research with a view that reform-oriented teaching is the ideal approach for students, particularly marginalized students. While I was aware of some of the critics of this particular approach within this context, I was not on board with thinking that there might be issues in using a reform

curriculum or pedagogy. As you will see in this dissertation, I call into question my thinking about reform-oriented teaching as an ideal. Before moving to my introduction chapter, I discuss how I transitioned away from a White savior complex to become more of a White ally in my role as a mathematics teacher. I also share why race is a central part of this dissertation.

**Moving Away From a White Savior Complex to a White Ally**

I acknowledge that I was not immune to a White teacher savior mentality when I initially started teaching. By this phrase I am referring to White teachers' beliefs in helping Black students in poverty to "make it out," which is based on a deficit perspective in which a White person sees their knowledge and way of being as something Black children need to save them from themselves. I have come to understand how this way of thinking ignores systemic inequalities and racism, while also marginalizing students' cultural heritage, families, and neighborhoods (Titone, 1998). It is condescending and ultimately unhelpful.

Early on as a teacher, I engaged in reflections about my thinking, as I read more and more about African American history and racialized experiences in the U.S. I became aware of this problematic thinking that I harbored. I began to realize that this came from a misunderstanding of the vast barriers when considering the intersection of race and poverty, and a veil of middle class Whiteness that I needed to remove in order to see the strength and resilience that already existed in my students and their families. In this journey of confronting my own Whiteness, I learned more about the history of slavery and Jim Crow, blockbusting and de facto segregation, systemic discrimination and inequalities, along with becoming more attune to present day racism that takes on many

forms and exists in all arenas of life for Black people. I also began to see the deleterious White hegemonic thinking associated with my narrow view of success. Considering these realities brought me to the question of what it might mean instead for me to try to *do right by my students*. This particular wondering is what took me back to the classroom after a hiatus for graduate school.

As I returned to the classroom to conduct my dissertation research, I also recognized how challenging and complex teaching could be. I often worried if I was doing things the right way or not. I knew that there were ways to implement high quality instruction. I worked constantly to improve my practice, but I also recognized that there were certain problems that could arise that did not always have a right or wrong way to proceed. Teaching as I had come to understand was an uncertain craft. At times looking at and listening to what other teachers were doing helped me better understand the conflicts that I at times felt when there were different motivations and desires for what schooling was to offer students. Some of these goals that folks had at the school in which I taught and conducted this research were based on the same White saviour mentality that I had grappled with, and it was always in the names of equity. It seemed to be prevalent among Teach for America (TFA) teachers. At this school slightly less than half of the teachers were TFA or TFA alum who had remained in the classroom after their two year commitment. Many seemed to feel that their job was to single-handedly address the achievement gap by moving their students two grade levels in one year, a mindset that championed the teacher as all-knowing and the students as deficient.

To me it seemed that TFA in general had particular messaging that instilled in their teachers an elitist, superiority mentality -- we know better than the locals and

because we are so smart and talented we can make change by just being here. In my encounters with White TFA teachers, I have found they seem to focus primarily on addressing the achievement-gap for students of color, while lacking cultural competencies and approaching teaching through a deficit-perspective. I worked as a teacher leader for several years in the district, which placed me in a position to offer guidance to new teachers, and here is where I observed this mindset among White TFA teachers. Thinking that "these kids just need a great teacher and then they will make it out" ignores the harsh realities of an unjust society with considerable bigotry and hate abounding, and instead champions meritocratic thinking. It also creates a racist dynamic involving the all-knowing White teacher who knows what is best for the impoverished child, a mindset that marginalizes Black children's strength, culture, and history. This is not to say that all teachers in this program think or operate in this way. Overwhelmingly though, the White TFA teachers seemed to neglect the racialized experiences of Black students, which Martin (2009) refers to as "learning while Black," and fail to take into account the role of Whiteness, particularly how they are adopting Whiteness and using it to oppress Black students (see Matias, 2013 for more discussion on this issue).

In my return to this school I tried to ally myself with the Black teachers in the building and parents in a way in which I could seek their wisdom and guidance because I knew as a White woman, even with my daily interracial interactions with my friends and family, I have not had the same racialized experiences as my students. I looked to others to help me unpack what it might mean *to do right by* Black students. While the need for institutional changes to address racial injustices are enormous and beyond the scope of my work as a teacher, I did see the micro-level decisions that I made in my classroom and

in my school as a way to genuinely give respect to and care deeply about Black students, their experiences and their futures, to construct positive opportunities for students that are in their best interests, and above all else to steer clear of doing harm by constantly checking myself, my language, my interactions, and my motivations. It was no longer about trying to save students. I tried to think instead of how to do right by Black students.

**Why Talk About Race in My Dissertation**

"So why do I talk about race in my dissertation?" That is what several White scholars have asked me. With a follow-up question of "Aren't looking at dilemmas and opportunities to learn in teaching and discourse relevant to *all* students?" Yes and no. Doing right by students is of course something one would hope all teachers do, if we are defining *doing right by* students as generally attending to and meeting the goals of a curriculum and the needs of the students. However, because we live in a country in which there is a history of oppression and accumulated inequities, and racism is normalized, there are particular populations for whom we have created an educational debt (Ladson-Billings, 2006), and who continue to face systemic discrimination and disadvantages (see Lozenski, 2017 for a discussion of these realities). Therefore for marginalized populations, race is a salient factor. And, for White people too, race is a political reality, even if not acknowledged. Race informs the very foundation on which an institution is built and how individuals within an institution act and are treated by others. It is what has allowed White people to establish unfair privileges and advantages. It shapes who we are and how we see the world. I agree with Martin (2006) that, "disregarding race in discussions of education in America would be dishonest and sloppy science" (p. 198).

Race as a political reality, is in part what makes my students' schooling experiences not the same as White students. They attend a school in which all of the students identify as Black, yet more than 50% of the teachers assume themselves to be White. In contrast, most White students are taught by teachers who look like them with a teaching force that is more than 90% White in the United States. This reality brings an array of issues that are unfairly placed on Black children in schools, many of which I address in my first standalone paper (Chapter 2) about dilemmas in teaching. Further, Black students' experiences in many, if not all, arenas of their and their families' lives are not the same as their White counterparts. I offer some examples here as a lens into why race is salient. In upcoming chapters I return to some of these disparities.

To begin, employment, income, and overall wealth disparities affect Black families across the United States in ways that point to accumulated discriminatory practices. According to Policy Now (2017), a policy research and advocacy organization, "if average Black family wealth continues to grow at the same pace it has over the past three decades, it would take Black families 228 years, and Latino families 84 years, to amass the same amount of wealth White families have today." These disparities come as a result of an unjust history and the persistence of racialized institutional barriers in this country (Kendi, 2017; Kraus, Rucker, & Richeson, 2017). One such barrier is segregation, resulting in part from the discriminatory practices in companies offering loans and selling homes, as well as the design of public transportation that limits where people without vehicles can reside and work (Baum, 2010; Kendi, 2017; Kraus, Rucker, & Richeson, 2017; Wilson, 2009). Limitations are not only present in terms of who lives where and who gets which jobs, but also wage gaps are well documented along racial

lines (Patten, 2016). Food access is also inequitable with food deserts disproportionately impacting people of color in urban environments (Buczynski, Freishtat, & Buzogany, 2015). These particular systemic inequalities are only a part of the story. There are plenty of other examples. And, further, individual racism in the form of overt racist acts and more commonly micro-aggressions caused most often by White people are something Black people have to deal with daily. Throughout this dissertation I continually return to the salience of race as I grapple with what it might mean to do right by Black students.

## Conclusion

At the end of this dissertation I offer recommendations for mathematics teachers, particularly White math teachers, to address concerns of equity that are directly relevant to Black students. Some of the recommendations I offer are ways in which White teachers can grapple with Whiteness in the math classroom. While I know that we cannot individually dismantle an ideology of Whiteness that pervades institutions in this country, each person can work at identifying Whiteness and can act in certain ways that are anti-racist in an attempt to resist their own taking up of Whiteness. My particular story is not a prescription, but rather one example of how a teacher can do this work in her personal life. Developing consciousness about race is not a destination or something one achieves, rather it is an ongoing journey that one agrees to embark on. Further, this dissertation research attends to how a teacher can grapple with Whiteness in her role as a mathematics teacher with Black students. I acknowledge though that each person has a different pathway. I hope that readers of this dissertation see this chapter as a backdrop that informs my particular interpretations and recommendations as I attempt to better understand how White teachers can do right by Black students.

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# Chapter 1: Are There Alternatives to Just Getting Out of the Way? Conducting Research that Considers How White Teachers Might Do Right By Their Black Students

> "*School would be so much better if there were no teachers. I wish they would just get out of the way.*" Riddick T. Parker, Jr., my African American husband, reflecting on how he viewed teachers when he was a child.

## Introductory Stance

This dissertation represents a contribution to the scholarly research and practitioner knowledge on teaching mathematics by considering what it might mean to not harm Black students, and instead to hopefully provide opportunities and experiences that are in their best interest. The overarching theme of this dissertation is a quest to think about how teachers, and particularly White teachers in their unfortunate majority representation in the teaching force, might do right by Black students. My dissertation includes three stand-alone pieces that apply different approaches to studying teacher decision-making in light of Black students' experiences in a society where systemic racism, institutional inequities, and individual microaggressions toward marginalized populations are the norm. While research is supposedly assumed to be an objective practice, the stance I take is a political one. I am driven by a desire to address issues of access and equity that stem from sociocultural and historical realities. Yet in doing this work, I know that white supremacy might be a permanent fixture for my lifetime, and if there is any chance for revolution it will likely be as Martin (2015) contends "violent reform" that is "necessary to change the conditions of African American, Latin@,

Indigenous, and poor students in mathematics education" (p. 22). I do not believe my dissertation is part of a revolution that Martin speaks of, as this would require not merely critiquing, but rather overhauling an entire system of schooling and institutions that perpetuate White norms, values, and sensitivities (see Martin, 2015 on relevance to mathematics education). I still hope though to contribute in some way to the conversation around how teachers' micro-level decisions can be a way for them to act in an anti-racist way that will allow them to do right by Black students in a mathematics classroom, unlike my husband's teachers who too often had a negative impact on his learning and view of himself as a student.

In this dissertation I am looking at one teacher's actions, specifically my practices, to make sense of complexities that are relevant to mathematics teachers more generally. There is certainly a critique of using an N of 1 for a study design in terms of the validity in generalizing one teacher's experiences. Further, practitioner-research may be viewed as a self-serving endeavor and not valuable in terms of the limitations in making broader claims. To address these concerns, I want to make clear that the intent of this work is not to generalize "findings" to teachers at large. Rather, this dissertation is one case that illustrates certain experiences, particularly around facilitating whole class discussions, that I believe many teachers can relate to, not in the exact details, but in the general problems of practice that I consider. In particular, this research speaks to the role of a mathematics teacher in making decisions that can not always be made based on best practices found from empirical data. This is, in part, because some decisions are simply about managing dilemmas, which are unsolvable problems, and other decisions are made knowing there is likely a best practice, although limited information, thus far, that is

specific to a population of students in a particular context. My dissertation offers illustrations of dilemmas in teaching that are relevant to mathematics teachers and considerations of how curriculum and pedagogy might afford or constrain Black students' opportunities to participate in discussions and to learn mathematics concepts and language through whole class conversations about math.

This chapter begins with considerations of what it means to study teaching by teaching. I include examples of practitioner research in the field of education and the contributions this dissertation makes to this literature. There also is a section that attends to why I chose to use a practitioner research study design. Here I share the affordances of this methodological approach, more generally, and, specifically, in relation to the research I am conducting. The next section provides information about the context of the research, as well as the curriculum and pedagogical approach I attempt to use. I move from here to share how I am building on relevant practitioner research, followed by a section on the salience of race and why I use the language of "doing right by" Black students. Finally, I end the chapter with a brief overview of the three research projects in this dissertation.

## Studying Teaching by Teaching: Practitioner Research Study Design

There are many different conceptualizations of practitioner-research. Some views of this type of research are inclusive of the endeavors of teachers taking an inquiry stance (see Cochran-Smith & Lytle, 2009, and Lampert, 2000, for more discussion). In this broad take on the practitioner research genre the teachers are not necessarily trained as researchers. There is an array of language naming these methodological approaches

involving teachers investigating their practices, such as, self-study, teacher research, and action research. These types of practitioner research are aimed at improving teacher practice, both in one's own classroom and in other teachers' classrooms who find the research relevant, or at improving a school (see the following for further discussion: Anderson & Herr, 1999; Cochran-Smith & Lytle, 1993). Often teachers work alongside a university-based colleague to initiate and carry out the research. Sometimes this work is part of a professional learning opportunity, such as, professional development connected to a local university or through pursuits of high education (e.g., Herbel-Eisenmann & Cirillo, 2009). Further, some of this work is carried out by academics studying their practice of teaching at the college level, particularly as a way to examine the teaching of teacher educators (e.g., Adler, 1996).

Another more conservative view of practitioner research, distinguishes teacher inquiry from research conducted by a trained researcher. In this way of thinking, the practitioner researcher is conducted by a professor or doctoral graduate student who returns to the classroom for a short time to conduct research on teaching (e.g., Brantlinger, 2013; Chazan, 2000; Lampert, 2001). Cochran-Smith and Donnell (2006) see this approach as "work by researchers who are also teachers studying their own practice" (p. 507). Further, Cochran-Smith and Donnell (2006) describe this approach as "using practice as a site for research" (p. 507). This type of practitioner research in education became popular in the late 1980's and gained more traction in the 1990s (e.g., Ball, 1993, 1995; Lampert, 1985, 1990; Lensmire, 1994; Wong, 1993). At the height of its popularity in mathematics education, three books written by researchers using this

methodological design came out in a two year span (e.g., Chazan, 2000; Heaton, 2000; Lampert, 2001).

I align myself with this particular conceptualization of practitioner research. As a graduate student interested in studying mathematics teaching, I strategically returned to the classroom to conduct research on teaching, as opposed to being a teacher who opted to carry out an inquiry about my practice. While still many academics are skeptical of this methodological approach, there are reasons why this method makes sense to use, particularly when the aim is to address problems in mathematics teaching practice. In the upcoming subsection I describe some of the advantages of this approach and how these affordances directly relate to the research represented in this dissertation. As I shift to discussing why this research methodology makes sense for the questions I address, I talk about practitioner research assuming that I am referring to investigations conducted by trained researchers, and not for the purposes of improving their practice, but rather to make sense of the nature of mathematics teaching and to address particular questions that can speak to theories and understandings about mathematics teaching.

**Reasons for Using a Practitioner Research Study Design**

As a practitioner-researcher there is insider knowledge of a classroom and a school that cannot be accessed by an outsider conducting research on teachers' decision-making within schools. For instance, teachers have intimate understandings of their students and their experiences in a classroom, some of which might not be realized from an outside observer (e.g., Chazan, 2000; Brantlinger, 2010, 2013). In my research, I have knowledge of our classroom experiences and of my individual students from being together in these roles for a year. I know my students in a way that an outside researcher cannot know

them. Also, I have a keen awareness of classroom dynamics and interactions, again that are informed by my perspective as the teacher, and while I could share this with a researcher, I am not positive that through interviews I could adequately communicate all of the intricate details of what occurs in our classroom and how I know my students. What is more, it is this insider knowledge that I draw on in recalling general and particular classroom tendencies that inform what I make of the experiences in the discussions recorded late in the school year. Also, there are many unique facets of the school, Applegate, that even through interviews with administrators it is unlikely an outside researcher could adequately know and understand. With this awareness of the potential role of the school culture, I bring a particular level of caution in making certain claims about my teaching practices, and can refer to possible ways in which the school culture might be responsible.

Another methodology consideration in researching teachers' practices is how observers can project their own views and beliefs on a teacher and his/her practices (Brantlinger, 2010). Of course all qualitative research is interpretive in the sense that a researcher is making claims based on their views and insights. Yet when an outside researcher conducts interviews with teachers and observes teacher's actions and words, they may attend to an alternative reality as compared to how a teacher-researcher would otherwise view teaching; thereby potentially making the research less relevant to teachers. This is because researchers might hold particular views of teaching and students that lead to claims that might otherwise be seen differently from someone working in the field as an educator. By using a practitioner-researcher study design, I can look directly at how my positionality and experiences relate to the ways in which I am understanding my

students and my decisions, without concern over two levels of interpretive considerations.

Also, in a similar vein to autoethnographies, there is an emotional component in practitioner-research. The emotions come from the commitments and relationships in teaching. When attempting to understand dynamics involving power and culture, it is essential to include the emotional experience of the phenomena (Jones, 2008). I found that emotions were central in my teaching, particularly as a White teacher in an all-Black school who wants to try to do right by Black students. With an insider perspective, I am better able to consider these emotions than an outside observer.

Brantlinger (2013), having conducted practitioner research around mathematics teaching involving a critical mathematics (CM) curriculum in a secondary classroom, contends that "Practitioner research provides an outlook on education that is unavailable through the use of other methodologies" (p. 5). Further, Hatch and Shiu (2012) argue that there are particular benefits to having some of the research on practice conducted by those working as practitioners, just like how "In medicine, both dedicated researchers and practitioners, general and specialist, can and do contribute to the body of clinical knowledge that is derived from accumulated case studies" (p. 298). According to this perspective, practitioner-research is better suited when addressing particular types of research questions.

For instance, the intimate knowledge that comes from practitioner-researchers can be of great benefit when thinking about the nature of teaching (e.g., Lampert, 1985, 2001). In this dissertation, one of the projects (Chapter 2) addresses this area of research by attending to dilemmas in practice. Further, in the analysis I am examining the role of a

mathematics teacher, knowing that as a practitioner-researcher I may be able to identify ways that stakeholders are influencing mathematics teaching, which is something teachers might otherwise not even realize (Chazan, Herbst, & Clark, 2016). That is, if teachers were asked about the obligations that shape their actions, they may not be able to speak to these, as often teachers are unaware of how their actions are influenced by certain norms and assumed ways of doing mathematics teaching (Chazan et al., 2016). As a practitioner-researcher aware of the research conceptualizing the role of mathematics teacher, particularly in the ways that teachers might be constrained by societal norms, context, and institutional factors, I can attend to the obligations that could be shaping mathematics teachers' decisions.

Also, a practitioner-research study design has advantages in looking at the interactions between a teacher's enactment and how students' experience particular curriculum and pedagogy. A teacher-researcher can capture nuances that might only be understood as someone who has a history with a group of students (Hatch & Shiu, 2012). More specifically, Hatch and Shiu (2012) claim that "teachers of mathematics are uniquely placed to investigate - and record - aspects of their teaching, their classroom and their students that are hidden from others" (p. 297). In Chapter 3 of this dissertation, I draw on the particular ways in which I know my students and their experiences. Specifically, I make interpretations that come from my insider knowledge about the role of particular language usage in creating access for my students and the disconnect between their experiences and the CMP curriculum. In Chapter 4, I also draw on the ways in which I understand my students and our interactions in whole class discussions to interpret what I hear them saying in interviews. I believe this is the intimate knowledge

that Hatch and Shiu (2012) speak of, which would be hard to access without spending an exorbitant amount of time in our classroom and getting to know the students and our relational dynamics.

Finally, there are advantages in using this particular methodological design when researching understudied contexts (e.g., Brantlinger, 2013, 2014) and when examining curricular and pedagogical approaches in mathematics teaching that are not readily available in most classrooms (e.g., Ball, 1993; Brantlinger, 2013, 2014; Chazan, 2000; Heaton, 2000; Lampert, 1985, 1990, 2001). At the time of this research, the school district in which Applegate resides did not allow outside research involving teachers or students. However, they did allow teachers and administrators to conduct research after a formal review through their IRB. The director of research of this district had concerns over the all too common deficit mindset in explaining teaching and learning with students of color. He felt strongly about protecting teachers and students in this impoverished urban district from the type of rhetoric that does more harm than good. Potentially for reasons like this and because of a tendency of White academics to avoid such contexts, there is a paucity of research involving teachers and students in all Black schools. Using a practitioner research design gave me an opportunity to conduct research on mathematics teaching in this particular understudied context. Further, reform-oriented curriculum and teaching is not readily available. While there are entire schools and various teachers who attempt to incorporate these approaches, combining both a particular context and teachers using particular approaches is hard to come by.

In addition to many advantages that practitioner research offers when addressing particular types of research questions, there are also concerns raised about this approach.

For instance, some practitioner research is not situated within a research program and attends solely to bettering one's practice. As I mentioned previously, often this type of practitioner research is referred to as action research or teacher research, but the words "practitioner research" are also employed by some to describe inquiries that lack theoretical underpinnings and explicit attention to how the study builds on previous research (see Zeichner, 2007 for further discussion of these critiques). Some of the practitioner research serve as counterexamples in that researchers establish their work within a research program and in doing so attend to the contributions their investigations of practice can make. (e.g., Ball, 1993; Brantlinger, 2014; Chazan, 2000; Lampert, 1990). In an upcoming subsection I situate the three studies from this dissertation in the relevant practitioner research on mathematics teaching and share how I intend to build on this body of literature. Before I do this though, I provide details about the research setting for my dissertation and the mathematics curriculum and pedagogical approach that I use as these details shape the research I draw on.

## Research Context for This Dissertation

In this section, I provide background information about the Applegate and the immediate neighborhood, details about the particular norms and traditions of Applegate that make it a unique urban, all-Black middle school, and my role as a mathematics teacher at Applegate. Also, I provide details about the CMP curriculum and the reform-oriented pedagogical approach I attempt to use in my teaching. I offer additional information about the school in upcoming chapters. Specifically, in Chapter 2 as I describe one of the dilemmas I faced in teaching mathematics I provide information about the collaborative planning efforts at Applegate. I also share more on the culture of

Applegate in Chapter 4, given how school culture relates to the research questions I address around students' perceptions of mathematical ability and participation.

**School Demongraphics**

The research takes place in a middle school in a large urban mid-Atlantic school district. Applegate (pseudonym) is a Title I school approximately 350 students (in 2013-2014), of which 85% of the students receive free or reduced lunch (FARMs). The school is 99% African American and has evolved to having a somewhat diverse teaching staff with 47% White non-Hispanic, 30% Black/African American, 15% Asian/Asian American, and 8% White Hispanic. It is a public charter school, meaning that students living in the urban district can submit an application to be entered in a lottery for the school. In this particular urban district, teachers at charter schools are public school employees of the district. The majority of the teachers at Applegate at the time of this research have taught for more than 3 years. In terms of where the students reside, most come from the immediate neighborhood or adjacent neighborhoods in the Eastern part of the city where Applegate is located. At the time of the research the school is in its seventh year and in the second year of implementing the Connected Mathematics Program (CMP), a reform-oriented mathematics curriculum.

At Applegate, students are grouped in mathematics classes based on their scores on the NWEA MAPs test. Students scoring below grade level are grouped together in smaller classes (<20 students); whereas students scoring at or above grade-level are grouped in larger classes (>25 students). The smaller mathematics classes would be considered "low-track," although the staff refers to these classes as "Number Sense," indicating that this particular group of students likely still needs to work on their number

sense with concepts that were likely part of previous grades. The larger groups, a combination of students scoring on-level and advanced, are referred to as the "Number Analysis" groups, suggesting that tasks may be taken to a greater depth and classes can move at a faster pace, covering more grade-level curriculum than the Number Sense groups. The placement in these classes is fluid in that students can move back and forth between classes, although a great deal of care is issued in making such decisions. While tracking is certainly not a beneficial practice for students in mathematics classrooms (e.g., Boaler, 2006, 2011), teachers at Applegate did not have input into the structure of the mathematics tracking.

**The Intersection of Race and Class in the Immediate Neighborhood of Applegate**

Applegate is tucked away about 100 yards from an extremely busy street. There are many alleys that students cut across on their way to school or headed home. In the mornings and afternoons students can be seen heading to the corner store, which sits just over the sidewalk of the busy street to grab a snack. The choices are limited. Usually students purchase chips or cookies along with a soda or a juice. A majority of the students attending the school reside in the neighborhood in which the school is located or in the immediately surrounding neighborhoods. Some students get rides to school, but most either walk or take public transportation. The bus stop at the end of the school day is very busy with students from neighboring schools also waiting for buses. There are no crossing guards at this busy intersection. Based on district policies, this is not a luxury given to middle schools serving students ages eleven to fourteen. The teachers at Applegate set up a schedule to make sure that adults walk with students out to the bus stop and are present while students are waiting, keeping a close eye on the busy street and

getting students safely across. There are also people from the community walking by and waiting for the bus, as well as heading to the corner store. The White teachers stand out given that close to 90% of the people living in this neighborhood identify as Black.

This particular neighborhood doesn't appear to have quite as many dilapidated or vacant houses and buildings as other parts of the city, but unemployment and poverty run rampant, with an unemployment rate of 14% in this neighborhood and one in four families living below the poverty line (US Census Bureau, 2016). There's also a rather startling $100,000 difference in median home value in this neighborhood as compared to homes in the city overall (US Census Bureau, 2016). These numbers speak to some of the challenges that families who live here face. What is more, due to segregation in the city, my students and their families are likely to only encounter other people who come from a similar socioeconomic background while in their neighborhood, thereby limiting their social networks.

The neighborhood in which Applegate resides is also considered a food desert, a designation given according to the distance to a supermarket, the median household income, the percent of households without vehicles, which measures the overall availability to healthy food. Violence in the neighborhood is a part of my students' realities as well. In the ten years of this particular middle school's operation, six students have passed, four of them losing their lives to homicides committed in the very neighborhood in which the school stands. Racial injustices in the policing and judiciary systems are also affecting my students and people they know, including encounters with a police force that engages in racial profiling, and jail and prison sentences that unfairly target Black people due to discriminatory policies and practices. These experiences speak

once again to the political reality of race, and shed light on the ways in which the intersection of race and class brings great obstacles for students.

**The Applegate Way: What Makes This All-Black School Different from Most**

Applegate has a unique focus on three aspects of health - academic, social/emotional, and physical health. There are well-established school-wide norms, including extensive introductions in sixth grade to the "ways of the school," with a continual reference to these norms (the Applegate way) by teachers, administrators, and students across grade-levels. There are also school-wide traditions and celebrations carried out every year. Teachers introduce sixth grade students to the Applegate way in the first two weeks of school within daily instruction. This way of doing things includes teachers and administrators using harmonicas to signal they need students' attention, a commitment to using a calm tone (rather than yelling), switching classes to classical or jazz music, communication among staff occurring through cell phones rather than a PA system, teachers and administrators eating breakfast and lunch everyday with students in the same groups that are called advisories, and these same adults meeting students outside on the play yard in the morning and walking them out to their bus stops in the afternoon. There is certainly a familial approach evident in the Applegate way, in that students have the same two advisory teachers the entire year, with their lockers to store their things in one of their rooms, and a period of time called check-in and check-out that allow students time to talk with their advisory teachers at the beginning and end of the day. These teachers are also the main point of contact with families around concerns, questions, and accolades.

An important part of the Applegate way is a focus on physical health. Students engage in a minimum of 60 minutes of physical activity during the school day. For many students and on many occasions, there is even more than 60 minutes spent engaging in physical activities. This includes every Friday an extra 30 minutes of structured physical activity. Also, there are 10-15 minutes of a physical activity about two to three days per week incorporated into each mathematics and Humanities classroom (referred to as "Sparks"). Finally, there are opportunities for physical activities, such as football, basketball, four-square, jump rope, dancing, and informal games of tag (i.e., chasing each other around) on the schoolyard for about 30 minutes prior to the start of school, with administrators providing supervision of these activities. There is also no soda allowed in the Applegate school building, even during lunchtime. There are limits to candy consumption, as well, which includes no candy for breakfast and an appropriate amount for dessert at lunch. Even the school uniforms communicate a commitment to physical health. These include shorts or pants and t-shirts made of a dry-fit material that students can easily move in and that wick away sweat and keep them cool.

Another central aspect of the Applegate way are "workouts" assigned for not following an Applegate rules (e.g., no gum chewing, must complete homework) or for any behavior that is seen by teachers as requiring a consequence (e.g., talking back, being late to class, repeatedly not following directions or disrupting others). A workout consists of sitting silently for 20 minutes after school with the workout hosts for the day (teacher-led). There is also a huge emphasis on being kind to each other. Part of the Applegate way is learning what is expected in terms of how the adults want students to speak to them and to each other. In the hallways or in classrooms you can hear teachers saying

"we don't speak to each other like that at Applegate," when a student shouts at another student, uses a harsh tone, or mean language. Weekly advisory sessions occurring one hour per week provide activities that aim to foster certain characteristics, including but not limited to, perseverance, teamwork, compassion, and honesty. These are some of the values of Applegate, for which students earn shout-outs when someone (adult or peer) sees them demonstrating these qualities during the course of a week. In advisory, general education students also have the experience of interacting with four to five Life Skills students during these activities. Life Skills is a program designed for students who have significant disabilities, usually a combination of cognitive, physical, and social/emotional impairments. Teachers strategically engage students in activities to foster compassion, doing the right thing, standing up for others, and interacting with people who are different in some way from themselves.

**My Role as a Teacher at Applegate**

I have worked as a teacher in this particular district for seven years, five of which I taught sixth and seventh grade mathematics at Applegate where I conducted this practitioner research project. I began teaching at this school when it first opened. At that time the founding members looked to teachers for advice and to assist with responsibilities that typically are carried out by administrators. This shifted over time, with much less input from teachers in the year of this project. Two years prior to this research, I had suggested to the administrative team to consider the Connected Math Program (CMP) as a mathematics curriculum for the school, as opposed to adopting the district-endorsed curriculum Agile Minds.

The implementation of CMP began with the sixth grade class in the first year, sixth and seventh in the second year, and all three grades by the third year. In the summer, I also helped organize one day of professional development with a veteran CMP teacher. As the only mathematics teacher of two grades, I had the opportunity to meet with both the sixth and seventh grade mathematics teams. Each grade level met twice each week, and sometimes three times per week to engage in lesson planning, discuss assessments for each unit, address student concerns, and to problem-solve. Early on in the year a member of the administrative team would join us in our meetings, but by the spring their presence at the meetings was minimal. In the next chapter of this dissertation I provide more details about the context of the school and my reasons for using a practitioner research design. I also present why I chose to use the concept of how to "do right by" Black students as a unifying theme across the three standalone projects that comprise this dissertation.

**The Mathematics Curriculum and Pedagogical Approach**

*Reform* curriculum emerged in response to the NCTM's call for shifts in the approach of teaching mathematics. From this call, the National Science Foundation (NSF) funded many curriculum development projects (see Schmidt, McKnight, & Raizen, 2007 for a historical overview), one of which was the Connected Mathematics Project (CMP). This is a middle school mathematics curriculum developed by mathematics education researchers working in conjunction with teachers. In general, reform curricula typically incorporate high cognitive demand tasks that are based in real-world contexts, and the lessons are structured to give students opportunities to think and reason about the mathematics and to come up with their own solutions. Often students are

expected to come up with or at least to consider multiple approaches for solving a problem. The emphasis in reform curricula are often on problem-solving and reasoning, as well as, justifying and questioning. While conventions and processes are addressed, skill-based practice is rarely incorporated. For instance, in CMP there are no problem sets in which students would only practice a series of computational problems or vocabulary lists in which students might define the mathematical terms and give examples.

CMP has the following organizational structure: units, investigations, problems, tasks. This means within a unit there are usually four investigations. An investigation is a set of lessons that are related around a particular topic within a unit. Within each investigation there are typically four problems, or they could be referred to as lessons. Within a problem, there are usually three or four tasks, denoted by A, B, C, etc, and within each task there are usually four to five questions. For example, in the Comparing and Scaling (CS) unit in Investigation 2, there is Problem 2.1, 2.2, and 2.3. These are three separate, but related lessons. The CMP teacher's guide typically recommends one lesson per day, although with the Number Sense groups we usually spent 1.5 to 2 days per lesson, or we would reduce the number of tasks within a lesson to be able to carry it out in one day. The authors of CMP intend for teachers to launch students into the set of tasks within a problem, then to give students time to work in partners or groups to explore the mathematics in the tasks, and finally the whole class comes together for a summary discussion.

For this dissertation, I focus only on the whole class summary discussions. The NCTM Standards (1989) indicates "Communication with and about mathematics and mathematical reasoning should permeate the 5-8 curriculum" (p. 66). Reform curricula,

such as CMP, purposefully incorporate opportunities for whole class discussions. This is based on a perspective that oral communication within mathematics classrooms can provide students valuable learning opportunities to hear the mathematical register in use, to practice and refine their adoption of such language, to clarify their ideas and hear others' thinking about the mathematics, and to learn how to construct arguments and to provide justifications (NCTM, 1989, 2000, 2014). Discourse in what some refer to as *traditional* mathematics classrooms, particularly in whole class discussions, has typically followed a sequence known as IRE, which involves teacher initiation, student response, and teacher evaluation (Cazden & Beck, 2003). however, there are many mathematics teacher educators advocating for whole class discussions that engage students in meaningful mathematics in ways that foster independent thinking, reasoning and justification, and opportunities to hear and use the mathematics register and to develop understandings of mathematical concepts (e.g., NCTM, 2014).

In my work as a teacher-researcher, I looked to the NCTM Standards for Teaching Mathematics (1991) identification of a teacher's role in discourse. Specifically, they see this role as one of a facilitator in which he/she poses questions that foster students' thinking, listens as students share their ideas, pushes students for justifications, shapes the discussion by choosing which ideas to pursue, contributes mathematical language and notation to students' mathematical ideas, and finds ways to ensure students are engaging in the discourse. I worked hard to utilize this pedagogical approach, drawing on numerous resources around reform-oriented pedagogy to guide my practice (e.g., Chapin, O'Connor, O'Connor, & Anderson, 2009; Hufferd-Ackles, Fuson, & Sherin, 2004; Stein, Engle, Smith, & Hughes, 2008). While the NCTM and these texts

share what they view as ideal approaches based on a belief in reform mathematics teaching, the reality is that most teachers attempting to implement a reform curriculum likely fluctuate between traditional and reform pedagogical approaches (e.g., Marks, 2009); thereby enacting more of hybrid. This was certainly the case for me, as I found myself, at times, resorting to more traditional ways of instructing, such as, telling students how to think of a particular problem or concept, or asking questions that would funnel students to the correct answer. The hope is that teachers are intentional in their pedagogical decisions, even if this means drawing on what some see as traditional methods for particular reasons (e.g., Chazan & Ball, 1999). I believe that I at least attempted to be aware of my decisions and why I was making them. Of course, this is not always possible. My daily procedure though was to review my lesson plans that I had created several weeks prior, making notes about strategic ways I might deviate from my lesson plan based on how I saw my students' needs from what happened the day before.

## Building on Relevant Practitioner Research

I offer now an overview of a small body of mathematics education research that investigates the experiences of teachers and their students in classrooms using particular ways of teaching, specifically, reform-oriented curriculum and pedagogical approaches, *and* doing so with a practitioner research methodology (e.g., Ball, 1993; Brantlinger, 2010, 2014; Chazan, 2000; Heaton, 2000; Lampert, 2001). This research speaks to the nature of mathematics teaching, and provides insights and raises questions specifically about implementing reform-oriented curriculum and pedagogical approaches.

In light of the reform movement in mathematics education, Ball (1993) and Lampert (1985, 1990) investigate the challenges that arise in attempting to carry out reform-oriented teaching of mathematics. In doing this, they are using their teaching as cases to address questions about what happens when teachers use reform-oriented mathematics teaching. More specifically, they consider, *What are the particular dilemmas that emerge and what is a teacher's role in handling such dilemmas?* These researchers shed light on problems of practice, and in doing so illustrate the uncertainty in the nature of teaching that stems from competing aims. Similarly, Heaton (2000) attempts to better understand how a mathematics teacher implements a reform-oriented curriculum and practices, although her main focus is on a teacher's learning process as she attempts to engage students in mathematical practices touted as ideal in reform teaching and learning. Chazan (2000) builds on this foundation of practitioner research by considering what is possible in using reform-oriented teaching with high school students in an algebra class. Like Ball (1993) and Lampert (1990), Chazan (2000) considers the opportunities for students to learn what it means to do mathematics from this orientation of teaching and what particular mathematics is available through the interactive constitution of classroom activities, such as, mathematical conversations. Chazan (2000) also attends to dilemmas that emerge, building on understandings about the nature of mathematics teaching when using a reform-oriented pedagogical approach. Further, from this work and Ball's investigation of her practice at the elementary level, these researchers advance conceptualizations around a teacher's role in classroom discourse (Chazan & Ball, 1999).

Following the tradition of this variety of practitioner research, Lampert (2001) draws heavily on the education literature for conceptual and analytical models as she uses her teaching practice as a site of research. For example, she looks to the "triadic nature of the relationships in teaching practice" (p. 477) conceptualized by education researchers (e.g., Cohen & Ball, 1999), and from this examines the nature of each of the three relationships among a teacher, her students, and the content. Further, she uses systemized ways to record and collect data from her classroom over the course of a year. She received funding from the National Science Foundation to conduct this research, and particularly to catalogue the data in digital form so that others may use it, as well, to study the practice of teaching. Lampert (2001) considers the many aspects that comprise the role of teaching mathematics. For instance, teaching the whole class, teaching to establish a classroom culture, and teaching to connect content across lessons are a few of the many aims in teaching that she investigates. Overall, she is addressing the nature of mathematics teaching when using a reform-oriented approach, while also considering how to use the everyday artifacts of teaching and learning to better understand the problems of practice.

In their practitioner research, Chazan (2000) and Brantlinger (2013, 2014) also, importantly, examine some of the ways in which context matters, attempting to make sense of some of the complexities in using a reform-oriented pedagogy, and for Brantlinger (2013, 2014) with a critical mathematics layer. Both researchers consider how a particular population of students in a particular context experience these approaches to teaching and learning mathematics. Brantlinger (2013, 2014), in particular, examines how this approach disrupts some of the patterns of disengagement stemming

from the traditional schooling process that does not honor societal realities and what they mean for racially and ethnically marginalized students in a unique schooling setting. In my work, I aim to also consider the ways in which a particular context, specifically, an all Black Title I school in an urban district, influences students' experiences with certain aspects of a reform-oriented curriculum and teaching approaches, specifically, whole class discussions and the decisions I make during this part of the lesson.

In this body of practitioner research, it is evident that the researchers all have a desire to do right by their students in the schooling process. That desire is also likely what drives other mathematics educators, practitioners and researchers alike, who pursue the use or examination of particular curricula or pedagogical approaches, taking into consideration who the students are and how they experience the learning process. My research attempts to build on this work by addressing research questions that relate to an understudied school context while aiming to apply more recently developed conceptual frameworks that may shed new light on some of the complexities of teaching mathematics, specifically as they relate to questions of access and equity while using reform-oriented curriculum materials and pedagogical practices.

## The Salience of Race in This Research

Martin (2006) argues that "views of mathematics as context-free and culture-free often omit discussion of or deny the effects of the racialized experiences of African Americans in mathematics learning and participation" (p. 204). As I mention in Chapter 0, I recognize that my students' experiences of learning mathematics while Black is a function of not only how they are perceived and treated within a school and a classroom,

but the ways in which race shapes their everyday experiences in a society that propagates racist ideologies and perpetuates institutional barriers, as well as individual microaggressions. Martin (2000) found that these shared experiences of being Black in the United States, along with school-level factors, are what make the racialized mathematical learning experiences of Black children. To ignore these racialized experiences is problematic.

In this dissertation, I look to a societal context as a backdrop in considering my students' experiences in and psychological orientations toward mathematics. Spencer (2009) explains that "the experiences of African American children in mathematics are racialized" because "their experiences are shaped by their unique historical and social realities and relationships with the dominant culture" (p. 201). This brings me to the concepts of Whiteness and "doing right by" Black students. I use the concept Whiteness to capture what it is White teachers may need to wrestle with when considering how to "do right by" Black students, which refers to a way of addressing the particular experiences of Black students in teaching that goes beyond equity.

**The Concept of "Do Right By" Black Students**

I use this language "do right by" as a way to recognize and honor a collective Black struggle and a shared cultural heritage of people from the African diaspora. This phrase is something familiar to me from being in predominantly Black spaces through playing basketball, spending time with Black friends, and in being with family through marriage to my African American husband. Also, I am rather certain that I have come across this phrase through my appreciation for literature, plays, and poetry written by Black authors, playwrights, and poets. I cannot pinpoint exactly when and from where I

took up this phrase, but this collection of words and how I hear it used in Black spaces feels like it captures what I hope educators and researchers can do to attend to the needs and experiences of Black students learning math and in a way that goes beyond the concept of equity. More specifically, equity to me is about fairness. Yet, "doing right by" in a mathematics classroom is more than this. It is about being anti-racist. This means that for me and other White teachers, we have to identify ways in which we, often unknowingly, take up Whiteness, and find ways instead to resist the tendency to act according to assumed ways of doing things that marginalize or discriminate against non-White students. Doing right by is about social justice and attempting to provide opportunities and experiences that empower Black students, from which they can feel confident and capable in doing mathematics, and give them high quality instruction from which they can develop and build in-depth mathematics knowledge and understandings. It is about honoring the cultural heritage and experiences of Black youth, and being part of the efforts to challenge the institutional racism, systemic inequities, and individual microaggressions they face in mathematics classrooms and schools in general. Moreover, it is about recognizing even in the efforts of well-intentioned liberal-minded White people, there are agendas that might not be in the best interests of Black students as they are learning mathematics.

By using the phrase "do right by" in my work of studying mathematics teaching, I aim to do the following: (a) apply a racialized lens in teaching mathematics and in my research to study teacher decision-making that recognizes historical and sociocultural oppression, (b) work to better understand the academic and social experiences of Black students engaging with particular mathematics in a particular context so that I can

communicate what I learn about my own grappling with Whiteness as a mathematics teacher, and (c) use what I learn to make recommendations in hopes that I can help other White teachers and administrators move beyond the equity rhetoric that characterizes Black students as deficient and consider the role of context in determining what is best for a particular population of students. I am intending to look at ways that educators might support Black students in learning the content of mathematics in a caring, respectful, and just way without falling into a trap of viewing what is possible through a lens of Whiteness.

In this dissertation I draw heavily on the work of Black academics, as I feel this is essential in understanding how to provide Black students what it is they need in mathematics classrooms to find their success (see Delpit, 1986, 1988, for a discussion on the detrimental exclusion of Black educators and researchers in these conversations; see Martin, 2007 for a discussion on the use of the term success versus achievement). By talking about "doing right by" Black students, I hope to convey that this is not about White people figuring out what is best for Black students. Rather, I am one White person, attempting to use my race consciousness to contribute to conversations about the mathematics teaching and learning of Black children, and I am trying to do so in a way that sees Black voices, culture, and understandings as the prominent views on which to draw.

**Grappling with Whiteness**

In order to do right by Black students, teachers will have to grapple with Whiteness. As I stated in chapter 0, I see Whiteness as a socially constructed category in which there is an ideology of dominance and superiority. While all groups of people

naturally see their perspectives and ways of doing things as the ideal, having had predominantly White people in power and a history of using race as a social category to keep people of color from power positions, there is a negative connotation with Whiteness. The exclusion and oppression of people of color by Whites for hundreds of years through systemic efforts means that Whiteness brings with it certain advantages for only White people that come as a result of discriminating against people of color. While White people individually may claim to not be racist, the system is already designed to favor Whites; therefore, we cannot escape systemic racism and inequalities. By being White and operating in this system, cashing in daily on the privilege of being White, including not even having to think about race and racism if one so chooses, White people can take up Whiteness and in doing so continue to marginalize people of color.

By grappling with Whiteness, teachers can come to terms with White privilege. They can come to better understand the experiences of non-White people, given the presence of institutionized discrimination. They can learn about a history in this country that brought about Whiteness as a social and political construct. Further, from these understandings, people can develop a racialized lens that takes into account these historical and present day realities that perpetuate inequalities. In this research I explore the role of my racialized lens as a mathematics teacher who tries to take into account these realities when making decisions with all-Black students in my classroom. I consider ways in which I grapple with Whiteness in hopes of making sense of how White mathematics teachers can attempt to do right by Black students.

## Overview of the Three Projects

In the next three chapters, I present three stand-alone research projects. Each project includes research questions, a literature research, methods and analysis, and a conclusion. The first research project (Chapter 2) focuses on dilemmas. In this research I considers how conflicts arise from competing obligations that are part of the role of mathematics teacher and the ways in which a racialized lens influences some of the conflicts. The second research project (Chapter 3) focuses on students' opportunities to learn the mathematics register by considering language usage in whole class discussions as compared to the intended curriculum. The third research project (Chapter 4) looks at how a teacher's practices in whole class discussions can influence the relationship between students perceptions of their mathematical ability and their participation. Throughout the three research projects, I try to make sense of what it might mean to do right by my students in hopes of contributing to a conversation around how teachers, and particularly White teachers, can do right by Black students.

As you read this dissertation, I ask that you keep in mind an argument from McDonald (1992) that researchers and practitioners need to embrace teaching as an uncertain craft. Specifically, he recommends that doing this involves looking to teachers to learn about this uncertainty and how they manage it. Here he articulates this view of teaching:

> I suggest we start by attending carefully to what teachers say. Teachers are, after all, closest to teaching. Although they are as weighted as other interested parties by false certainties, they must also manage the work day as it actually is. One consequence is that, at least tacitly, they come to know teaching's

> uncertainty and how to manage it. This knowledge embeds itself in what they say. (McDonald, 1992, p. 8)

According to McDonald, listening to teachers is a way we can come to better understand the uncertainty in teaching and how teachers negotiate decisions. Using a practitioner research study design creates a particular opportunity for advancing knowledge about teaching mathematics that is closest to the work itself. If there are ways in which teachers can make decisions to do right by Black students, it is likely these understandings will come from teachers.

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## Chapter 2: Managing Dilemmas in Mathematics Teaching: A White Teacher Grappling With How To Do Right By Black Students

### Introduction

In this work, I utilize a practitioner research design to study internal conflicts that resulted in two dilemmas in my own mathematics teaching with seventh grade students in an all-Black urban middle school. I first turn to the education literature on what is meant by a dilemma and why teachers are seen as dilemma managers. Next, I describe some of the ways in which I see and know my students and their lived experiences as Black children in a U.S. schooling system. That is, I consider what it means to look through a racialized lens, coming from my eyes and my words, and taking into account experiences of those close to me in a multiracial social and familial world within which I live. After laying this backdrop, I share my thinking about how teachers can get it right for Black students, including some of the uncertainties and questions around what this could entail. Next, I describe the methods I used to recall how the dilemmas unfolded, and then I move to the conceptual framework that I employed for analysis. By analyzing competing obligations I share how I was pulled in different directions, leading to internal conflict and the emergence of dilemmas.

In my description of the first dilemma, referred to as the computational skills dilemma, I provide a hypothetical conversation with colleagues that portrays different tensions based on the relevant competing aims of teaching and learning mathematics. I share how I managed this dilemma as a way to illustrate how these problems of teaching are not solvable. From here I move to an analysis of the competing aims that obligate teachers of mathematics. Further, I bring to light how aims around wanting to do right by

Black students contributed to these tensions. Next, I offer details about a gendered discussion dilemma. Through a letter written to my son I hope to provide the reader with some of the differences in the lived experiences of Black boys as compared to Black girls. This sets the stage for my description of how I managed this dilemma involving gender equity concerns, specifically around who participated in the spontaneous student-led dialogue about mathematics. From here I analyze the competing obligations to various perspectives on teaching mathematics, and describe how I grappled with these goals as I kept an eye toward wanting to make sure I was attending to what is right for Black students. In conclusion, I offer a discussion that brings together ideas about the nature of mathematics teaching in a particular context through identifying and analyzing dilemmas with a methodology that fosters intimate understandings of what it means to be a teacher of mathematics, and particularly with considerations for what it might mean to do right by Black students.

## Managing Dilemmas

The nature of teaching is not a linear path to achieving a singular goal. In thinking about mathematics teaching specifically, there are various aims that teachers feel compelled to attend to, some having to do with content, but others having to do with the needs of society or individual students' development, as well as those relevant to the outcomes desired by an educational institution. When different goals for the teaching of mathematics lead to tugs in different directions, a conflict can arise. In the education literature, this is referred to as a *dilemma*, a situation that causes uncertainties, with arguably different possible routes to address such conflict (Lampert, 1985). As a dilemma

arises, Lampert (1985) contends that a teacher "cannot hope to arrive at the 'right' alternative in the sense that a theory built on valid and reliable empirical data can be said to be right." (p. 181). This is because dilemmas are "unsolvable problems" as teachers bring with them "contradictory aims to each instance of her work" (Lampert, 1985, p. 181). Further, Goldring and Greenfield (2002) contend that "dilemmas reveal deeper 'contradictory stances' that present a paradox of competing positions" (p. 12). The most that teachers can hope for in these instances is to manage the dilemmas. Lampert (1985) finds that as dilemma managers, teachers usually "consider the alternative solutions" before deciding on a course of action (p. 181). In terms of mathematics teachers specifically as dilemma managers, this means they are grappling with the various different goals and desired outcomes related to students' learning of the content, which are causing internal conflicts. Teachers can really only navigate through dilemmas, knowing that no matter what they decide there is no solution.

Thinking of a teacher as a manager of dilemmas challenges the notion that teaching comes with certainty about which best practices or procedures to use at any given time (McDonald, 1992). Identifying and analyzing dilemmas in teaching, and specifically the various divergent obligations that lead to these, is one approach to better understanding the nature of teaching. Specifically, how teachers in a school teaching particular mathematics grapple with the commitments they feel reveals some of the conflicts that create dilemmas (Chazan, Herbst, & Clark, 2016). In this research project, I consider two of the dilemmas that came up in my teaching of mathematics. More specifically, I look at the tensions that emerged around (1) the incorporation of additional computation practice and (2) the spontaneous student-directed mathematics discussions

involving only boys. In my investigation, I explored some of the conflicts that I felt as I analyzed the ways in which I was compelled to act based on particular messaging around what it means to teach mathematics, while also attending to my desire to get it right for Black students.

In this project, race and personal experiences related to race are salient because this is part of what shaped my perceptions and decision-making. Looking at teaching as an uncertain craft requires taking into account that "teaching is personal" (McDonald, 1992, p. 20). This means that at the root of teaching decisions, particularly acting as a manager of dilemmas, a teacher's beliefs, experiences, and perspectives matter. McDonald (1992) argues that "this sounds trite, until one considers how little writing about teaching, and research and policy making about teaching, considers the role in it of the individual teacher's gender and class, of the teacher's moral vision and intentions, of the teacher's own felt conflicts and tenderness, of the contrivances of the teacher's person that become the teacher's persona" (p. 20). Not mentioned in McDonald's text is race and a teacher's awareness of racialized experiences. By taking into account these salient aspects of a teacher's persona, I hope to unpack some of the complexities in managing dilemmas that have not yet been addressed in the literature, and to do so in a way that accounts for the various messaging that shapes teachers' decision-making.

By analyzing dilemmas in this way, I am also acknowledging that context matters when conducting research on the nature of teaching. Herbst and Chazan (2012) contend that "The people that take the roles of teacher and student, and to a large extent also the knowledge that takes the role of "content," are constrained not only by the rules that tie them to each other but also by obligations to their environments" (p. 610). The authors

are referring to the ways in which the norms of what is customary for mathematics teachers depends on the particular institution in which the teaching takes place. This chapter attempts to address a need for understanding how context can influence the particular commitments of teachers. This requires taking into account the population of students within a school, the type of school and the ways in which it operates to create certain expectations of teachers.

Further, I looked to Chazan et al.'s (2016) conceptualization of the position of mathematics teacher as a role that is influenced by various stakeholders who hold particular perspectives on the goals for teaching and learning mathematics and expectations for outcomes. In this framing, Chazan et al. (2016) brings to light the role of context in shaping mathematics teaching by capturing some of the ways a teacher might feel constrained within a particular environment amidst the compulsion to act according to the messaging from stakeholders. This moves away from viewing teachers' decisions solely from a lens of individual agency. Dilemmas arise because there are tensions among different goals for mathematics teaching, as well as certain expectations for outcomes to which teachers feel obliged to act accordingly. It is the case though that often teachers are not even aware of the obligations that influence their actions, unless they are somehow deviating from what is expected. Deviations from these norms occur, at times, because of particular views that go against the customary ways of teaching mathematics within a particular context.

With this research my intent is to build on the current body of practitioner research literature (e.g., Chazan, 2000; Chazan & Ball; 1999; Heaton, 2000; Lampert, 1985, 2001; Brantlinger, 2014) and previous work around dilemmas in mathematics

teaching (e.g., Ball, 1993; Lampert, 1985; Romagnano, 1994; Williams & Baxter, 1996) by adding a layer that considers a way of analyzing competing commitments and unpacks how a racialized lens informs conflict within the confines of assumed ways of doing things. In order to do this work, I found it necessary for me to describe what a racialized lens entails as it relates to the way in which I view teaching mathematics with Black students. This included sharing how I see racism and discrimination, which comes in part from the ways people in my life have been affected by these societal maladies. I also looked to the literature to articulate the realities that Black Americans face. My intent in sharing these lived experiences is to help the reader understand how racialized experiences shape a teaching persona and the way in which a teacher views his/her students. Further, this lens influences obligations to particular goals and expected outcomes in the teaching of mathematics. By examining some of the conflicts among these goals and expectations that lead to dilemmas, I am attempting to better understand some of the complexities in this uncertain craft of teaching, while also considering what it might mean to do right by Black students in teaching mathematics.

## Seeing My Students Through a Racialized Lens

In my first two chapters, I describe some examples of the ways in which particular community forces can shape Black students' experiences. I personally came to this work as a White teacher with a multiracial family and social world, having an awareness of the historical and present day systemic inequalities that affect Black students' lives. I remind the reader here some of the ways in which the sociopolitical construction of race, and the subsequent racism that serves to marginalize particular

groups in the United States, has had an impact on Black people's lives and what this means for the ways in which I perceive my students' experiences in learning mathematics. I begin this section with a recapturing of some of the widespread racial inequities stemming from racism. Next, I share a framework that helps me illustrate various levels on which I know my students, spending the most time on the collective level to give details of the tendencies for Black students' experiences in schooling to be markedly different than their White peers.

To briefly reiterate from what I described in the first two chapters, students like those whom I teach, specifically Black children growing up in an urban environment, face an array of possible negative experiences from institutionalized racism in healthcare, public service fields, the justice system, housing, workforce, and more. For instance health disparities that Black children and their families face as compared to their peers come in part from a greater likelihood of living in a food desert (Larson & Story, 2015) and the racial biases experienced in healthcare (FitzGerald, & Hurst, 2017). Also, for Black children and their families there exists an unjust justice system in which innocent until proven guilty does not apply, and for Black males in particular, a pipeline appears to connect schools to jails (Bobo & Thompson, 2006). Further, Black children and families are affected by a policing system that does not necessarily serve and protect people who look like them (e.g., Voigt, Camp, Prabhakaran, Hamilton, Hetey, Griffiths, & Eberhardt, 2017), and instead instills and perpetuates a fear that renders Black bodies disposable (Coates, 2015), with a greater likelihood of Black males experiencing excessive force and deadly violence at the hands of police than White males (Ross, 2015). There are also unfair housing practices and job discrimination that still today affect people who look

like my students and their families (Baum, 2011), and my Black family members and friends too.

Many of these realities I have seen firsthand from having lived in a neighborhood similar to that of my students with my African American husband. Also I have witnessed some of these unjust realities in this city and in other places across the United States, including how my husband has been targeted by police and the racial biases experienced by my friend from both students and colleagues as a Black professor at a predominantly White university (see Richards, forthcoming, for further discussion).

What is more, like my husband as a child and so many Black children (e.g., Delpit, 2012; Nasir, Atukpawu, O'Connor, Davis, Wischnia, & Tsang, 2009), my students are exposed to low expectations and negative stereotyping, including derogatory labels that impact their schooling experiences and potentially their view of themselves. Further, administrators of schools serving predominantly students of color often frame Black children as "change-worthy or as a problem in need of fixing" (Jackson, 2009, p. 181). Conducting educational research that takes into account the context in which we live requires attending to the realities of race in this society, and not just race as a categorical data point, but the qualitatively different experiences that a Black child has in life and in school than their non-Black peers (Lozenski, 2017). For my particular students there is also the reality of having limited opportunities to learn about and become immersed in a culture of power given the realities of socioeconomic segregation (Baum, 2011). It is essential to consider the intersection of race and poverty. This includes taking into account the everyday struggles that many of my students' families face of trying to live within the financial constraints of low wage jobs. Further, even if my students

individually are not from a family in poverty, they are living in neighborhoods and surrounded by other students who do face this challenge.

Having these understandings of my students' and their families' lived experiences along racial and class lines, I look to a framework that can help me account for the ways in which race and racism in particular can shape teachers' commitments in teaching mathematics. Specifically, I draw on a model developed by Lawrence Clark, written about in Chazan et al. (2016), that conceptualizes the levels on which a teacher views their students' mathematics identity formation and development. This tri-level model assumes that racialized experiences are part of learning mathematics. Clark refers to the three levels as the individual, collective, and universal (Chazan et al., 2016). Below I describe what each of these levels entails and convey how this applies to the ways in which I understood my students and their learning of mathematics. While mathematics identity is not the focus of this project, this framework helps me illustrate my perceptions of my students in relation to mathematics, and lets me do so through a racialized lens by offering a layer that involves the identification of students' collective experiences. Following my description of how I am understanding my students, I articulate some of my wonderings of how teachers might attempt to do right by Black students, which I further explore and grapple with in the descriptions and analyses of the two dilemmas in my own mathematics teaching.

Knowing my students involves many things. First, part of this knowledge is understanding my students' developmentally, according to their age, and how children, in general, learn particular mathematics content. Also, knowing my students involves trying to imagine what it means to be a Black child learning mathematics in an all-Black school,

and what Black youths' experiences are potentially going to entail beyond middle school. Further, it involves knowing about each students' individual relationship with mathematics, including their feelings of connectedness to the content and the way in which they view the utility of the content. Clark's model captures these aspects of a teacher knowing her students. First, the universal level is about "teachers' broader understanding of the ways, theoretically, features of students' mathematics identity are thought to influence students' mathematical participation and performance," although typically "teachers develop or draw on lay versions of these theories" (Chazan et al., 2016, p. 1061). This includes anticipated difficulties with particular mathematics and how students might conceptualize particular concepts. Also, this includes expected student behavior or ways of being that would be true of middle school students, in general. Next, the collective level is about a group experience, specifically, "teachers' knowledge and understanding of the experiences of particular groups of students in mathematical contexts," while also considering an understanding of the "developmental trajectories of students' mathematics identity and formation throughout students' school careers." (Chazan et al., 2016, p. 1061). Lastly, the individual level is a teacher's awareness of each students' perceptions of their mathematics disposition, that is how they see themselves in relation to the mathematics (Chazan et al., 2016).

I first briefly touch here on the universal level. I follow this with a more in-depth portrayal of how I understand my students at the group level to illustrate the way in which I take into account race and class in my perceptions of my Black students' experiences in life, in schooling, and particularly in learning mathematics. Finally, I offer

a brief description of what it means to know my students' mathematical identity from an individual level and what this means in the teaching of mathematics.

**In What Ways Are My Students Like Other Students**

In some ways my students are just like other middle school students. This *universal level*, according to Clark in Chazan et al. (2016), is about the way in which a teacher sees the tendencies of students in this particular age group. Here I share some of the things I think are true of most adolescents, including my students. More specifically, I describe, in general, how students of this age operate socially and emotionally and some of the challenges they face in the learning of ratios and proportions in a seventh grade mathematics classroom.

First, students around the age of twelve to thirteen crave independence and affirmation from peers (Wood, 2007). They are attuned to their identity and often this comes through comparisons to their peers. Students also tend to recognize what they like and do not like, as well as, understanding and communicating what they feel they are good at or not good at (see Wood, 2007 for a discussion of these developmental experiences). Middle school aged-students are also known for pushing boundaries, which includes negotiating and challenging limits, both of which are important skills to develop, and if done so with appropriate responses and guidance, will serve students well later in life (e.g., Manning, 1993).

Next, in terms of how I see my students' willingness to take an active role in their learning of mathematics, there are some similarities to other middle school students. For example, I perceive that all of my students have a desire to learn. This seems part of human nature. When this enthusiasm at times wavers, I ascribe this to extenuating

circumstances given societal context, not a lack of motivation. Also, in terms of engaging and participating in particular mathematics, my students are typical in many ways of middle school children. For instance, in terms of the particular struggles that middle school students tend to have with mathematics concepts at this stage, my students have some of the same difficulties. For instance, students' movement from fractions to ratios often comes with certain overgeneralizations, such as, thinking that all ratios are fractions (Bush & Karp, 2013; Lamon, 2012). In general, when middle school students see a number written as a/b they immediately think fraction. Transitioning students to understanding an additional possibility, that a/b could be representing a comparison of two unrelated quantities, instead of representing a number that is a part of a whole, is a challenge for middle school mathematics teachers.

**How I Understand My Black Students' Collective Schooling Experiences**

The *collective level,* according to Clark, refers to shared experiences that occur for particular groups of students (Chazan et al., 2016). Systemic racism and discrimination have led to many shared experiences among Black people in the United States, which includes learning as a racialized experience (Coates, 2015).When thinking about learning mathematics, in particular, this subject area brings unique challenges some of which are specific to the lived experiences of being Black in the United States, something Martin (2012) refers to as *learning mathematics while Black.* I share some of the ways in which Black students are perceived and treated, as well as some of the obstacles they have to overcome, given the racialized learning of mathematics. I relate this to the collective experiences that my students have faced or are likely to experience during their school career.

First, unlike White children, my students do not have the privilege of just being children without receiving judgements. They are judged everyday by society, institutions, and individuals based on the color of their skin. For example, in schools Black students are more often than White students labeled as troublemakers or seen as misbehaving when they engage in the same behaviors that are considered *just being a kid* when exhibited by White children (Downey & Pribesh, 2004; Ladson-Billings, 2011). This is particularly true when considering White teachers' perceptions of Black students' behavior (e.g., Gershenson, Holt, & Papageorge, 2016; Okonofua & Eberhardt, 2015; Zimmerman, Khoury, Vega, Gil, & Warheit, 1995). I worry about this often when thinking about my niece and my own children. For example, I wondered if giving my children the space and opportunities to explore and push boundaries, and permitting them to have a voice and to take risks without regulating their every move, am I setting them up for failure in a society that expects Black children to be docile and conform, with consequences for acting otherwise? Another occurrence that Delpit (2012) brings to light in her description of her daughter's experiences is the invisibility that many Black children feel within schooling, something her daughter felt in predominantly White schools with White teachers.

What is more, Black students are stereotyped as academically inferior to White students because of their skin color (Ferguson, 2003; Solorzano, 1997). This label is perpetuated by things like the *achievement gap* rhetoric. This phrase *achievement gap* first emerged publicly in writing in reference to disparate outcomes of schools by race in a 1956 newspaper called the *Washington Evening Star*, specifically to support an anti-integrationist agenda (Jones, 2013). The achievement gap today is used to refer to the

disparities in performance outcomes on standardized tests among racial and ethnic groups, as well as, groupings by socioeconomic and special education status. Labeling the gap between White and Black students' scores is considered by some to be a naive and misdirected comparison (Martin, 2012). Further, it has been argued that this messaging portrays students of color and their families, with the exception of Asian students, as deficient (see Gutiérrez, 2008, & Gutiérrez & Dixon-Roman, 2010 for a critique of "gap" gazing). In our society the language of the achievement gap prevails as the rhetoric of choice to capture differences in outcomes and to motivate, or potentially pressure, schools and teachers into a course of action, which often has meant taking on a "no-excuses" agenda (Ladson-Billings, 2014). This refers to a strict accountability approach that is often implemented in schools labeled as *underperforming* based on the presence of *gaps* in performance outcomes (Golann, 2015).

Further, critiques of the achievement gap language argue that this messaging marginalizes an entire group of people, rather than recognizing the unfair advantages that White people have had throughout U.S. history (see Lozenski 2017 for discussion on this). In light of this rhetoric, Black students are often viewed as less capable and are relegated to low expectations (Flores, 2007; Nasir et al., 2009). Delpit (2012) shares how her daughter experienced this repeatedly at predominantly White institutions. Further, I witnessed this firsthand as a college athlete. Specifically, playing basketball at an academically elite, Division I university, I listened to people speculating that the Black students on our team were there because of basketball, sometimes even within earshot of my fellow Black teammates. As a White college athlete, I never once had anyone make that assumption about me, even though basketball is indeed what allowed me to attend

this university. This weighed on me and continues to as I wonder about how my own children's academic abilities will be perceived simply based on their skin color.

In terms of mathematics learning in schools, there is also evidence that Black students are less likely to experience reform-oriented teaching practices (Lubienski, 2002), which have been found to have many beneficial outcomes for students (Boaler, 2002). Ladson-Billings (2014) argues that Black students often experience a pedagogy of poverty, which involves sitting silently and completing worksheets, an approach steeped with low expectations. Further, there is evidence of Black parents reflecting on their experiences of being stereotyped and disadvantaged while learning mathematics in school, and while evidence shows that their agency has been used to attempt to counter such practices, disempowering experiences in schools, around learning mathematics in particular, is commonplace for Black people (Martin, 2006). One of the caregivers for my children, who is Black, spoke candidly with me about her own experiences in schools, specifically noting that she did not receive adequate instruction in part because of the schools she attended and how she felt she was perceived as a Black student. Through a few tutoring sessions, she left my house feeling confident to retake the math portion of a nursing exam and went on to ace the exam. She was immediately accepted into nursing school. This speaks to the reality that she was more than capable, but was not given opportunities within mathematics classrooms to capitalize on her potential.

Based on an awareness of the negative experiences that Black students may face in schooling, and particularly in mathematics classrooms, I wondered often what is it that I could do in order to do right by the Black students in my classroom. In an upcoming section I share my wonderings around what it might mean today to do right by Black

students in teaching and learning mathematics. First, though I describe how I understood my students on an individual level, specifically, differences in my perception of students' mathematics dispositions.

**The Individual Differences I See Among My Students**

The *individual level* is about a teacher knowing how her students see themselves as learners of mathematics and how they see mathematics. This involves perceiving students' mathematics dispositions; that is, knowing whether or not students believe they are good at math and whether or not they see mathematics as something that is useful and worthwhile to them (Chazan et al., 2016). For Greselfi and Cobb (2008), mathematics disposition is about "the extent to which students come to identify with the discipline" (p. 50). According to Leonard (2008), for African American students to develop a positive mathematics disposition, "they must realize that mathematics may be found in many aspects of African American life and culture" (p. 162). Seeing mathematics as relevant to their lives has been found to be directly related to students' achievement and persistence in mathematics (Martin, 2000). Here I briefly describe some of the variability that I saw in my students mathematics dispositions and how this changed over time.

There were students in my low track seventh grade class who I perceived as feeling uncertain about whether or not they were good at math. I noticed they hesitated to volunteer to participate and if I called on them they appeared nervous to share their thinking, and not because they were shy, but rather it seemed they were insecure about their mathematics abilities. For example, Shaquan is a student who I sensed did not believe he was good at math. This changed over the course of the year, as some of his hesitation seemed to be about the lack of familiarity with mathematics discussions and a

reform curriculum. As students grew more comfortable and felt safe to share, participation shifted. I also had several students who from the first day of class consistently exuded confidence in their abilities, and this was often apparent in their eagerness to participate in discussions and to help others during group work. Sasha comes to mind as an example. Then, there were many of my students who felt they were good at math depending on the particular content we were studying or the way in which I asked the questions. This meant I would at times see certain students participating and appearing confident, and then in a different investigation or unit the same students would question themselves and appear fraught with doubt about their math ability. Nate is an example of a student in my class who at times felt he was good at math and at times felt he was bad at math. In particular, it was in the integers unit that he exhibited a positive mathematics disposition, but not in the ratios and proportions unit. I remember him telling me that he was just not good at that *type* of math.

I also saw a range in terms of students' view of the usefulness of mathematics and how it applied to their lives. I remember one of my students, Devon, really taking to a biking scenario and talking about how he wanted to go on a bike tour someday. He was a student who had a bike and rode it in his neighborhood quite a bit. He excelled in this unit, in part, I believe because he saw the mathematics as relevant to something in which he was interested. I had another student, Talib, share in class how his mom had bought orange concentrate in a can after he told her about the orange juice scenario from class. He was thrilled to be able to make the orange juice and apply what he had learned in class about ratios to a real-world experience at home. However, I think many of my students did not feel connected to the biking scenario or the orange juice concentrate because both

of these situations were not something with which they were familiar. Looking back there are certainly changes I could make in the future to make it more relevant, such as, using ratios of sugar to water mixed with a powdered juice packet, such as, Kool-aid. I grew up drinking Kool-aid and I know most of my students did, as well. Further, I know there were times too when it was particularly unclear for students as to when they would ever use what we were learning. For example, I remember when we were discussing a computation skill worksheet given as homework the night prior to our conversation, Michael asked what kind of math this was and why we needed to know it. It seemed for him that it was not connected to the reasoning and problem-solving we had been doing all year, and he was unsure how specifically it related to the unit on ratios and proportional reasoning. Being aware of how students are seeing the mathematics gives teachers a way to better understand their students' relationship to the content, which can serve as a foundation for facilitating students' connection with and success in constructing understandings of the mathematics.

This third level along with the universal and collective levels are intended to show how a teacher might think about his/her students in terms of their mathematics identities. My hope in using this framework was that I could paint a picture of how I see my students and their experiences in learning and doing mathematics. The collective level, in particular, gave me a way to share how a racialized world affects my students' mathematics experiences. In the next section I present an argument as to why we should consider doing right by Black students and what it might mean to do right by Black students more generally. I also share some uncertainties that contributed to the conflicts

that I will discuss in the upcoming analysis on the dilemmas of computational practice and gender equity in discussions.

## What Might It Mean To Do Right By Black Students in Teaching Mathematics?

Researchers, policymakers, and practitioners across the United States are currently grappling with ways to ensure that *all* students develop both conceptual and procedural knowledge (e.g., National Research Council, & Mathematics Learning Study Committee, 2001), and how to effectively incorporate students' thinking in discussions in mathematics classrooms (Leinwand, 2014). It seems to me though that there should be an urgency around these matters for Black students. This means that the goals in teaching mathematics with Black students at times likely need to be different than White students. I first point out where I believe this urgency comes from and how it affects Black students in general. Next, I remind the reader of the challenges that are specific to the lived experiences of Black students and their families. I move then to considerations, given these realities, of what it might mean to do right by this particular population of students. Throughout I include questions and areas of uncertainty around the goals for teaching mathematics with an eye toward getting it right for young people who have and continue to be marginalized and discriminated against, even in schools.

First, the urgency for me in teaching mathematics with Black students comes from the debt that is owed, from hundreds of years of unequal schooling opportunities that net intergenerational unequal preparedness and disparate outcomes in test scores, graduation, and subsequently life circumstances (see Ladson-Billings, 2006 for more discussion on the educational debt). This debt, along with institutional racism in other

arenas outside of school, results in years and years of disadvantages in the workforce, income levels and wealth accumulation that still have ramifications today (Lozenski, 2017). It affects who attends which colleges and who moves into which jobs, or who is able to even secure a job. Yes, even today these effects are still felt. Recent research confirms that Black students nationwide who attend college still do not have equal footing with White peers. For example, O'Sullivan, Mugglestone, and Allison (2014) have found Black students with a college degree have the same likelihood of landing a job as their White peers with high school degrees. A finding that the authors attribute to hiring discrimination and a lack of inherited wealth from past generations due to a long history of systemic racism. There are also many other examples of institutional racism that I described in detail in the first two chapters of my dissertation and referred to in an earlier section in this paper. The tremendous obstacles in schooling, the workforce, and most, if not all, arenas of daily living, such as housing, health care, etc. contribute to the urgency that I see to address what is right for Black students. The marginalization and oppression of Black people in the U.S. changes the game when thinking about the goals and desired outcomes for teaching mathematics with Black children.

I ask the question then, what goals and outcomes matter, if we are to attempt to do right by Black students? I looked to the literature to unpack what might be key elements more generally in teachers attempts to get it right. Lozenski (2017) reminds us that the historical realities of racism need to be taken seriously, if we are to contribute positively to Black students' educational experiences. This includes being aware of how such racism today is affecting Black students' lives. For him, this means being strategic to empower students, knowing they will face a future within a country that embodies

inequitable and unjust policies and practices (see Lozenski, 2017 for further analysis and discussion). This is not a new idea though. Ladson-Billings (2009) found that successful teachers of Black children help their students "understand the world as it is and equip them to change it for the better" (p. 152). How this looks often depends on who each teacher is and what they take this to mean (e.g., Chazan, Brantlinger, Clark, & Edwards, 2013). Also, teachers have to consider the ways in which their school and administrators may constrain their interpersonal interactions and content-based decisions (Chazan et al., 2013). What will happen to teachers if they go against the expectations communicated by their institutions? Further, what if teachers are not aware of the sociocultural and historical realities of systemic inequalities and racism, or do not know how to or feel comfortable taking actions that are informed by these aspects of students' lives? How will this affect the goals and expectations that teachers feel compelled to address?

In teaching and learning mathematics specifically, Martin (2007) contends that mathematics teachers need to use mathematics learning as a way to empower their students to develop positive racial and mathematical identities and to navigate and address the societal realities of racism and inequalities. Empowerment might come through practices known as culturally relevant teaching, which includes ensuring that Black students have a voice in the classroom (Ladson-Billings, 2009). For instance, students could share their thinking and be given opportunities to see themselves as an authority (e.g., Boaler, 2008). To do this effectively though teachers need to be competent in structuring tasks and discussions in ways that gives students opportunities to present arguments and justifications (Smith, Desimone, & Ueno, 2005), not an easy feat for young, inexperienced teachers who are present at higher rates in predominantly

Black schools (Clotfelter, Ladd, & Vigdor, 2005). Black students too are less likely than White peers to have teachers who have the type of knowledge necessary to engage students in meaningful problem-based learning with discussions that build on students' thinking (Ball, Hill, & Bass, 2005). Also, these practices are not always possible as teachers are experiencing more constraints on their autonomy in curricular and pedagogical decisions (e.g., Wills & Sandholtz, 2009). While a goal of empowering Black youth through mathematics teaching and learning is essential, I wonder what would this look like across different institutions who take on various perspectives for what it means to know and do mathematics? If schools do not see the importance of this strategic effort, I also wonder would teachers still feel compelled to act on this goal? In addition, teachers need to take into consideration the possibility that students might resist such practices, given the feeling of discomfort that can come with something unfamiliar and that requires students to be put on the spot in front of their peers (Romagnano, 1994).

Also, ideally to empower Black students, mathematics teachers would value students' strengths and their knowledge that they bring to the tasks (Ladson-Billings, 2009). First, this requires getting to know students and building relationships with them. However, research has found that White teachers are far less likely to have meaningful relationships with Black students; thereby making it unlikely that they will act on these principles (Douglas, Lewis, Douglas, Scott, & Garrison-Wade, 2008). Further, with time constraints in an era of testing accountability, teachers in general tend to spend less time working at building relationships with students (Nichols & Berliner, 2008). How can teachers navigate this quandary of devoting time to interpersonal connections with

students while also putting in the additional required time to meet expectations around an accountability agenda?

Advocates of culturally relevant teaching also contend that mathematics teachers should hold Black students to high expectations, engaging students in cognitively demanding tasks that require problem-solving and critical thinking (Delpit, 2006, 2012; Leonard, 2008). When this happens though, some researchers have found that students from lower SES backgrounds and students who have previously struggled with mathematics have difficulty accessing the intended mathematics in the problems and became stuck, which potentially leads to frustration and disengagement (e.g., Lubienski, 2000; Woodward, Baxter, & Olson, 2001). If teachers are to create ways for students to access the tasks, potentially by building prerequisite skills or including scaffolds, what sort of time is required to do this and how does this impact a plan for coverage of particular content? Further, mathematics teachers need to find ways to support students in their learning of conventions, strategies, and skills (Delpit, 1986, 2012; Leonard, 2008). This can bring challenges as teachers who are trying to establish a reform-oriented classroom may need to spend additional time on necessary procedural and computational skills knowing that Black students specifically will be judged in particular ways if they lack such knowledge (Delpit, 2006; Ladson-Billings, 1997; Leonard, 2008). I am left wondering what is the right balance of conceptual versus procedural particularly for mathematics teachers of Black students?

There is also advocacy for providing counter-narratives in mathematics instruction that build on Black students' strengths and critique institutional racism. The former accomplished by creating a community in which students come to believe in their

capacity to learn and do mathematics (e.g., Boaler, 2008; Gresalfi & Cobb, 2006; Malloy, 2009), and the latter carried out by turning to a sociopolitical agenda that fosters students' knowledge about and action toward the realities of historical and present day inequities and microagressions toward people of color present in this nation (e.g., Brantlinger, 2013, 2014; Clark, Badertscher, & Napp, 2013; Gutstein, 2003; Moses & Cobb, 2002). In using these approaches though there are considerations for teachers specific to their own knowledge, beliefs, and identities, and the school in which they teach that may allow or interfere with teachers providing such counter-narratives or social justice oriented discussions either as part of a motivational agenda or as part of a curricular agenda (Chazan et al., 2016; Clark, Frank, & Davis, 2013). Again, I wonder to what extent schools may afford or constrain teachers in their actions of empowering Black students? I also wonder, to what extent will parents or students welcome or resist such pedagogical approaches, especially as political messaging is incorporated within the work (e.g., Brantlinger, 2014), and depending on the racial dynamics of the students and the teacher (e.g., Martin, 2007)? What does it look like to garner support for this type of approach in mathematics teaching? Also, will following a social justice oriented curriculum give Black students what they need to excel on standardized tests, particularly those that matter to them, such as tests for high school graduation or the SATs? Could teachers focus on both a political agenda and learning essential mathematics, and how do teachers do so when the curriculum they are asked to use does not include socio-political goals (e.g., Moses & Cobb, 2002)?

There are many wonderings I have about what it might mean to do right by Black students in a mathematics classroom. These are some of my thoughts on this topic that

influenced the ways in which I felt obligated and eventually conflicted as some of the goals I had for my students came in conflict with other aims from various stakeholders. Also, I offered many questions around how mathematics teachers and schools might get it right for Black youth. This means even with a racialized lens that helps me see my students' lived experiences and the sociocultural and political realities of this world, I still feel uncertainty in particular instances of my teaching about what approach I should use. In part, this is because teaching is not always certain. Dilemmas are a part of teaching. In this work, I explore the navigation of two dilemmas in particular that involve certain obligations, including my desire to positively affect Black chidlren's mathematical experiences. In the next section, I discuss the analytical approach that I utilized to investigate these dilemmas, followed by a description and analysis of each of two dilemmas. In my conclusion and discussion I return to the conversation of doing right by Black students with an intent of encouraging others in research and practice to consider what this might mean and how institutions can support, rather than inhibit, this goal.

## Data & Analytical Approach

### Data Sources

There are two primary sources of data for this research, specifically, lesson plans and classroom videos (including transcriptions of videos). The lesson plans were written in collaborative planning meetings with the two other seventh grade math teachers and myself. We met two to three planning periods each week to craft these plans, heavily drawing on the teacher's guide from CMP. In these meetings we would often discuss

issues or concerns related to the implementation of CMP, and we would problem-solve together. Occasionally one of our school administrators would sit in on these meetings.

Approximately six months after conducting this research, I began watching the video recordings of whole class discussions (11 in total) from the Accentuate the Negative and Comparing and Scaling units and read through my lesson plans. I carried out a stimulated recall (Lyle, 2003). The focus of this recall was on recounting the dilemmas that I encountered. Specifically, I focused on situations in which I felt conflicted about what to do, knowing that any decision I made was not going to be entirely right or wrong, in that the action I took satisfied some goals and desired outcomes while compromising or sacrificing others. In retrospect, keeping a detailed daily teacher journal that captured my thought processes around my teaching may have served as a more reliable or valid account of the dilemmas that I faced than using stimulated recall. However, I am confident that even six months later I could recount many of the dilemmas that occurred in my teaching with CMP as these were problems that worried me, that I reflected on frequently, and that I often spoke about with colleagues. Therefore, they were ingrained in my mind.

Through a stimulated recall with videos and lesson plans, I wrote detailed descriptions of several dilemmas. Yinger (1986) talks about stimulated recall (SR) as a method for producing a "new view" based on reflection, an understanding of what happened that was not available at the time of the original situation (p. 271). While in some studies forming a new account of what happened may be problematic, here it is advantageous to be able to come back to an experience of particular problems in teaching with new insights into what led to such occurrences. It is important to note though that

the accuracy of a recall is a limitation of this method, given that current occurences and mindsets do influence how someone sees what happened previously, yet without an awareness of the changes in the story from the actual situation (Lyle, 2003).

From these detailed accounts of several dilemmas, I chose two on which to focus for this work. I selected these two particular dilemmas because they were related to other dilemmas that researchers had written about in the literature, with room to build on some of the understandings about the nature of teaching and teacher decision-making. Also, these dilemmas are problems of practice that schools and policy makers are grappling with today, as the Common Core brings renewed emphasis on balancing conceptual understandings and procedural knowledge, as well as fostering conversations in which students think and reason about mathematics. After selecting the two dilemmas, I returned to the detailed descriptions that I had written with a particular focus on identifying the competing forces that led to the dilemmas. I used an analytical framework around obligations in mathematics teaching to inform my interpretations (Chazan et al., 2016). Also, I examined the ways in which race and my own racialized views of my students' experiences brought goals that at times came in conflict with other aims in teaching mathematics. In the next section, I describe in more detail the analytical framework that I employed.

**Analytical Framework: Understanding Obligations in Mathematics Teaching**

Teachers' actions are based on more than their own individualized agendas. Teachers' decisions are influenced by norms and expectations that they hear in messaging around what it means to be a teacher of mathematics at a particular institution. Chazan et al. (2016) contend that

> "Mathematics teaching is an activity for which there are a range of stakeholders all of whom influence the institutional environments in which instructional systems reside and whose interests may be championed by different agents, professions, and academic disciplines. Those stakeholders not only support the existence of the practice of mathematics teaching by providing context and resources with which teaching and instruction can pursue their work, but they also do so from different perspectives on what mathematics education is expected to accomplish." (p. 1062-1063).

According to Chazan et al.'s (2016) framing of the influencers of mathematics teaching, there are four categories that capture different perspectives of the various stakeholders in education, referred to specifically as society, knowledge, organization, and client. The four categories are based on differences in the types of goals and outcomes that matter to stakeholders. I share here brief descriptions to familiarize the reader with these different perspectives. In my description of the first dilemmas I present the ways in which these influencers show up in my colleagues and my experiences as mathematics teachers, and lead to some grappling around how to proceed. For the second dilemma, I focus on how such perspectives affect me in a particular teaching situation with consideration given to the ways in which my son's mathematics learning experiences will likely be markedly different than my daughter's given how Black boys are viewed. These perspectives that shape the role of mathematics teachers are not specific to me, rather they more generally represent an array of desired goals and outcomes for mathematics teaching and learning according to different constituents who all play a part in shaping schooling.

First, a *society perspective* captures the views of stakeholders who are concerned with the ways in which outcomes of mathematics teaching and learning affect the public. An example might be organizations who care about comparing performance outcomes across racial groups. The goals for mathematics teaching formulated by a *knowledge perspective* focus on the particular mathematics that students learn. For example, mathematics education researchers, mathematicians who think about the teaching and learning of mathematics, and organizations and specialists who do as well, typically share messages from a knowledge perspective. Stakeholders focusing on the *organization* tend to "see the outcomes of mathematics teaching as indications of an institutional process of educational administration where they attest to the legality, efficiency, and effectiveness of education organizations (e.g., countries, districts, schools), their resources, or their processes." (Chazan et al., 2016, p. 1063). An example of groups coming from an organization perspective might be school administrators with their concerns about mathematics outcomes as it relates to meeting requirements for Adequate Yearly Progress (AYP). Clients refers to the consumers of education, which are the students and their families, and they usually have a perspective that focuses on achieving particular individual outcomes. A *perspective of a client* might include performance goals to earn a degree or to move on to higher education. This captures goals around "students' individual development, power, opportunity, achievement, or well-being" (p. 1063). Stakeholders structure professional obligations, specifying what it means to be a teacher of mathematics at a particular school in a particular time. One way to conduct this analysis could be to use Chazan et al.'s notion of professional obligations (i.e., discipline, individual, interpersonal, institutional; 2016); however, I have opted to use stakeholders,

specifically, the four different perspectives of these constituents, as organizing categories. I find that this allows me to make sense of the origination of the messaging that shapes the profession of mathematics teacher.

In the upcoming sections, I give an overview of each of the two dilemmas that I faced. The first is about seventh grade teachers wanting to give adequate time to the reform curriculum that emphasizes conceptual understandings, yet wanting to make sure students also have access to the skills necessary to carry out various procedures within a particular unit. Many teachers experience this dilemma as both are important in learning mathematics (National Research Council, & Mathematics Learning Study Committee, 2001). After describing dilemma one, I offer a hypothetical conversation with my colleagues to illustrate the various relevant obligations that mathematics teachers are likely to feel when faced with this type of dilemma and some of the conflicts that arose. The next dilemma I describe involves spontaneous, unregulated conversations about mathematics among students during summary discussions in my classroom. There are repeated episodes within the discussions of uninterrupted student to student dialogue. Yet, in looking closely at these episodes, it became clear that only boys were participating in this way, while girls are raising their hands waiting to be called on to share their thinking. I provide a letter to my son following a description of the dilemma in hopes of communicating the ways in which I believe young Black boys' experiences in schooling (and in life) are likely to be different than young Black girls, and for this reason some of the conflicts that arose for me around how to proceed.

The particular dilemmas described here around teaching procedural knowledge and gender equity in mathematics discussions are ones that teachers face, although how a

teacher manages the messaging from an array of stakeholders and her course of action may look different depending on her teaching persona. To conduct this analysis, I focused on the following two questions: (1) To which particular perspectives of stakeholders did I and my colleagues feel obligated and in what ways were there tensions among various commitments that led to this dilemma? (2) In what ways can a racialized lens influenced the conflict from which a dilemma emerged? In my analysis for each dilemma, I thought about the tensions I felt. Then, I used Chazan et al.'s (2016) four perspectives of stakeholders to better understand how messaging about mathematics teaching can conflict. In doing this analysis, I realized that while this feels personal, grappling with competing goals for mathematics teaching from different constituents is actually something shared by mathematics teachers. There are common obligations about particular ways of operating as a mathematics teacher today. This analysis attempts to unpack some of the ways in which goals and expectations that originate from different perspectives of stakeholders can create conflicts among teaching commitments, and therefore lead to dilemmas.

### Dilemma 1: Developing Computational Skills: Who Needs What and Why?

My colleagues and I found that the Comparing and Scaling unit in CMP, with its focus on ratios and proportional reasoning, was limited in the amount of opportunities to practice with what might be considered the computational skills in the unit. We decided to incorporate more computational skill practice beyond what the curriculum offered, such as practicing how to find equivalent ratios and solving for an unknown in a proportion that is written in various forms (e.g., a/b = c/d, a:b=c:d). We agreed to

incorporate this practice after students had opportunities to develop related conceptual understandings. Through our conversations, I realized I was grappling with how exactly to proceed. Should I incorporate computation practice problems within the CMP tasks and what would this mean for my pacing? Should I give a set of practice problems and allow students to use calculators so they can focus solely on the computational steps? Should I have students complete the practice problems for homework since we do not have much extra time in class? Should I make time in class for students to complete the practice problems and, if so, should it be exploration or should I use direct instruction to model how to solve them? Should I incorporate dialogue about their approaches in order to keep this work aligned with the reform-oriented pedagogy to which students are now accustomed and that affords them a different type of learning experience? Finding a way to incorporate computational skill practice without sacrificing conceptual understandings and mathematical practices was important to me, as it is for many mathematics teachers today. Yet, in this situation, deciding how to proceed brought me turmoil with no solution in sight, given the competing aims for this type of mathematical practice and taking into account my particular students.

I did not record conversations with colleagues as we talked about how to incorporate computation practice, although I can speak to the particular ways that we each thought about creating these opportunities for our students. We all felt compelled by certain pressures and norms, yet there were also differences in how we saw mathematics teaching and particularly for Black students. These differences in our perspectives made me aware of not only the conflicts I felt, but the ways in which I considered deviating from what was expected. I present here a fictional dialogue among the three of us to

illustrate what I perceived as our allegiances to particular perspectives from stakeholders who shape what is seen as important in teaching mathematics. I found myself negotiating between various ways to approach the situation, none of which were wrong perse given the various constraints on teachers, yet I was also not able to see an absolutely right way to move forward. It seemed one way of doing the computation practice addressed certain desired outcomes; while neglecting other outcomes, and the same was true for a different approach. It would accomplish one goal while failing at another. Further, there were certain ways that I saw teaching Black students based on my own background and awareness that shaped how I prioritized the various pulls I felt from different stakeholders. In the upcoming analysis section, I discuss various goals for teaching mathematics that come from different stakeholders, and how particular decisions attend to certain ways of doing things and expected outcomes while neglecting others.

In order to triangulate my interpretations of my colleagues' perspectives on this dilemma, I presented them questions about their views related to teaching Black students mathematics and statements from this fictional conversation. I compared their responses to the fictional dialogue to see if I captured some of the differences in how we see our responsibilities. I solicited their feedback and critique as to the accuracy of the ways in which I interpreted their positions and beliefs, and from this made necessary adjustments to the script. Below is the hypothetical conversation that I developed.

**Hypothetical Conversation With Colleagues**

This is a constructed conversation that highlights some of the particular commitments that seventh grade mathematics teachers at Applegate prioritized as they navigated an array of goals from various perspectives on computational skill practice.

**Carrie:** I definitely think students need more practice finding equivalent ratios, and solving for an unknown in a proportion. CMP focuses so much on conceptual understandings that the practice part seems inadequate. These are skills that all students need to know how to do. It should be a priority in any curriculum.

**Hollie:** Yes, our students definitely need more opportunities to practice these skills than what is given in CMP. These skills are a gatekeeper for Algebra and I want to make sure our students, in particular, have what they need to succeed in Algebra and to pass the HSA, otherwise without the HSA and a high school degree the barriers our kids will face are enormous.

**Allison:** Yeah, our students do need more practice, especially to be able to carry out the steps of solving proportions like the ones that they will see on the PARCC or the NWEA, and you're right, they need this for the HSA too. I'm really worried about the PARCC and NWEA tests. You know Casey said our charter renewal is coming up and we really need to show that we are addressing the achievement gap. You know they're going to compare us to other schools in the city and in the state in terms of our students' scores compared to other students.

**Carrie:** I hear you, and maybe we can use practice problems from these tests, you know those released items from the tests, but keep in mind that the PARCC has complex problems and I was envisioning us just giving simple problems

sets for practicing skills. I'm not sure incorporating test practice and skill practice together is the way to go. What if we first practice the skills using straight forward worksheets with one type of skill at a time? Then, as the tests get closer we bring in test prep because we do need to get these kids passing the test. Really though there's no reason they shouldn't be able to do it unless they just don't work hard or if they come in with too many deficits, and in that case there's not a whole lot we can do about it.

**Hollie:** I get that we have limited time, but I think we need to make strategic decisions about skill practice that take into account some of our students' struggles with pre-requisite skills, like not knowing the answers to single-digit multiplication problems by memory. I think we can help students with this skill development as we work on grade-level skills relevant to this unit. In fact, I think it's essential that we do this. Our students need this for their future math experiences in school, in jobs, and in life. Especially for tests they may take later in life, like the SATs, GREs, a nursing exam or plumbing exam or military exam, or whatever career path they pursue.

**Allison:** Yeah, that's true, and they need these pre-requisite skills to do well in our classes and on these tests as well. Seems like we have to take the time to address it.

**Carrie:** I'm just going to give them calculators. I'm not willing to spend time on skills that all students were taught in previous grades and that they should

have learned.

**Allison:** They may not have calculators for these problems on the PARCC or the NWEA though, so what will they do then? I think I am going to hold coach class in the afternoons to address some of these skills. And, I think we should use the worksheets from the website we were talking about the other day that has sets of problems that are similar, like a set of problems with the first number in the proportion missing, for students to practice grade-level skills.

**Hollie:** I wish the practice could happen as they are doing the CMP problems, meaning as they do the CMP tasks we incorporate some additional problems within the task that gives them more practice. However, I know we barely get through the tasks as it is. So, it isn't possible to add on more to the tasks unless we extend lessons over several days, which means we'd probably have to cut a unit out of our long term plan for the year.

**Carrie:** Yeah, we can't do that. If we incorporate more parts to the task this means they'd have to work through additional word problems and think through the conceptual parts, then again it seems like we're spending too much time on this aspect and not enough on practicing steps and procedures that they need to know how to do. They need reinforcement of skills, like doing a set of problems that are similar to really get the hang of it. I lean toward cutting out some of the tasks, as I think there are

already too many in each investigation. In place of tasks, we could put more skill practice.

**Allison:** Let's use those Common Core practice sheets and give it to them for homework. That way they can do practice sets each night to reinforce the skills.

**Hollie:** What if they practice doing it incorrectly though? If they are just doing this work at night, at home and there's no discussion of the work in class, then their work might be reinforcing incorrect thinking.

**Carrie:** Well, grading them immediately would tell us if that is the case and we can fix it by modeling how to solve the various problems and having them practice a few in class together to make sure they are solving them correctly.

**Allison:** Yeah, I think we need to model how to solve them and have them practice for homework, and give opportunities for coach class for extra support for those who need it after school because I think these types of skills could make a difference in terms of getting students to pass the PARCC or to score higher on the NWEA.

**Hollie:** The other issue I foresee with only using homework as the time for practice is that some of the students in the Number Sense group do not complete homework regularly.

**Carrie:** If we spend time modeling and having students practice, then they are getting exposure in class and then it's on them to decide if they want that homework grade. I mean, it's an easy homework grade, if we are already practicing the skills in class.

**Allison:** I like the idea of modeling and practicing the skills in class. This makes me feel better as they are more likely to solve the problems correctly on the homework, although I am going to make sure students who aren't completing their homework or who need help come to coach class because I don't want students to miss this skill.

**Hollie:** I agree, I think coach class for extra support is key. I also am wondering if using some of the summary discussion to share the steps that students took to solve a proportion, meaning we have them include what they multiplied by and why, like how they determined what scale factor to use, this may help reinforce students' grasp of the ways to solve various problems involving a proportion with an unknown value. I think we just have to make sure it is written in different forms, for students to get used to seeing a proportion written various ways. And, I think they will benefit by hearing the thought process from their peers. They can then ask questions and talk it through.

**Carrie:** We don't have time to make this part of the discussion, plus I think a lot of kids in the Number Sense class get confused when they listen to the ways

their peers solved a problem. I actually think it can be more of an obstacle than a help.

**Allison:** Yeah, I think time is an issue and I see what you mean about kids getting confused by listening to others. I think we are better off just showing them and then having them practice. I'm going to do this at the end of class, after the summary. We will solve a few of the problems together after I show a few on the board, and they can complete the rest for homework. Students who need more assistance can come to coach class. I will also work on things like single-digit multiplication with those students who need it during coach class. I am not going to have students using calculators for this at all as I don't think they will be allowed calculators for computation purposes on the tests.

**Hollie:** Okay, so it sounds like we are agreeing that because of time constraints we will use the Common Core sheets for extra practice problems and assign it as homework, but then how we go from there will look different in each of our classes. I know I'm going to request that students do not use calculators, except maybe to check their work. I'm also going to use time in the summary discussions to have students share steps for solving problems and their reasoning behind their approaches. I think this will serve to reinforce procedures, give space for clarifications, and address wrong ideas. I also want to hold coach class, like Allison, to give support to those who need it. And, I'm going to build in some time for pre-

requisite skills, like single-digit multiplication facts. I think asking students to look for patterns and build on the ones they already have memorized can help them tremendously with this skill.

**Carrie:** That's fine, but I am going to tell students to use calculators and I am going to show them how to solve each of the sets of problems and let them practice some in class before giving the homework. So, it sounds like we will just do this differently.

**How I Managed Computation Skill Dilemma Compared to My Colleagues**

Like other teachers facing a dilemma, I improvised and pulled practices together to suit the situation for the time being (e.g., Lampert, 1985). I decided that incorporating additional skill practice could not b e in the way that I had hoped, that is, through additional problem-based tasks with computational skill practice built-in. I felt that there was too much pressure around pacing. I instead opted to use worksheets that my colleagues suggested with sets of computational problems that could be done for homework. These problems related to the work we had done in each CMP investigation, in that students had already had opportunities to develop conceptual understandings that connected to these computational skills. This decision to use worksheets for homework to practice skills was made based on my commitment to stick as close to the pacing guide as possible and cover as much of all the units that we had aimed to complete. Unlike my colleagues though, I addressed the prerequisite skill of single-digit multiplication prior to assigning this skill practice and incorporated discussions about the procedures for solving the problem sets on the worksheets (solving for an unknown in a proportion) after

students had a chance to complete them at home. My hope was that through these discussions, connections could be made to conceptual understandings, as well as giving students an opportunity to clarify and grow their knowledge of computational processes through talk. While my decisions to carry out skill practice in these ways still made me feel uneasy, I took action and moved forward knowing that it was not a problem that could be *solved*, but rather it was *a dilemma to be managed.*

I felt compelled to make sure my students had computational skills, and not only the grade-level procedures and steps for the mathematics within this particular unit, but also prerequisite skills, because I know that as Black students they have a different reality to face than most White students. This meant that I was not comfortable just giving calculators and ignoring the fact that most of my students had not yet memorized the solutions to single-digit multiplication problems. This is even the case for students with individualized education plans (IEPs), most of whom were supposed to have access to a calculator as an accommodation. The time devoted to this skill was mostly spent examining patterns in single-digit multiplication problems and building off of what students already knew. For example, I asked students to consider how 3 x 8 is related to 6 x 8. My thinking was that if students knew 3 x 8 is 24 and they knew that to get to 6 from 3 you simply double 3, then they could draw the conclusion that they just double 24, to get 48. In terms of building on their previous knowledge, an example of what I did was helping students see how their knowledge of multiplication with 5 can help them find other answers. My students all knew the single-digit multiplication problems involving 5 by memory. Therefore, if they know 5 x 9 is 45, then 6 x 9 is just one more 9 added on to 45, to get 54. I have only anecdotal evidence of the benefit of spending time on furthering

students' knowledge of this particular prerequisite skill. I found my students using these strategies in conversations with me in coach class, when talking to their peers in class and after school, as well as in discussions in class. I wish that I could have done more to support my students in mastering this skill, but time was certainly an issue. My hope is that students would continue to explore strategies that could be of help as they move to higher level mathematics and realize that having these basic skills are a necessary part of their success.

In terms of the grade-level skill practice, specifically, finding equivalent ratios and solving for an unknown in a proportion, the students were asked to complete problem sets for homework and the next day we would discuss students' approaches for solving some of these problems. I did not use direct instruction to teach how to solve these problems. Rather, I referred to problems we had solved in the CMP tasks as I was passing out the homework. Some of my students did not consistently complete this homework and for those who did, sometimes the attempt was fraught with guesses rather than well-developed approaches. However, I found through discussions the day after I gave the homework, we could share with each other ideas for how to solve these problems and even those students who had not yet spent time thinking about and doing the problems, had time and a springboard from which to make sense of them. These discussions took place at the beginning of class and did not happen everyday. It was more of an impromptu talk, than a well-planned summary discussion. I let students share with each other how they carried out the steps for a particular type of problem and why. Sometimes we had to cut the discussions short and sometimes we had to cut out parts of a task in an investigation to fit in these discussions. I encouraged students to ask each other questions

and to share alternative ways to approach a problem. I also asked lots of questions to attempt to make sense of some wrong ideas and to reveal some of students' thinking that was not always apparent as they initially described how they had solved a problem. For those students who seemed to need additional support, I offered one-on-one time after school in the form of coach class.

My colleagues and I used the same problem sets for homework. From what I gathered, one colleague modeled and guided students through the first few problems on the worksheets, allowed students to use calculators, and gave a homework grade based on accuracy in the completion of the remaining problems. The other seventh grade mathematics teacher followed suit with the exception of calculators. She instead requested students not use them and incorporated practice of prerequisite skills, such as single-digit multiplication problems, into coach class for those students whom she felt needed it. She also had students who did poorly on these worksheets come to coach class for additional support. Making the decision to do things differently than my colleagues was not easy. For me there were a lot of internal struggles around this dilemma, although not necessarily because I felt I should conform to my colleagues' views. Rather, I felt conflict in the competing pressures around equity and pacing, empowerment and efficiency, access and accuracy. In the next section, I share an analysis of some of the particular obligations communicated by stakeholders that contributed to this dilemma.

## Analysis of Obligations to Perspectives on Teaching Computation Skills

**Obligations to societal perspectives on mathematics teaching.** At Applegate, a societal message that seemed particularly salient to my colleagues and me when considering incorporating additional computation practice was the idea that teachers

should be addressing the achievement gap. Specifically, in teaching Black students, we needed as a school to produce certain rates of proficiency on standardized assessments. The rates for our Black students needed to be comparable to the rates of proficiency for White students in the city and the state. Allison, in particular, reminded us of this goal in her talk of wanting to incorporate skill practice in hopes of adequately preparing our students for upcoming standardized tests. For Allison, it seemed Black students' performance on standardized tests was a priority, ahead of other commitments. She wanted to stick to the pacing guide to make sure we covered as much content as possible, and so for computation practice she felt committed to using direct instruction and homework worksheets so as not to take up too much time on this particular skill. I never sensed that there were tensions for Allison around making these sorts of decisions as her practice was geared toward improving students' test performance. For me, I certainly understood the commitment to raising Black students' scores on standardized tests. Yet, I felt conflicted by goals for mathematics teaching and learning that aimed to address racial disparities in testing outcomes without addressing systemic inequities.

Specifically, I struggled with incorporating additional computation practice for the purpose of trying to get students to score better on standardized assessments when there is a debt owed to Black students because of hundreds of years of racial discrimination that has not yet been addressed (see Ladson-Billings, 2006, for a discussion on this). So yes I wanted to see Black students scores improve, and thereby address the achievement gap. However, I felt committed to other goals in my mathematics teaching that seemed likely to better serve Black students in their individual futures within this society that has a history of racial injustices. Specifically, I felt conflict

between carrying out computation practice for test prep goals versus empowerment and content goals. I wanted to honor the latter and teach particular mathematics and in particular ways, yet because of the time it takes to do this type of teaching that I am referring to, more conflict emerged.

What is more, societal messages related to the achievement gap rhetoric have also been leading schools to use strict "no-excuses" accountability measures, specifically in predominantly minority schools, in hopes of improving achievement outcomes (Golann, 2015). My colleague Carrie seemed to feel obligated to this goal of teaching and learning mathematics with this particular population of students. In the hypothetical conversation, I mentioned Carrie's reference to this perspective, specifically, when she talked about prerequisite skills and homework completion. Allison and I also felt compelled to hold students accountable, although our interpretation of what this meant looked different. For us, this included giving students support through opportunities like coach class. An obligation to accountability likely informed each of our decisions around additional computational skill practice, however, the common strict, no-excuses notion of accountability used in predominantly minority schools did not resonate with me.

My issue with this view is that it fails to take into account historical inequalities. Instead of recognizing systemic issues that relate to disparate achievement outcomes, it views the students as the problem. Through this method students are expected to become a particular type of learner, what Golann (2015) refers to as a "worker-learner," meaning that students learn to "monitor themselves, hold back their opinions, and defer to authority" (Golann, 2015, p. 103). Further, the no-excuses approach, often communicated by constituents like policy makers and administrators, when implemented in certain ways

can undermine other goals that serve the betterment of each student, such as building positive mathematics dispositions. For Carrie, as is the case for other teachers, this approach may not cause conflict given that it has been found to lead to certain desired results, specifically improvements in Black students test scores (Golann, 2015). Here is where the dilemma came for me. I want improvements in Black students proficiency on standardized assessments, yet I do not want to sacrifice other goals, such as, helping them believe in their capacity to do mathematics and seeing the relevance of mathematics in their lives. Further, by taking into account systemic inequalities, I want to prepare students for more than a test. I want Black students to be armed with mathematical knowledge and experiences that can serve to empower them to overcome present day challenges.

In summary, disaggregating data by race and addressing the achievement gap are ways of viewing "outcomes of mathematics teaching as public goods" (Chazan et al., 2016, p. 1063). A notion of fairness is underlying these societal perspectives. Fairness in this way is viewed from a perspective of outcomes on tests, in that being fair means expecting all students to have similar rates of proficiency. The no-excuses accountability mindset that has emerged as a way to address the achievement gap, particularly in schools serving students of color (Golann, 2015), is about a means to particular outcomes. This approach of holding students accountable with a certain strictness offers a way of improving students' proficiency rates on standardized tests. This rhetoric within society obligates teachers of mathematics to have goals of improving Black students' test performance and to holding students accountable in particular ways. The messaging of improving Black students' test scores is something to which all mathematics teachers

likely feel obligated, although the way in which teachers carry out these commitments may look different. Further, for some teachers attending to these goals for the purpose of producing certain data outcomes conflicts with other obligations, particularly, commitments to teaching and learning particular mathematics and to individual students' development; thereby, at times leading to dilemmas.

Also, there is an alternative view of fairness that informs some mathematics teachers' commitments, and that is one that takes into account sociocultural and historical realities of institutional racism that prevent equitable outcomes (Ladson-Billings, 2006). According to this perspective, high expectations for Black children are important, while also taking into account the systemic inequalities that have occurred over hundreds of years and the ramifications this has for Black students' learning experiences. From this perspective, an overhaul to educational policies, along with institutional changes beyond education, are necessary to ameliorate the achievement gap (Lozenski, 2017). Further, an alternative perspective takes issue with the by-products of a "no-excuses" approach (e.g., Golann, 2015). In particular, some argue that this approach results in a militarization of teaching and learning for Black children, and the creation of a particular type of learner suited for lower-wage jobs (Golann, 2015). Alternative voices who take into account historical context and the racialized mathematics experiences of Black students are not opposed to Black students' scoring better on tests, but rather call into question the consequences of data comparisons across racial groups and teaching agendas based on these comparisons (e.g., Delpit, 2012; Lozenski, 2017; Martin, 2000).

This analysis speaks to how certain obligations that emerge from commonplace perspectives in society shape the role of mathematics teacher. And this analysis sheds

light on ways that race and views on race affect the way people operate in society, and particularly how people do their jobs. Certain commitments emerge from being attuned to particular aspects of history and knowledge of constituents' lives. Presently, teachers in the U.S., particularly those in schools serving predominantly students of color, likely feel compelled to address the achievement gap and to administer a no-excuses accountability approach with their students. It is not that teachers are not attempting to be fair when they act on these obligations. Rather, for many teachers they are simply adhering to customary ways of teaching math and a widespread societal view of fairness. I wonder though with teaching being an uncertain craft, what this means for Black students, when White mathematics teachers, in particular, manage dilemmas without obligations to acknowledge and address racism? As I think about doing right by Black students, I wonder how would these teachers define what this means? I wonder, *can* White teachers do right by Black students without taking into account historical and present day realities of systemic racism and an educational debt owed to Black students? These are questions that arose for me as I analyzed mathematics teachers' obligations to societal perspectives.

**Obligations to knowledge goals in the teaching of mathematics.** Similar to how my colleagues and I felt obligated to societal messages about fairness in mathematics teaching and learning, we too felt what Chazan et al. (2016) refer to as "an interest in whether students learn specific mathematical ideas and are able to use them" (p. 1063). This can be thought of as obligations to a knowledge perspective, which means caring about what mathematics is to be taught (see Chazan et al., 2016, for further discussion). For example, we were compelled to make sure we were covering the content standards in the Common Core State Standards for Mathematics (CCSS-M). Relatedly

we all were committed to the mathematics to be taught through the curriculum at Applegate, specifically, the Connected Mathematics Program (CMP). Further, because of our desire for students to know particular skills, we all felt obligated to incorporate additional computation practice, after students had opportunities to develop conceptual understandings through the CMP lessons. Yet we wanted to carry out this computation practice in different ways. As I considered the goals for the particular computation practice I wanted to incorporate, conflict emerged for me. I knew that my pedagogical approach would shape the particular mathematics my students had the opportunity to learn. I felt tension around what to teach and how to teach it, knowing that the approach I aimed to use in the computation skill practice went against what my colleagues were doing and what my administrators seemed to want. This was because my goals for students in terms of the math I wanted them to learn deviated somewhat from what was expected.

I believe these differences came, in part, from some of the resources that I brought with me to teaching at the time. Specifically, I am referring to my knowledge of reform-oriented mathematics teaching and learning that I accessed through graduate coursework and CMP conferences. From these resources I incorporated particular pedagogical strategies that aligned with the Standards for Mathematical Practice (SfMP) from the CCSS-M, as well as with the intentions of the CMP authors. For example, I used discussions as a way to draw on students' thinking, after students had time to first attempt computation problems independently. I found this was particularly helpful in addressing wrong ideas, clarifying students' thinking, and giving students opportunities to hear multiple ways of solving a problem. Also, through the discussions we made connections

to some of the conceptual understandings from the CMP lessons. So, while my colleagues and I all felt committed to content in the CCSS-M and CMP, unlike them I opted to not use direct instruction for computation practice. Instead, I used discussion-based learning around the processes for solving for an unknown in a proportion.

However, as I attempted to use these practices affiliated with this approach in skill practice, the administrators were sending particular messages about what it means to do mathematics. Their perspective was from a traditional view of mathematics. They believed teachers should communicate to students when they are right or wrong, and in general they should specify the right way to do a problem. This does not mean the Applegate administrators were against students sharing their thinking or critiquing one another. But ultimately they wanted us to let students know how to do something because *we are the authority.* I lost points in my evaluation for not doing this. My principal felt that my students might be confused about the ideas circulating and needed to hear me give the final stamp of approval by stating which particular idea was correct. This was when we were deriving a formula for finding the area of a rectangle. All of the students' ideas that we discussed were correct, but one formula was the most efficient. A student stated this was the case. I wanted students to have a chance to see themselves as the authority because for me mathematics is about arguments that can be challenged (See Battista, 2004, for further discussion on what this looks like).

I felt that creating opportunities for students to be an authority in learning mathematics was particularly salient for Black students. I thought back to my students' experiences at a private school as they were asked to reason through a cognitively demanding task, and because they were so used to low cognitive demand math problems

and direct instruction they faltered, and tried to persuade the teacher to resort to telling them how to proceed. From this experience I began to question traditional mathematics teaching and became more cautious in using it in my practice. The dilemma for me came when my commitment to teach particular mathematics to my students came into conflict with how my administration and colleagues viewed teaching mathematics. I did not want to be penalized for deviating from what was expected, such as in my evaluations. Also, I knew incorporating discussions with computation practice would prevent me from adhering to the pacing guide set by the administrators, as this approach requires more time. This was a problem that made me uncertain if I should proceed in this way. I discuss this further when I talk about obligations to an organization perspective, in which efficiency and effectiveness are central goals for mathematics teaching and learning.

Today the most common approach used in K-12 mathematics lessons across the United States is still traditional-oriented mathematics teaching (Stigler & Hiebert, 2009). Further, utilizing a reform curriculum, like CMP, does not guarantee that mathematics will be taught according to the intentions of the authors (Remillard, 2005). Mathematics teaching, even with this type of curriculum, can still be carried out in the ways in which administrators and teachers are accustomed, usually meaning traditional-oriented mathematics teaching and learning. It is difficult to shift from traditional to reform mathematics teaching, with teachers finding even when they start to shift they revert back to how they had taught previously (e.g., Marks, 2009). In part, this is because for most mathematics teachers, as well as administrators, what it looks like to teach and to know mathematics is ingrained in their thinking from their previous experiences of learning mathematics, in which they typically experienced traditional instruction (Stigler &

Hiebert, 2009). Shifting the way that administrators and teachers view mathematics, particularly what it means to know and to do mathematics, is at the heart of teaching mathematics in a reform-oriented way (Ball, 1988). However, there is a certain efficacy that comes with using methods like direct instruction, in which teachers feel confident that they have told students what they need to know (Smith III, 1996).

Also, there are arguments for reconsidering reform approaches in light of what is best for Black students (e.g., Delpit, 1986, 1988; Martin, 2015). While Delpit (1986, 1988) is referring to literacy and writing, her contentions for educators and researchers to recognize the assumptions in curriculum and pedagogy that are bound up in White liberal agendas is also relevant to reform materials and approaches in mathematics teaching. She argues for a balance in which Black students have an opportunity to engage in critical thinking while also learning skills that give them access to a culture of power. For Delpit (1986, 1988), this means that the approaches to teaching touted as ideal in these predominantly White-led reform movements, are not necessarily how she recommends carrying out teaching with Black students. Specifically, she states, "I suggest, instead, that there is much to be gained from the interaction of the two orientations and that advocates of both approaches have something to say to each other." (Delpit, 1986, p. 384). While Delpit (1986), is referring here to approaches for teaching writing, she refers to finding this balance (between reform and traditional pedagogical approaches) in mathematics teaching, as well (Delpit, 2012).

Due to the constraints from administrators and prior mathematics experiences that shape what mathematics teachers teach and how they are to teach it, what does it mean for doing right by Black students if teachers feel obligated to use a traditional

pedagogical approach in teaching mathematics? Is it enough to say that as long as students are given opportunities to learn and practice grade-level computation skills, then we are doing right by them? Or, is doing right by Black students, at least in part, about the opportunities to learn particular content from the particular curriculum and practices utilized to teach mathematics? Further, how are teachers to navigate content and pedagogical dilemmas when faced with constraints from administrators or limits to their own resources? How does this affect what it looks like to do right by Black students? How might teachers find a balance in drawing on both reform and traditional pedagogical orientations within the constraints put forth by administrators to do right by Black students?

**Obligations to an organizational perspective in the teaching of mathematics.** The role of a mathematics teacher in U.S. public schools is not only about the particular mathematics that they are teaching. Institutional operations also influence mathematics teaching, usually through expectations communicated about particular desired outcomes for an institution. At Applegate, my colleagues and I felt obligations to certain types of results for the good of the school, which Chazan et al. (2016) refer to as "outcomes of mathematics teaching as indications of an institutional process of educational administration" (Chazan et al., 2016, p. 1063). According to Chazan et al. (2016), the focus of these goals for mathematics teaching can be thought of as coming from an *organization* perspective. For example, in reference to organizational obligations that affected our decisions around computation practice, we felt obliged to the legality of students' Individualized Education Plans (IEPs), to a year-long pacing guide, and to particular improvement goals for students' test scores in route to the school meeting

AYP. These obligations though again influenced me in ways that were different from my colleagues. I discuss here how for me these obligations were in conflict with other teaching commitments, contributing to a dilemma to be managed.

To start, both of my colleagues followed students' IEPs by giving them calculators. My colleague Carrie also allowed students without IEPs to use calculators for computation practice in this unit. In contrast, I felt conflicted about having my students use calculators when engaged in this practice. Carrie seemed to feel strongly about focusing on grade-level skills, thereby using calculators when computation skills from prior grade-levels was involved. For Allison, calculators were not allowed for students without IEPs on computation practice because they would not always have these tools on assessments. For me, I knew that not following students' IEPs had legal ramification and that is why Applegate administrators expected teachers to closely attend to these specifications. Yet I also wanted to give my students opportunities to develop certain computation skills, like attempts at mastering single-digit whole number multiplication. This felt important to individual successes in their futures, such as in college or in a workplace. I felt they would be limited, if they were not able to carry out simple arithmetic. This goes back to the urgency I see for Black students in particular and what it would mean for them to not have these skills. More specifically, I worried about the negative stereotypes Black students may face related to their intelligence and qualifications, specifically as this relates to perceived math ability. Also, I wondered about the methods that had been used to teach students these skills in prior years, and if potentially some of my students would benefit from alternative approaches. I decided to request that students not use calculators when engaged with computation practice unless

just checking their answers. Given that I would be leaving at the end of the school year to return to graduate school, I was willing to face any possible ramifications for this decision, yet I still felt uncertainty about this choice.

My colleagues and I also felt obligated to adhere to the pacing guide, per our administration team's request. The administrators had goals for particular content coverage in terms of students' preparedness for standardized assessments. This focus had to do with their desire for favorable outcomes around students' mathematics proficiency in order to meet AYP and successfully acquire charter renewal. I certainly understood the administrators' interests in teachers being as efficient as possible as a means to effectiveness in improving test scores. I have my colleague Allison pointing this out to us in the hypothetical conversation. Throughout the school year, I found she was often attune to these messages from administrators. It did not seem like it was an issue for my colleagues to stay on pace; whereas for me I felt tension with such little leeway to incorporate things that seemed extremely important, such as discussions. As previously mentioned, my colleagues decided to only do computation practice on homework, preceded by telling students how to solve the problems through a brief modeling exercise. I however could not let go of my commitment to incorporating conversations about the computational processes in order to give my students opportunities to learn particular mathematics. By incorporating talk, I ended up having a slightly slower pace; therefore, I covered less content than my colleagues. My slower pace caused some additional problems, in that the administrators request for data meetings were delayed because I was usually behind.

Some of the obligations to mathematics teaching from what Chazan et al. (2016) call an *organization* perspective, such as following IEPs and pacing guidelines, compel teachers because of interests in adhering to institutional goals and outcomes. I know firsthand that feeling obliged to follow certain expectations that have to do with institutional outcomes are part of a mathematics teacher's experiences in public schools in the United States. Some of these goals for teaching and learning mathematics originate as mandates from district, state, or federal entities; whereas, some of these expectations are specific to a particular school. Dilemmas arise for teachers though when other commitments to mathematics teaching conflict, such as having a goal for individual students' success that gets in the way of expectations for efficiency (Chazan et al., 2016).

In considering what it means to do right by Black students, I wondered about the obligations from this perspective that may constrain the teaching of mathematics in particular ways. While the goals for mathematics teaching from an organization perspective may at times align with obligations to the discipline of mathematics or to each individual student, there are times when this is not the case. For instance, efficiency and effectiveness depend on what is trying to be accomplished. Exposing students to as much content as possible that can appear on a yearly standardized assessment may help institutions improve student proficiency rates as a means for meeting AYP. However, this might mean schools sacrifice learning mathematics in a way that is more aligned with the discipline of mathematics or that empowers Black students in particular to feel mathematics is useful in their daily lives. If administrators or teachers are not coming at mathematics teaching with a racialized lens that takes into account Black students' mathematics and life experiences, how will organizational goals for teaching

mathematics affect doing right by Black students? More specifically, how might these goals from an organization perspective constrain teachers' attempts to do right by Black students?

**Obligations to the perspective of clients of mathematics teaching.** There are also obligations that my colleagues at Applegate and I felt to individual students' development and success. According to Chazan et al. (2016), feeling obliged to the clients of mathematics teaching and learning involves considering what is "good or bad for the individual child along many dimensions, few of which are mathematics-specific" (p. 1063). In terms of this perspective of the client, providing additional computation practice was, in part, a way for us to help students achieve certain goals, such as, having the tools to do what was needed to graduate from high school. As previously mentioned, some of our commitments driving computation practice were about improving students' scores on standardized tests, but we also all felt compelled to attend to individual goals for each student, like passing the upcoming unit test, moving to a higher math group, or earning a certain grade. We talked with students regularly, as well as with students' parents, to develop goals for students and to determine what we as teachers of mathematics could do in support of these goals. Conversations such as these were part of the expectations for teachers at Applegate. In terms of the way in which my colleagues and I each interpreted what is best for each of our students, there were differences. The lens that I brought making race and historical context salient, influenced what I viewed as being in the best interest of my students.

First, in terms of shared obligations, the mathematics teachers all felt compelled to help students to set goals for their scores on the NWEA MAPS test. As mentioned in a

previous chapter, the scores on this test determined placement in math groups, specifically the lower or higher track math classes. The motivation to address computational knowledge was in part to give students some of skills they might need to improve their scores on this test, allowing some students to obtain a score that would allow them to move to the higher math group. Movement to a different math class was somewhat fluid, in that a significant jump in their NWEA score along with exceptional performance in class would lead us to consider moving a student in a low track math class to another track. The reverse was also true. Allison often referred to the NWEA scores, which points to her strong commitment to helping students individually meet their goals, or goals she had for each student, for this test. Certainly, helping students meet these goals was important to me too. Yet, I also felt compelled by other individual goals. In particular, I felt strongly about my students each having mastery over certain prerequisite skills, like single-digit whole number multiplication. I believed that this would allow them to meet various personal goals, like graduating from high school and succeeding in the workforce or in college.

As I mentioned previously, there was an urgency for me to attend to these types of goals given what I know about the realities of obstacles for my students, such as remedial coursework as a gatekeeper to college and the potential discrimination my Black students might face in the workforce or college as they may be perceived by others as less capable. With this goal in mind for my students, I also had conflict in knowing the different levels of mathematics readiness for each of my students and the particular challenges that students with IEPs faced based on their particular diagnoses. There was one student in particular who scored on the NWEA MAPs assessment at the first grade

level and had experienced lead paint poisoning, of which one of the symptoms is memory challenges. For this student in particular, I faced a quandary of what to do. Should I uphold my goals for knowing multiplication facts and not allowing a calculator to be used with computation practice for this particular student? This is an example of some of the conflict I felt as I considered what was best for each of my students.

In addition, as part of my commitment to adhering to the best interests of each of my students, I felt obliged to use my mathematics teaching to empower my students. In particular, I wanted to foster positive mathematics identities in each of my students. In other words, my goal for each student was that they would see themselves as capable to learn and do mathematics. For me, this meant incorporating individual support, through coach class. Also I addressed this goal by using dialogue about mathematics to create a community in which students expected that they would have opportunities to share their thinking and to feel valued. This is in part why I felt so strongly about continuing discussions as we approached computation practice. I worried that by changing my approach, this could alter the dynamics of who is viewed as the authority in the classroom. I wanted my students to see themselves as capable of figuring out if something is mathematically correct and develop reasoning to support their ideas. I did not want to stifle this through a shift to direct instruction. For my students who are unlikely to have experienced a reform-oriented approach in their mathematics schooling experiences, I did not want to confuse students or risk undermining a classroom environment that I had created in hopes of building positive mathematics identities.

In general, students and their families have particular goals for mathematics teaching and learning that relate to students' development and success. This may include

obligations to help students achieve particular outcomes and to develop and empower students in their learning of mathematics. Teachers feel obligations to their students, potentially to different degrees depending on the teacher and on each of their students. However, the ways in which teachers interpret and attend to individual goals for students varies. My view of my students' needs and desires in terms of what mathematics learning could do for them came again through a racialized lens. Through this analysis I wondered what does it mean to do right by Black students when attending to individual student goals? What happens in addressing these goals if teachers of Black students are not aware of the ways racialized experiences influence students' learning of mathematics and their mathematical dispositions? When teachers do have a sociocultural and historical awareness, how do they overcome students' previous negative experiences and address the potential challenges that Black students will individually face in light of institutional racism?

I return to these considerations for doing right by Black students as teachers feel pulled in various directions around competing aims and expectations in teaching mathematics. The next dilemma I share is also about gender equity and the uncertainty I felt when considering what it might mean to do right by Black female students and Black male students knowing that the intersection of race and gender brings differences in experiences between these two groups of students.

### Dilemma 2: Spontaneous Boys versus Compliant Girls

In the summary discussions for each CMP Investigation in my mathematics classroom, there were times when there was student to student talk with little to no intervention on my part. For example, a student would share an idea and another student

would ask a question or respond with why they agreed or disagreed, and from here other students would continue the dialogue without me, the teacher, calling on anyone or redirecting, or giving any type of approval or disapproval in the conversation. In essence, it just flowed. These moments felt like a pendulum swinging continuously. The times I would jump in felt like I stopped the pendulum and pulled it back and then let it go; thereby, allowing it to swing again, until I jumped in and repeat. What I found though in my classroom in these instances of the perpetual swing of the pendulum was a group of boys who consistently talked back and forth with each other about the mathematics. During these times, there were girls raising their hands, but not jumping into the conversation. I questioned myself during these episodes of spontaneous boys and compliant girls, unsure of how to proceed.

As I thought about what to do, I grappled with some of the conflicting goals for facilitating discussions in my math classroom, making it unclear as to which route to take. I knew though that the ways in which I internalized teaching Black students, particularly with gender now in the picture, was influencing my interpretations of the goals for such discussions. I also knew this was a dilemma as there was not a right or wrong way to proceed. Any decision I would make would result in some goals being met and others cast aside or compromised. I knew I wanted to take into account the experiences of my particular students and with a lens toward gender differences, which meant for me to consider the racialized learning of mathematics with gendered experiences in mind. In particular, I felt compelled to take into account what I understood about a school to prison pipeline for Black boys (Heitzeg, 2009; Piquero, 2008) and the overrepresentation of Black boys in disciplinary situations (Redfield &

Nance, 2016). It is the case that Black females are also experieincing inequitable disciplinary actions in schools (e.g., Blake, Butler, Lewis, & Darensbourg, 2011), yet this is in comparison to White and Hispanic female students. In the context in which this research is conducted, Black males are overrepresented in all levels of punitive disciplinary measures; therefore, this awareness shaped my decisions in facilitating discussions in a gendered learning space.

As I was writing this dissertation and wondering how to convey to a reader the way I see the racialized experiences of Black males in the United States, particularly in school, I immediately thought about how my husband reacted when our son was born. We did not find out the gender prior to our daughter's or son's births and when I asked my husband what he was thinking shortly after they arrived in the world, his reactions were quite different. I share this to capture what both my husband and I were feeling, and that is a sense of fear for our son and what he will face in this world as a boy, a man, and most significantly a Black man. Every parent of course fears for their children, wanting to keep them safe and to guard them from harm or pain, but this general feeling of protection is different than what my husband was alluding to when he said to me he felt joy mixed with anxiety about having a son, a Black son.

When I recorded the whole class discussions for this practitioner-research my son was not yet born. Yet, as I wrote this dissertation and reflected on this gender dilemma, my son was at the forefront of my mind. I present here a letter to my son. This letter from me is not necessarily meant to be given to him. The intent in writing this letter for this dissertation is to offer the reader a personal connection to the realities that Black boys face. It conveys the fears I have for my son, based on what I know is likely to be part of

his experiences, which will in many ways be different than his sister's experiences given the way society reacts to the intersection of race and gender. My intent is to paint a picture for the reader of some of the differences in the lived experiences of Black boys as compared to Black girls.

**A Letter to My Son**

Dear Trey,

As I begin to write this letter I have tears in my eyes. These tears come from fear. The same fear I have when your dad does not arrive home from work at the time I anticipate is what I feel when I think of you going out into the world. This fear is not a normal, everyday fear of losing the people we love. This is a malignant fear that affects all Black people and people like me who are married to a Black man and who have Black children. Yes, of course you have a White mama, but I say "Black" because as you know by now, that is how people will see you. So, my fear, where does it come from? It is a fear that comes from you inhabiting a Black body, and particularly you being a Black boy and someday a Black man. An author named Ta-nehisi Coates helped me to better understand what I was feeling and that I am not alone. He writes to his fifteen year-old Black son, "I am afraid. I feel the fear most accurately whenever you leave me. But I was afraid long before you, and in this I was unoriginal." (p. 14). You might ask me why I have this intense fear for your life, and while I fear for your sister, it is not the same degree of fear that I have for her. I write here a letter to you, to explain as best I can the fear I have for you, my son. In this letter I share some of the words of Coates (2015). Since I am not Black and am not a man, I found it fitting to include this man's powerful words to help guide me in saying what I know to be true. Of course your father will also

share with you throughout your life his knowledge, wisdom, and guidance in your journey as a young Black boy. This letter is just a glimpse into my anxiety that goes beyond any of the everyday parental concerns for one's children, a worry that comes with having a Black son in this world.

By the time you read this letter, you might already understand to some degree this fear that I feel. It comes from knowing how you as a Black boy will be perceived, how you will be treated, how you can live or die at the hands of people who hold biases and hatred toward you and who have a fear of you, not for you. It will not be exactly the same for your sister. And, do not think this is just about boys being treated differently than girls. Yes, indeed all boys are socialized in particular ways that are different than girls, by parents, by schools, by society. Yet, what I am referring to is about skin color and gender coming together. It is about the hurtful and tragic ways that skin color is the basis on which people are denigrated and oppressed, and killed without repercussions. I hate having to tell you this, but I would rather you know and somehow prepare you for what may come, than for you to experience it and end up questioning yourself. Instead, I want to teach you how to question everything put in front of you, to create in you a critical eye with which you view society and what it presents. And also how I want so desperately to protect you from any negative thinking you may have of yourself at the hands of people acting on stereotypes from their own biases and insecurities. Yet I know I cannot protect you from these people and their actions. I cannot even guarantee you life in a country in which, as Coates (2015) states, it is "traditional to destroy the black body" (p. 103). Not even my White privilege, something which I detest but know exists, can save you. Coates (2015) speaks an unfortunate truth about your life when he says to his son the following:

"You have been cast into a race in which the wind is always at your face and the hounds are always at your heels. And to varying degrees this is true of all life. The difference is that you do not have the privilege of living in ignorance of this essential fact." (p. 107).

I think of your father at this moment and a situation in his fifth grade class. A White teacher in a diverse class of students, singles out your dad as a young Black boy for behaviors that to his teacher reflected defiance. For your dad, the son of a fifth grade teacher and an elementary school principal, his behavior was not an act of defiance, but rather boredom and frustration with how he was being spoken to and treated based on racialized and gendered biases. This White teacher perceived your dad's active movement, his wonderings, and his polite refusal to do busy work as a threat. This teacher's judgement landed your dad in a psychologist's office, and resulted in a report about what was believed to be wrong with your father as a young, smart, curious Black boy. As your father shared this experience with me, he indicated how much this negatively affected him. I share this with you because of course I fear that these experiences of racism will impact you too. I cannot help but contrast your dad's experience with that of your nephew, Jacob. Also a very active child who, like your dad, had no interest in worksheets involving skills he already knew, yet he was not labeled as a problem, but instead accommodated at the request of your aunt and uncle. I felt the difference was Whiteness. Teachers are not afraid of Jacob. They do not hold negative perceptions of him based on his skin color. And, your dad's experience is not only about being Black, but also about being a Black boy. Your cousin Sophia has not as of yet had teachers impose judgements on her for her energy and assertiveness. And, like Sophia, your sister will not likely be perceived as a threat to teachers. This is because Black girls

are less likely than Black boys to be labeled as defiant for the types of normal age-appropriate behaviors your dad exhibited.

Coates (2015) draws on a famous rapper Nas to capture his feelings about schooling. He likens school to a poison. I have seen this too, the toxic effect that schools can have, especially on Black boys in how people see them, and then how they come to see themselves. It can also poison children through what is taught and what is hidden. From Coates (2015) own experiences in school, he states that "schools were not concerned with curiosity. They were concerned with compliance" (p. 26). This is still the case in most schools, and particularly true for Black boys. In part because Black boys are viewed by most White people as a threat and capable of doing great harm, even as innocent children. Yes, I know this is absurd. Their bodies and voices are viewed as something that needs to be disciplined, contained, made to obey. I have witnessed this. There is research to corroborate what I have seen. And, your father has experienced this firsthand. The schools are full of White people and some non-White people who hold these views. So too are police stations, hospitals, companies, etc. It is not that your sister will avoid the poison of schools, or the judgements and unfair treatment that comes from racism, but her experiences will be different because perceptions of Black girls are not entirely the same as that of Black boys.

What is more, Coates (2015) makes a point to his son that White people, rich or poor, are seen as equals. That is the luxury they are afforded in this country. Coates contends that by White people having "the right to break the black body," this has resulted in a view among most White people that "there was someone down in the valley because a mountain is not a mountain if there is nothing below" (2015, p. 105). This

portrayal of the White experience paints an image of White people seeing Black people as below them, beneath them, inferior to them, and it is used as a justification in harming or destroying Black bodies with no recourse, something that has lived on through White privilege and racism. These words of Coates brought to my mind an experience of one of my Black students. A student with whom I was very close. His name was Troy. He was a tall boy with dark brown skin. I met him as a rising eighth grader. I was told by the principal at the first school at which I had taught that Troy was on a third grade math level. The principal felt sorry for some of the experiences this student had endured, and offered to pay for tutoring for the summer to help address this disparity. I was asked if I wanted to be his tutor. We worked three hours each day on math, everyday of the summer, and he did some math problems at home, as well. We also spent time talking about life and playing basketball, and overall enjoyed doing math together. By the end of the summer he was essentially on grade-level according to the NWEA MAPs test.

Upon his acceptance into a private boarding school to begin his ninth grade year, he was deemed by the school staff a very capable young man with a bright future ahead of him. This particular private school was created for low-income students with significantly challenging homelives, with a focus on guiding and supporting students through stable and nurturing relationships, as well as offering excellent academic opportunities. Even with this commitment, during Troy's first year at the private school, the school expelled him. This was a situation of two young people, Troy, a Black boy, and a fellow classmate, a White girl, becoming romantically involved and doing what lots of high school students do, exploring their sexuality together. The school has a policy that requires a boy and girl to not be alone with each other, in an attempt to prevent such

behaviors. However, typically students are not expelled for such actions. It was another tragic situation with double standards that held a Black boy to different expectations and enforced different consequences, than that bestowed to a White girl who was also involved. Race and gender intersected with an unjust outcome. If you are wondering what happened to Troy, well, he returned home and he dropped out of high school. Sadly, he became engulfed in the streets. My heart still aches for this young man and his family. The breaking of a Black body, again at the hands of White supremacy. I am also inclined to think that this particular situation had to do with Troy being not only Black, but also a boy. I wondered if the outcome for a Black female student violating this particular school policy would have been the same as that endured by Troy. I am not sure, but my sense is that gendered racism is something that makes my fears for your sister in the world different than the fears I have when I think of you facing the world.

This story I hope conveys how troubling it is to me that you will not be held to the same standards as your White peers. Just because there are rules and consequences in place, even those explicitly stated, it does not mean those rules will be enforced in the same way for you as they are for others. Society will not give you second chances. And, I do not want you to think that the pain and suffering that comes from discriminatory policies and unjust consequences will only come at the hands of White people. My fears are about a society in which we live and the institutionalization of racism. There are people of color too who harbor and exhibit such racism toward Black people. It is systemic. Please know, you did not do anything wrong. You do not deserve this treatment. You deserve to be a child, to play, to shout, to run, to move. And, as you enter adolescence, you deserve the opportunity to find independence and to engage in all the

fun things that students entering young adulthood like to do, like playing loud music, hanging out with friends, dancing, laughing, and carrying on as young people do. Unfortunately, because of the way that you will be viewed in society, I beg that as you do these things you are cautious. I want you to be an adolescent without fear, just as Coates desires for his son. Yet I am scared, because I know that too easily the blame for something will be placed on you, a Black boy, before any White child. Even if the White child is in the wrong, you will still be blamed.

This, in part, is because of White people's fear, not fear *for* you, but fear *of* you. I have seen this in their eyes with simple things like Black boys wearing hoodies. At Applegate, the school I taught at, there were rules early on banning hoodies. After some questioning of this rule, finally it was removed. But, I think of Trayvon Martin and how wearing a hoodie can get you killed in this country, if your skin is the color of Barack Obama, our 44th president. This is because of the fear that White people harbor just at the sight of Black boys and Black men. Yes, even our former president acknowledged that what happened to Trayvon could have easily happened to a son of his, because of the bias, the prejudice, the racism, that so often is tucked away in people's subconscious, only to have these same people stating "I'm not racist." And, President Obama, like you, has a White mother. No one refers to him though as biracial. In our society he is Black. There is a long history why this is the case and your dad and I will certainly provide you with this history lesson within our home, as this is not something you will learn about in school.

As you move through school and make friends, I want you to know too that your skin color, a product of your parents, will be lighter than other Black children, and with

this there is some privilege. It is unfair and unjust, this hierarchical denigration of Black people according to skin tone. Yet, it exists. Your sister will likely feel the benefits too, unfair as they are, because of her even lighter skin tone, as well as concessions that come from being a girl, such as not being feared. Gendered racism, that is what I call this. I think too there is something that happens in the socialization process that does contribute to girls exhibiting more reservation and compliance than boys, sometimes as early as primary grades and certainly by middle school. This difference coupled with gendered racism that brings different judgements on and expectations for Black boys, means your sister's experiences will not always look like yours. Again, not your fault and not a result of anything you did.

You can rest assured though that your dad and I will always be here to help you understand what is happening, no matter how unfathomable it is that young children bear these burdens. We will support you and guide you, and above all else teach you to wonder, to question, to critique. We will also teach you coping skills and help you foster your own path to negotiate a way in this unjust world. We will be by your side while also giving you the space you need to learn in your own ways. And, we will be scared. This fear is something I know I cannot help. It is natural given the realities that you will face. I will work hard though to not let it paralyze me or you, but instead use it to empower you and to guide your development, doing the best I can to help you find tools, to have a voice, and to draw on wisdom to pave your path and find your way in this world.

Love, Mom

I brought to my classroom an awareness of the gender differences in the experiences of Black boys compared to Black girls. I share in the next section how I

managed the dilemma of spontaneous boys initiating and sustaining mathematics conversations while compliant girls sat back in their chairs with their hands raised, waiting to be called on. Following this section, I present an analysis of the obligations that I felt as I grappled with different goals relevant to this particular situation that conflicted, resulting in this dilemma.

**How I Managed the Gendered Discussion Dilemma**

In my classroom throughout the year I had purposefully made an attempt to create an environment in which students felt they could speak to each other. This is evident in the setup of the classroom. The desks organized in a horseshoe. Also, my responses often directed students to talk to each other and to say what they were thinking, as opposed to looking for my approval or for me to give an answer or an explanation. You often could hear me say things like, "Talk to them," as I pointed to the class, or "I don't know, what do you think?" when asked a question that I felt my students should ponder rather than me answering. I also would say, "Does anyone have a question or comment for….," in order to elicit dialogue from peers when hands did not go up after a student shared an idea. As I mentioned, there were times too when students would jump in and respond to each other without raising hands. Conflict arose for me when I found a pattern in these occurrences. There were boys who would willingly assert themselves to initiate dialogue with each other. It was not all of the boys in the class who did this, but three boys who consistently did so with some of the other boys joining in here and there in these student-led conversations. I did not give instructions about how to do this. I did not give verbal approval and I rarely halted the conversations, unless it was almost time for class to end. I felt excited by the student-to-student talk. Most of the time it felt meaningful and

productive, for an array of reasons. Yet, girls' voices were not present, and here is where I grappled with what to do.

I could see the girls sitting quietly at their desks. Some of the girls sat with their hands raised, but refrained from joining the conversation. In contrast, the boys who were talking leaned in, sometimes turning and shifting in ways that showed they were listening and attentive to the speaker. While the girls' eyes also moved to each speaker, their movements, if any, were in their arms, raising a hand even higher, seemingly to convey how adamantly they wanted to share. Yet, they did not share. This is because I made the decision to not jump in to these episodes of student-to-student talk. I wanted to include the girls' voices, but the boys jumped in so quickly and I felt that even if I interrupted the conversation, to encourage the girls to share freely, this would have changed the flow. I also thought too that if I prepped the class for this type of situation prior to it happening, it was unlikely to shift the girls' actions. Essentially by doing nothing more than listening and nodding, I was making a decision to do something. I was choosing to let the student discussions unfold, knowing that the boys involved were engaging in different opportunities to learn than the girls who seemed filled with hesitation as they followed an ingrained schooling expectation to raise their hands. I never explicitly taught students to raise their hands before speaking, but they seemed to naturally do this, except for these episodes in which some of my students went against the typical classroom norms and instead spoke freely to each other, questioning, critiquing, and offering different ideas.

I thought about the work of Lampert (1985) and one of her dilemmas in her mathematics classroom. Specifically, she found her proximity to the boys table kept them well-managed, yet it resulted in the tables of girls feeling distant, with less attention given

to their needs. She described how she seated the boys and girls in her class separately due to the rambunctiousness that comes at a certain age with mixed-gender groupings. With the gendered proximity-attention dilemma, she could not find a right or wrong approach to turn to, so she improvised in the moment. She worried though about wanting to make sure she was supporting her girls while also wanting to keep her boys focused. Like Lampert, I too felt compelled to want to empower the girls in my classroom who have a history of being excluded and marginalized in mathematics. In certain ways though the concerns I had around gender in learning spaces were different because I was not coming from a perspective of seeing Black boys as privileged like the White boys in Lampert's class.

My perceptions of the racialized experiences of Black males in schooling and in life made me attentive to their sense of belonging in school, in general, and their relationship to mathematics, in particular, in ways that felt somewhat different than Black females. My worry and fear for Black males in terms of what they would face in this world was also different than that which I had for Black females. My thoughts about the intersection of race and gender, as it relates to the goals of discussions in mathematics, led to the conflict that I felt. I offer here an analysis of this internal conflict as I was pulled in many different directions in this gendered dilemma. Looking through a racialized lens at the various perspectives on the goals and desired outcomes for teaching and learning mathematics, I analyze how I grappled with and negotiated various obligations in the role of mathematics teacher.

## Analysis of Obligations to Perspectives on Gender Equity in Discussions

**Obligations to societal perspectives on mathematics teaching.** As I reflected on the obligations that I felt to society's view on the goals and outcomes for mathematics teaching and learning related to this dilemma, I thought about a general message about girls and students of color missing from higher level mathematics classes and fields involving mathematics, also known as STEM. I felt compelled to empower my girls as it is ingrained in my thinking that girls need support and opportunities to overcome their underrepresentation in math. Yet I also know the pipeline to STEM fields is broken for both Black females and males (Young, 2005). Therefore, in my class I felt the need for a concerted empowerment effort not just directed toward the girls, but instead for all of my students, both girls and boys. This certainly felt different than the concern that Lampert (1985) speaks of, which I believe was focused on the White female students and her desire to provide them with opportunities to gain access to enriching mathematics experiences.

For Lampert (1985) and me, and for all teachers, remedying the White male domination of mathematics is about fairness in society and also about a need in our society. Teaching all students mathematics in a way that facilitates their success and makes them want to pursue more mathematics with a capacity to persist is about doing right by all students, as well as attending to the shifts in our economy that require more people with advanced levels of knowledge of mathematics. Yet, I also felt compelled by my own awareness of the differences in the lived experiences of Black boys as compared to those of Black girls, and what this might mean for addressing the underrepresentation of each of these groups of students in mathematics fields. For me, I felt particularly

concerned about the school to prison pipeline for Black boys, especially for boys in urban environments and living among concentrated poverty, like my students (Heitzeg, 2009). It seems young Black boys are too often channeled into a juvenile justice system, rather than into higher education (Piquero, 2008). Further, Black male students as compared to their White counterparts, as well as to Black female peers have experienced higher rates of grade retention, office referrals, IEP designations, expulsions, and dropping out (Redfield & Nance, 2016). With this, young Black males are less likely to pursue college and if they do, they are more likely to exit prior to finishing, than Black females (Harper, 2006).

These realities are relevant to the consideration of the underrepresentation of Black males in mathematics, yet the societal messaging usually is confined to more narrow concerns over a paucity of girls/women and minorities in STEM (e.g., Burke & Mattis, 2007; Chang, 2002). In this narrow view, attention is not given to gendered differences within minority groups, thereby the reference to females is about White girls and White women. I think most teachers hear this perspective and think about White females and students of color, in general. As mathematics teachers feel obliged to this message of fairness, they are likely to adopt whatever their district or school provides to try to make a difference for these particular students. For instance, it has been suggested that changes should be made to the curriculum and mentors provided to encourage a pathway to STEM fields (e.g., Chang, 2002).

They may also, like Lampert (1985), reflect on their own experiences and think about how this might inform their decision-making. What I find troubling in this messaging though is the failure to see the particular differences in the experiences of

Black males as compared to Black females in addressing such disparities in STEM. These considerations led to some of conflict that I felt when presented with a situation of the boys spontaneously engaging in mathematical discourse and the girls refraining from jumping in. I found myself wanting to let the student-led conversation flow; thereby, giving my Black male students opportunities to feel empowered by their own thinking and by being allowed to use their voices to make arguments about the mathematics. In this way, they could know what it feels like to share the authority in mathematics. Yet, I felt tension because I knew I was not affording the girls, who opted not to spontaneously share, the same opportunities. I also wondered if I stopped the conversations what was I taking away from the boys, by somehow potentially changing or halting their opportunities.

By looking through a lens that takes into account the intersection of race and gender, I found myself thinking about a more nuanced fairness perspective in addressing underrepresentation in mathematics. I wondered if empowering and encouraging Black students into mathematics and related fields would require seeing how race and gender intersect in societal messaging? Take for instance the beliefs and expectations of Black boys. It seems that these need to be considered when taking on obligations of fairness in teaching mathematics. Yet, what does it mean for Black students if their teacher does not consider such differences in students' experiences? Also, as I think about doing right by Black students, I wondered how teachers who are not accustomed to thinking about the intersection of race and gender would be able to do right by Black males in their mathematics classrooms? And for teachers who bring a racialized lens with an awareness of gendered racism, are there ways to do right by Black females while strategically

making decisions that prioritize doing right by Black males in a dilemma such as the one described?

**Obligations to the knowledge perspective in the teaching of mathematics.** An analysis of this dilemma also revealed the ways in which I wanted students to view mathematics, including specific ways of doing mathematics. My obligation to a particular knowledge perspective came from my commitment to the Connected Mathematics Program (CMP) and my own evolved way of seeing mathematics. Engaging my students in a reform-oriented curriculum and pedagogy meant that I could emphasize the role of reasoning and argumentation in mathematics. In particular, it was through mathematics discussions that I could foster students' opportunities to be an authority in mathematics, to argue and critique, to question, clarify and reason in their learning of mathematics. I wanted students to feel that their ideas mattered. I wanted them to have some ownership over the mathematics, that is in what we talked about and how we talked about it, and also in what they came to know to be true. Allowing the student-led episodes of talk to flourish without jumping in aligned perfectly with these knowledge goals for teaching and learning mathematics to which I felt obliged.

I felt that having students see themselves as an authority through the discussions was particularly important for both my Black female and male students. I thought back to my husband's experiences in his fifth grade classroom and my student Troy, both of whom were made to feel unfairly judged in their schooling, with different degrees of their non-compliance resulting in unjustified consequences. I know firsthand that these types of experiences are the norm for Black students, and particularly Black boys. Counter to these common occurrences, I had hoped that the mathematics discussions in my

classroom could be a time in which Black students felt they could go against what is assumed, they could question even the teacher, and present counter arguments using their own thinking as justifications. For me, it seemed this could be an empowering experience for Black students and in so open up a world of mathematics to a group who frequently steer clear, or are pushed away. I was excited about these episodes of student to student talk given the feeling that these were the very ways of teaching mathematics to which I was committed. Yet in this way of engaging students in particular mathematics a dilemma came up for me, specifically, when these empowering opportunities were only taken up in the way that I had hoped by a group of boys in my classroom.

Like Lampert (1985) and other mathematics teachers, wanting to ensure that girls are not forgotten in learning particular mathematics, I was conflicted in fostering the student-to-student talk since it did not involve the girls in my classroom. Yet, I also kept thinking about how I would likely have done things differently if it had been White boys in my classroom. To have just given these types of opportunities to White boys felt wrong because of a history of mathematics as a subject area from which White girls and students of color were and are often excluded. This is not the context though in which I taught. The Black males and females in my classroom both needed opportunities to overcome the results of historical exclusion and systemic inequalities. And, yet, I also wondered about the differences in the schooling experiences of Black boys as compared to Black girls with heightened anxiety about the obstacles that tend to be blocking the Black boys' pathways to academic achievement. I also thought about the way females are socialized, even across racial groups. I wondered about the compliance that I saw from my Black girls as they sat with hands raised waiting to be called on. I wanted to

encourage them to be assertive in using their voices to jump into the conversation, yet I also did not want to disrupt the natural flow of the dialogue that the boys had initiated and fostered.

For me, this analysis brought to light how an obligation to have students take ownership in mathematics discussions can present quandaries around who spontaneously takes this up and who does not. Mathematics teachers' obligations to teaching particular mathematics and in particular ways can sometimes result in conflicts as teachers take into account salient contextual factors, such as who their students are and what their students need. In particular, this work points to the need to see mathematics classrooms as gendered learning spaces and to pay attention to the meaning of intersections with gender, particularly race. As I thought about doing right by Black students in particular, I wondered what it would mean for Black female students to miss out on participating in the student-led conversations? I wondered about this in light of my giving their Black male counterparts, who rarely are encouraged to be assertive with their voices and their thinking, an opportunity to initiate and engage in productive student-to-student mathematics talk and what this means for them to have engaged in this? Then I wondered more generally how does a teacher do right by both her Black female and male students in situations like these, or is it not possible?

**Obligations to an organizational perspective in the teaching of mathematics.** In thinking about the role of an organization in teachers' obligations to gender and racial equity in mathematics teaching and learning, I realized that the messaging depends on the lenses through which administrators view students. At Applegate, there was little to no talk from the administrators about gendered experiences among Black students,

specifically, as it relates to the sociohistorical consequences of systemic inequalities. There were two exceptions that I can think of. First, the administrators did consider the gender distribution in each class, finding that the lower-track mathematics classes had more boys than girls, although no changes were made to address this reality. The administration thought of this in terms of the overrepresentation of Black boys in special education, something they felt was out of their control in a middle school. A second way in which attention was given to gender was through teachers' evaluations. I saw this in my own evaluation that was conducted by the principal. She documented that there were times when the boys called out while I was making statements and when I asked questions. The boys' remarks or questions were relevant and on-task, yet she questioned why I allowed this and worried that it got in the way of equitable participation from the girls.

These comments tugged at me, making me question my decision to not demand that students raise hands and wait to be called on. When I brought this up to my principal she suggested that I be explicit with students about the times I expected hands and the times when it was okay to call out. I wondered though about the call and response type atmosphere in a classroom that I had heard about and that I had seen in attending Black churches. It seemed in some ways, I had fostered that type of environment, something that was a part of Black culture. I too though was concerned that the girls' opportunities to participate were being stifled. I felt obligated to addressing my administrators concerns over gender equity in my classroom. I started to create boundaries around calling out while I was giving instructions or talking through a concept, and also when asking certain questions that I wanted everyone to have time to think about before discussing. I made an

effort to communicate these expectations clearly and directly, and tried to be consistent in holding students to adhere to these practices. At times though it was tricky since there were still instances in which I let students jump in and did not intervene, specifically during the student-to-student talk episodes in our summary discussions, without having specified prior to the discussion whether or not raising hands was expected. I tried though to adhere to the pressures that I felt from my administrators, while also grappling with my own uncertainty of what it would mean to do right by Black students while accounting for the intersection of race and gender.

For administration at an institution, gender equity concerns are usually thought of in terms of teachers' effectiveness. Some administrators may take into account race and gender together, and in doing so might be more willing to understand decisions like the one I made to let the boys continue talking to each other about the mathematics and to not label this opportunity as wrong. Further, when administrators take into account the intersection of race and gender in young Black males' experiences in mathematics classrooms, like that of my husband with lowered expectations and troublemaker labels, then they may see the conflict that can come with certain situations like the one I faced. However, without acknowledgement of how race and gender interact, administrators within an institution are likely to make teachers feel obliged to uphold particular practices in light of gender equity, void of a racialized awareness.

In considering what it means to do right by Black students, I specifically wondered about the role of a school in empowering Black students, with particular attention on how schools might attend to the differences between the schooling and lived experiences of Black female students as compared to Black male students. If

administrators or teachers are not coming at gender equity in mathematics teaching with a racialized lens, how will organizational goals for teaching mathematics affect doing right by Black students? More specifically, how might these goals from an organization perspective afford or constrain teachers' attempts to take into consideration gendered racism?

**Obligation to the clients of mathematics teaching.** As most teachers do, I felt obligated to address my students' individual needs as best I could, yet I also realized that sometimes what is best for other students or for a whole class can interfere with what is best for individual students. Also, it is difficult to keep track of all of the needs and desires of each student. When I looked at the students in my class and the ways in which I had attended to some of the desired outcomes they had, and those which their parents had for them, I realized I was fortunate to have many opportunities to address individual goals. Mainly this was because of the small class size, having only seventeen students, and rather long math classes (80-100 minutes). I had the time to build relationships with students and to come to understand how they saw themselves mathematically and what they wanted in their mathematics experiences. Below I share some examples of the ways in which I felt obliged to address students' individualized goals. In these examples, I also share some of the gender differences in how I saw the girls and boys in my classroom, and my reflection on how other teachers might potentially see them. This helped me make sense of the particular conflict I felt that led to the discussion-dilemma.

In terms of students with IEPs who I felt needed a lot of individual support, there were two students who came to mind, Stacey and Keontay. Stacey was a student who was moved to my class mid-way through the year, having formerly been in a self-contained

classroom at Applegate. Both she and her mom were extremely worried about her keeping up with the pace, as well as, having concerns about whether or not she would excel in a regular education mathematics class. I was able to give her one-on-one attention in a way that might not be possible with a larger class size. In particular, I often sat with her group at the start of group work to help facilitate her access to the task. For Keontay, a student who I described earlier in terms of mathematics performance and health struggles, I arranged for classroom support as well, although it looked slightly different. He was more willing to ask questions and to receive assistance from his peers, therefore I often looked to classmates to help create access for him into the daily tasks. What I wondered about Stacey and Keontay was how they would likely be perceived by other teachers. Keontay, as a boy, and specifically a Black boy who asserts himself by asking questions, often calling them out across the room, would probably be perceived by many teachers as loud and difficult. I remember in fact other teachers making comments about him, such as, "Oh, you have Keontay in that class. That's hard." Stacey on the other hand was very quiet and rarely asked questions. She did not appear off-task, even though she was often unsure how to get started and would just sit quietly not saying anything. As a Black girl who was reserved she would likely be perceived by teachers as a sweet child and even with her struggles in accessing the mathematics, she was likely to not be perceived as a challenge. Two students with similar needs, and yet how these differences in the ways they were likely to be thought of concerned me.

Two other students came to mind in thinking about individual needs, specifically, Malik and Sasha, who both desired to be in the higher-track mathematics class. I worked with both of them in class and after school or during other times of the school day to try

to give them additional exposure to concepts in the hopes this might better prepare them for the NWEA MAPs assessment, the test on which decisions regarding movement to the Number Analysis class were primarily based. For example, I would ask them to explain concepts to me while circulating during group work and I would offer extensions, which usually meant additional parts of a task that I had not assigned to the rest of the class. Malik was adamant about working alone most days and resisted having a partner during partner quizzes. I often wondered how his resistance would have been perceived by other teachers. I tried to find ways to encourage him to work with others, but I did not require that he do so as I knew his reasoning and wanted to honor his intense desire for studying and learning without having to do what he referred to as "catching someone else up." Sasha on the other hand loved to help others. I could pair her with a student struggling with a particular concept and she took on the role of teacher, trying to teach them while not giving them any answers. Some of these differences that I saw in Malik and Sasha were likely due in part to personality, yet I also felt that I saw the results of how boys and girls were socialized differently. When thinking about the intersection of gender and race, I also knew Malik's longing to work alone would likely be perceived in a negative way, with labels put on him, such as, uncooperative and resistant. Sasha on the other hand would be perceived by most teachers as an ideal student because she works hard and volunteers to help others.

The individual aims and expectations of each of my students, along with the differences in the ways in which the Black males in my classroom had been and would be perceived led me to feel compelled to consider the benefits of allowing the student-led discussions. Though, I also recognized the possible negative consequences these episodes

had on my female students. An analysis of the ways in which obligations to individual students influenced me in this situation, made me wonder 'Is doing right by both Black male and female students in a mathematics classroom a balancing act, knowing that particular attention needs to be given to the different ways in which race and gender affect students' lives, and specifically their needs and desires within the mathematics classroom? By addressing implications in the next and final section, I return to questions around what it might mean to do right by Black students.

## Conclusion & Implications

These two illustrations of the managing of dilemmas build on practitioner research that attends to the uncertainty in mathematics teaching (e.g., Adler, 1999; Ball, 1993; Lampert, 1985, 1990, 2001; Chazan, 2000). Specifically, this work offers a new way of examining the tensions that mathematics teachers feel as they face problems in their practice that are not solvable. Identifying the goals and expected outcomes in the teaching of mathematics from the perspectives of four stakeholders identified by Chazan et al. (2016), provides a way to understand the particular obligations that can pull teachers in different directions. Further, Chazan et al.'s (2016) model allows context to be made central, which for this research meant examining how my racialized lens informs feeling obliged to try to do right by Black students amidst other obligations in the teaching of mathematics. With this model, Chazan et al. (2016) move us beyond the idea of teacher as an individual decision-maker, and instead shed light on how teachers often act according to what is expected. When teachers deviate from such norms and customary ways of doing teaching it can be because of conflicts informed by a teachers' persona - background, experiences, and beliefs. As a teacher tries to justify her decision making it

is only then that she may become aware of the compulsory role in teaching mathematics and how her own views of teaching a particular population of students goes against some of the assumed goals for mathematics teaching and learning.

From this work, I have more questions than answers. However, there are some ideas that arise from an analysis of the competing obligations that lead to dilemmas, and hopefully the questions will continue to drive future research on mathematics teaching and how practitioners think about their work. First, because of the ways in which teachers feel obliged to uphold certain societal perspectives about mathematics teaching, teachers, particularly White teachers, may struggle to move beyond notions of fairness that fail to take into account the sociopolitical and historical realities of racism and inequalities. Further, when societal perspectives send messages about obligations to equity, such as, attending to the underrepresentation of minority students in STEM fields, there are important considerations with race and gender that White teachers may not feel compelled to address simply due to not understanding the complexities of such intersections. This speaks to how teachers are not necessarily acting based on individual motivations, but rather to norms and assumed ways of thinking about broader conceptualizations, such as, fairness and equity, that are typically defined by particular societal messages.

In thinking about how mathematics teachers feel obligated to particular ways of knowing and doing mathematics, taking into account the racialized learning experiences of Black students may alter some of the goals and desired outcomes on which teacher's would otherwise act based on assumed ways of teaching mathematics. With dilemmas though this does not guarantee that decisions will result in an ideal outcome. In fact, more

problems usually arise depending on the decision a teacher makes. I argue though that for White teachers, in particular, who do not attend to the racialized learning experiences of Black students and how gendered racism further defines Black students, particularly Black boys' mathematics experiences, the decisions in managing dilemmas from a perspective of knowledge could possibly lead to learning spaces that have negative consequences for Black students' mathematics identities and success. Therefore, Black students might bear the burden of the subsequent "problems" that arise when managing dilemmas through a lens of Whiteness.

For example, Delpit (1986) calls for educators to draw on progressive and traditional approaches to teaching in the hopes of giving students of color an educational experience that addresses their academic needs. It seems reform-type curricular and pedagogical agendas are based on knowledge goals that do not necessarily account for the experiences of students of color (Ball, Goffney, & Bass, 2005); whereas traditional instruction carried out in predominantly minoritized schools can take the form of compliance and low-expectations (Delpit, 2012). As teachers improvise to manage dilemmas, it would be beneficial to Black students if they did so with an awareness of how certain decisions shape students' learning experiences and thereby their opportunities to feel empowered versus disempowered in learning mathematics.

Obligations to an organizational perspective in mathematics teaching often bring constraints on teachers, that is, in what they are allowed to (or not allowed to) and expected to do. Here is where the institutional environment of a school can greatly impact how teachers can manage dilemmas while taking into account race and racism, as well as, gendered racism. I think for most teachers the perspectives of organizational goals are the

hardest to deviate from in that the direct contact with administrators and colleagues and the evaluative role of administrators, in particular, creates a strong compulsion to act according to obligations that teachers hear in the messaging of a school. Ideally, school leadership would bring racialized and gendered lenses to their work, although even with these, there are forces from other stakeholders compelling their actions, such that, the administrators themselves might be constrained.

Finally, feeling compelled by obligations to the clients of mathematics, specifically, students and their families, is of course part of being a teacher of mathematics. Yet, for me, what this means for White teachers working with Black students brings questions and concerns. More specifically, I worry the personal aims of students and their families might be interpreted through a lens of Whiteness, leading to decisions that again, as I mentioned previously, could result in more problems to address, as most dilemmas do, that disproportionately have a negative impact on Black students. Further, there are also considerations of how to address the previous negative schooling experiences of Black students, although without a racialized lens this might be perceived by teachers as something other than what it is.

In closing, I return to the question of what it might mean to do right by Black students. Throughout the analysis, I have asked this question, but specifically as this relates to each particular type of obligation that teachers feel compelled to act on in the role of mathematics teachers. Here I bring forth several broader questions. I recall Lampert (1985) asking what kinds of knowledge and resources teachers have available to cope with contradictions, and in this same line of thinking I wonder how do certain types of knowledge or resources, such as a racialized lens, cause certain contradictions and then

what kinds of knowledge and resources will help teachers cope with contradictions that occur in an attempt to do right by Black students? Also, I wonder how can we theorize a racialized lens as a necessary part of (White) teachers understanding their Black students and how to do right by them? Could a return to Clark's three-level framework (Chazan et al., 2016), on how to understand students' mathematics identities, be a way to theorize the necessary knowledge that teachers need to have about their Black students and how they connect with and learn the content? Could this be a way to think about the types of knowledge and resources that (White) teachers need in order to do right by Black students?

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## Chapter 3: Privileging Big Ideas Over Mathematical Language: A Lesson in the Impact of Whiteness as a Teacher Considers How to Do Right by Black Students

### Introduction

The mathematics curriculum is crucial to consider in mathematics teaching and learning, yet teachers themselves can act as the gatekeepers to students' opportunities to learn from the curriculum materials. This is because teachers rarely enact curriculum exactly as it is written (e.g., Stein, Remillard, & Smith, 2007). In particular, reform mathematics curricula present a unique fidelity challenge. Specifically, teachers are expected to facilitate mathematical discussions that incorporate their students' ideas and methods, and to allow for critiques and argumentation. In the role of discussion facilitator, the teacher shapes the dialogue in deciding who talks and when, how to focus the conversation, and what mathematical words and ideas to use. While the teacher's guide for a curriculum typically offers recommendations for orchestrating discussions, mathematic teachers are apt to deviate at times according to how they interpret their responsibilities. Language choices, in particular, constrain and afford students' opportunities to learn the mathematics register. By mathematics register, I am referring to "a set of meanings that belong to the language of mathematics (the mathematical use of natural language) and that a language must express if it is used for mathematical purposes" (Pimm, 1987; p. 76).

Pimm (1987) cautions to "not think of a mathematical register as constituting solely of terminology" (p. 76); rather, this register includes words, phrases, symbols, and ways of reading, writing, and speaking like a mathematician. Gee (2008), a sociolinguistic researcher, argues that "If students fail to know the languages of the

content areas, no really deep learning can occur, although they memorize and recite facts they don't fully understand and cannot themselves use in proactive ways" (p. 100). For marginalized students, in particular, acquiring the mathematics register provides a certain kind of empowerment in their journey through what can be an accumulation of disempowering school experiences (Delpit, 2012). In light of access and equity for Black students learning mathematics, I consider how language in mathematics discussions can afford and constrain students' opportunities to learn.

Through a practitioner research study design, I used my intimate knowledge of my students and our interactions to examine the particular ways in which the available mathematical language in whole class discussions indicates students' opportunities to learn the mathematics register (see Chapter 1 of my dissertation for an in-depth description of this research method). I compare the suggestions in the whole class summary discussions from the Connected Mathematics Project (CMP) teacher's guide to the enacted discussions in my low-track seventh grade mathematics class in a school wide Title I urban school with all Black students. I focus on teachers' mediating role between the intended curriculum and students' acquisition of the mathematics register. I also consider my perception of my students' academic needs and the assumptions embedded within CMP about what students should already know and be able to do, including the use of particular mathematical language. With this research I attend to the following overall question: *With an eye toward wanting to do right by Black students, in what ways are language choices in mathematical discussions affording and constraining students' OTL?* I do this by conducting a comparison of several classroom discussions against the backdrop of the CMP curriculum. I present data to address the following

research question: What opportunities to learn are indicated by (a) the language available to students and (b) the ways students are taking up the mathematical language and ideas?

Like Brantlinger (2013), I came to this research as a White teacher-researcher deeply concerned about the opportunities available to students of color in urban schools. In particular, these concerns are around wanting to give students empowering mathematical experiences in which students develop meaningful understandings of the content and become fluent in the language of mathematics. I held certain beliefs about reform curricula. Specifically, I knew the tasks have high cognitive demand and are said to mirror real-world situations. In my mind, I saw these materials as beneficial for Black students as it would allow my colleagues and me to have high expectations for our students and to make the mathematics relevant. However, I was also aware of some of the concerns and questions about reform curricula, particularly as I would hear educators and administrators questioning if students in the low-track classes can handle this type of curriculum. From a review of the relevant literature, findings point to both benefits and downsides to using reform curriculum with disadvantaged students. In this review, I share ways in which my research builds on current understanding about language usage in discussions, particularly as this relates to the experiences of marginalized students learning mathematics. I also attend to language considerations in Black students' lived experiences and what this means when taking into account students' learning mathematics while Black (Martin, 2012).

## Literature Review

In a push for reform mathematics, the National Council of Teachers of Mathematics (NCTM) Standards (1989) contend that, "Middle school students should

have many opportunities to use language to communicate their mathematical ideas." Further, the NCTM advocates for communication as a way to develop students' "ability to read and write mathematics and to interpret meanings and ideas" (NCTM, 1989, p. 78). In the updated Principles and Standards for School Mathematics, the NCTM (2000) continues to stress the importance of students learning of mathematical language, stating that, "Teachers must help students acquire mathematical language to describe objects and relationships" (p. 198). Further, developing a meaningful understanding of the language associated with mathematics concepts is part of effectively learning mathematics content (NCTM, 2000). According to Lemke (1990), a science education researcher, students build their understandings of science and mathematics content from the meanings they make of the language, representations, and processes that are specific to particular concepts, and how these connect to their previous understandings and other concepts. Further, Lemke (1990) argues that this happens through language exchange in discussions. Whole class discussions are a practice that can afford students opportunities to engage with specialized language of mathematics and to develop an understanding of the meanings and connections between mathematics terms and phrases (NCTM, 2014).

According to the NCTM (1989), using everyday language in conjunction with technical mathematics language in whole class discussions can help students connect to the mathematics. Specifically, the NCTM (1989) contend that "an interchange occurs between common and mathematical language. Mathematical language builds on the existing structure and logic of common language and connects students' experiences and language to the mathematical world" (p. 80). In addition, in order to build an understanding of the specialized language of mathematics, including notation and the

meanings of mathematical concepts, Gee (2008) argues that students "need to be able to simulate these in their minds and try them out in interactions, hopefully in contexts that do not punish them for initially unsuccessful or partially flawed attempts" (p. 100). Further in the NCTM Principles and Standards (2000), it says that "When teachers build such an environment, students understand that it is acceptable to struggle with ideas, to make mistakes, and to be unsure" (p. 271).

In summary, those arguing for a reform-oriented approach believe that whole class discussions allow teachers a means for students to experience productive exchanges with mathematical words and meanings from which students can learn the mathematics register and deepen their understandings of the content. Further, there is value in giving students an opportunity to be wrong and it be okay, to be uncertain and to grapple, and to express their ideas in ways that make sense to them as they build their mathematical understandings. Knowing that students' opportunities to learn through discussions depend on what language is used and how it is used (see, for example, Herbel-Eisenmann & Otten, 2011), in the next subsection I highlight some of the ways in which researchers have investigated language in discussions and describe some of the key findings relevant to my work. I also discuss the relevant literature on the experiences of marginalized students in whole class discussions and indicate how I situate my research in this body of literature.

### The Nature of Research on Language in Whole Class Discussions

As mathematics education researchers have attempted to make sense of mathematical discussions, they have come at it from many different angles. Some mathematics education researchers have focused on teachers' questioning patterns or talk

moves in discussions (e.g., O'Connor & Michaels, 1993; Wood, 1999), that in some cases serve as scaffolding for increasing participation and accessing the mathematics (Bell & Pape, 2012). While others have considered the expectations communicated through social interactions and the ways in which the teacher and students constitute sociomathematical norms (e.g., Brodie, 2007; Lampert, 1990; Wood, 1999; Yackel & Cobb, 1996). Understandably, some research has focused on the productiveness of discussions, with an attempt to measure discussion quality (e.g., Hufferd-Ackles, Fuson, & Sherin, 2004; Mendez, Sherin, & Louis, 2007). Other researchers have investigated discursive patterns that speak to the power dynamics and interpersonal positioning within discussions (e.g., Black, 2004; Brantlinger, 2014; Yamakawa, Forman, & Ansell, 2005). Still other researchers have focused more microscopically on how certain components of sentences and sentence structure shape the learning of mathematics (e.g., Pimm, 1987; Rowland, 1999), and the ways in which the use of particular grammar and the connections made to spoken, written, and diagrammed texts communicates certain messages to students about the meaning of the mathematics (Shreyar, Zolkower, & Pérez, 2010).

My work relates most closely to research on the mathematics language available to students in discussions (e.g., Khisty & Chval, 2002), the meanings construed through the use of particular mathematical words and how the words are used (e.g., Herbel-Eisenmann & Otten, 2011), and the ways a teacher attends to students' language and what this means for their learning of particular content (Adler, 1999). By sharing a summary of each of these pieces, I consider how this work informs my research.

**Mathematical language in classroom discussions.** Students take up mathematical terminology and begin to use it in whole class discussions from repeated exposure to the language (e.g., Khisty & Chval, 2002). In a comparison of the mathematical talk used by two teachers in discussions, the authors find that in one of the classrooms both the teacher and students are consistently using mathematical words and phrases; whereas, in the second classroom this is almost entirely absent. In the mathematically prolific discussion, the teacher and students are discussing two geometry problems. The concepts are area and perimeter, and students have pictorial representations to draw on. In the second grade classroom, the discussion is about sharing cookies among a certain number of people. The teacher in the second classroom does not use the word "division" or related mathematical words. Khisty and Chval (2002) use the second grade classroom discussion as contrast to the fifth grade classroom in which students are readily taking up the mathematical language, which they argue is in response to the way in which the teacher is "populating the environment with words and ideas" (p. 154). This work raises a number of questions, including, is it possible that at times mathematics vocabulary in discussions can get in the way of students accessing big mathematical ideas? In what ways might this depend on the particular mathematical content and the particular relevant language? Also, should a teacher shift the degree to which she uses mathematical language depending on where the class is in a given unit? I return to this research in the next subsection when I consider some of the dilemmas teachers are managing as they facilitating discussions with marginalized students.

Teachers make decisions not only on which words to use and when, but also how to use them. In a comparison of two classrooms, Herbel-Eisenmann and Otten (2011)

examine teachers' mathematical language, specifically in terms of how they convey meanings of words, make connections, and bring about understandings of big ideas. They use thematic analysis to look at the subtle shifts in the meanings of mathematical words, for example, base and height referring to quantities/measures or particular line segments in a diagram. In this part of their investigation, they look at the ways in which teachers in two classrooms shift between these two meanings, and the language that signifies to students how these words are used. The authors raise questions of equity around the expectations for students to grasp such subtle shifting, wondering how teachers could be more explicit about what they mean when using mathematical terms that have multiple meanings depending on the usage. Also, Herbel-Eisenmann and Otten's (2011) results make me wonder about the subtleties in the meanings of mathematical words when considering other mathematics content, such as, ratios and proportional reasoning.

Related, teachers also have to make decisions about how to address students' use of language in their expressions of mathematical ideas. In an analytical narrative vignette, Adler (1999) shows how a South African high school teacher grapples with a dilemma of whether to focus on making the meanings of mathematical language explicit or implicit at a given moment in a conversation when a student uses a word incorrectly. The teacher found that in her decision to make formal language transparent she inadvertently obscured the particular mathematics concepts. Adler (1999) states that this can happen when "The language itself becomes visible and the explicit focus of attention. It is no longer the medium of expression, but, instead it is the message - that to which the pupils now attend" (p. 62). This raises important questions for teachers when navigating transparency dilemmas, such as the one described by Adler (1999). While there is not

necessarily a right or wrong answer, teachers need to determine when to be explicit about the meanings of mathematical words and when is it not an appropriate time. Further, how might considerations around access and equity for marginalized youth affect a teacher's decision of when and how to teach the meanings of mathematical terms?

In the next subsection, I present research on how students of color and students from low-SES backgrounds experience mathematics discussions. Here, I attempt to stay true to Delpit's (1988) vision "that appropriate education for poor children and children of color can only be devised in consultation with adults who share their culture" (p. 296); therefore, I consider who is conducting the research and how Delpit might respond to the work.

### Language Dilemmas: Considering Marginalized Students' Experiences in Discussions

Given the particular expectations of reform-oriented curriculum and pedagogy, specifically, learning through cognitively demanding problems in realistic-seeming contexts with discussions based on students' ideas and reasoning, there are researchers who consider how particular marginalized populations experience this approach to teaching and learning mathematics (e.g., Boaler, 1999; Brantlinger, 2013, 2014; Lubienski, 2000). I review the relevant literature here.

**The misalignment of discussions for low SES students.** There is a concern in the literature that Lubienski (2000) attends to around "which students might be more accustomed to learning in ways aligned with current reforms" (p. 380). In a mathematics class with primarily White students from diverse SES backgrounds, Lubienski (2000) as the teacher-researcher examines the way in which her seventh grade students from

different SES backgrounds experience whole class discussions. Like some of her students, Lubienski comes from a working class background and wanted to better understand the way in which students from such backgrounds experience discussions. She finds that students from lower-SES backgrounds are more apt to become confused with the different ideas presented in discussions of reform-oriented mathematics than their higher-SES peers. Further, Lubienski (2000) reports that lower-SES students were less inclined than their higher-SES classmates to express their thinking about a method or an idea, instead focusing on getting correct answers. Lubienski (2000) concludes that "some characteristics of discussion-intensive classrooms might be more aligned with middle-class cultures" (p. 377). In her call for future research and attending to issues of equity, Lubienski makes the following recommendation: "If one considers preparing children to operate in a reformed classroom as involving explicit cross-cultural training into the "culture of power" (Delpit, 1986), perhaps educators can find ways to teach students the discursive skills necessary to thrive in discussion-intensive classrooms" (p. 399). Here it seems that Lubienski (2000) and Delpit (1986, 1988) would agree that teachers of marginalized youth need to find ways to attend to the language skills necessary to actualize the benefits of mathematical discussions.

**Mathematics language constraints.** Similar to Lubienski's (2000) findings for low-SES students, Brantlinger (2013) found that students in his class, all of whom were students of color from limited means, at times became confused during the conversations about the particular mathematics involved in making sense of real-world problems in a reform-oriented critical mathematics curriculum. Brantlinger (2013), a White teacher-researcher from a multiracial family, speculated that this was due to some students not

having the mathematical background knowledge or academic language to draw on, therefore, in these instances some students shared their knowledge of the context rather than the mathematics. In this way, the focus on the real-world context in critical mathematics activities impeded students' access to the mathematics, which led Brantlinger as the teacher to resort to telling students his mathematical interpretations and explanations in certain instances, an approach more aligned with traditional-oriented mathematics teaching. While he found there were some benefits to using a critical mathematics curriculum, specifically the increase in some students' participation in discussions, he indicates that he will likely abandon the critical mathematics approach promoted by Gutstein (2006) to teaching mathematics due to the shortcomings, but is open to other formulations (Powell & Brantlinger, 2008). He sees more benefits in a reform-curriculum, yet he also raises concerns from the results of a curricular analysis over how the mathematics register is made available to students in these types of curricula (Brantlinger, 2011).

More specifically, through a comparative analysis of a critical mathematics text, a reform curriculum, and a more traditional mathematics text used in elite suburban schools, Brantlinger (2011) found there are major differences in the degree to which mathematical language is presented as a way for students to learn mathematics concepts. In particular, Brantlinger (2011) makes the following observation:

> While the reformist texts drew connections between activities and ideas, they were more concerned with setting up non-routine mathematical tasks and public domain settings than developing connections between formal principles and ideas. As an apparent result, the reformist texts

> tended to leave mathematics principles expressed in informal terms or unstated. Explicit connections that could have been realized between tasks or between tasks and mathematical principles in the reformist texts frequently were left up to readers, to clarification by teachers, or were deferred to a later textbook activity or a later course (p. 407).

In summary, Brantlinger (2011) found that, in comparison to traditional texts, the critical mathematics and reform texts incorporated far fewer explicit opportunities in written form for students to engage with the academic register. It seems that in these curricula there are assumptions around the mathematical terminology and connections, either that certain words and understandings are already known or that classroom talk will be the means by which relevant mathematical language and ideas are learned. This study raises questions about access and equity for marginalized students' opportunities to learn. In particular, if reform curricula assume that discussions are the main means by which students are to learn mathematics language, or that students already have the necessary language, then disadvantaged students are once again excluded from the culture of power, unless teachers do something to address access to such language.

**Helping marginalized students use mathematics language**. While the focus on my dissertation is on African American students, I look to research with low-performing ELL students conducted by Khisty and Chval (2002) because it aligns with Delpit's (1986, 1988) call for finding a balance in pedagogical approaches. The teacher in this work, Ms. Martinez, foster's students' success with acquisition of the relevant mathematics register through discussions. She engages students in problem solving and requires students use justifications in their explanations. While some might refer to her

approach as reform-oriented mathematics teaching, the amount of talk that she does in the beginning of the year resembles more traditional teaching. Here is what Khisty and Chval (2002) observe:

> The reader may notice that in these episodes, there is relatively more teacher talk than student talk, and it may appear that students in her class do not engage in much dialogue. At the beginning of the year most of the talk is done by Ms Martinez. The students say few words. They speak in incomplete sentences. By the second half of the year, students speak in complete sentences and use the words correctly as demonstrated in the example below. What has transpired is a process of appropriation and internalisation. But to make the process work, students must have something to appropriate; ergo, Ms Martinez's own talk becomes essential, particularly at the outset. (p. 162)

It seems Ms. Martinez is explicitly guiding her students in the adoption of mathematical language and ways to express their mathematical ideas, by consistently using mathematical terms and asking questions too that require students to use mathematical language in classroom talk. She also expects students to use complete sentences to share their thinking. Khisty and Chval (2002) find that by the spring semester Ms. Martinez's students are using the mathematics register in impressive ways.

A comparison of Khisty and Chval's (2002) research to Adler's (1999) work, raises questions, including, how can teachers create opportunities for students to learn mathematical words and phrases in whole class discussions without focusing on the mathematical language to the extent that it impedes students' learning of mathematical

concepts? Further, in light of Delpit's (1986, 1988) call to develop both big ideas and skills, what does a balance in these goals look like in terms of teaching practices that can afford students access to big ideas while also attending to mathematics terminology to develop these skills?

**Department-wide efforts**. Boaler and Staples (2008) illustrate an example of how one mathematics department in a school dubbed Railside was able to overcome the drawbacks of using reform-oriented teaching with marginalized high school students. In particular, they found that reform-oriented curriculum and pedagogies at a school dubbed Railside, an urban school serving predominantly students of color, outperformed or performed as well as predominantly White student bodies at two high schools using traditional teaching methods. The students at Railside also had more positive perceptions of mathematics and participated in higher level mathematics course at higher rates than students in the other two schools. This trend continued over a three year period of time. In terms of the recipe for Railside success, Boaler and Staples (2008) found mathematics teachers had created communities of learners in which students come to appreciate different contributions from their peers, and students know that teachers will give clear expectations, explicit instructions on learning practices, and tasks involving high cognitive demands. From this students champion effort over ability, and they learn how to persist through challenging problems. Specifically speaking to the role of discussions in the Railside students' experiences, Boaler and Staples (2008) indicate that part of this success story was due to teachers' expectations for students to give justifications. Students also adopted this expectation of each other, and pressed for justifications in order to further their own understandings of the content. This research speaks to some of

the ways in which discussions about the mathematics can create opportunities to learn the mathematics, particularly when talk is framed around explanations that students must justify mathematically.

Boaler and Staples (2008), two White researchers, did not mention the race or ethnicity of the teachers at Railside, but they did acknowledge that the Railside curriculum and methods would not be characterized as culturally sensitive, although aspects of the teachers' work promoted equity in ways that resemble culturally relevant teaching. Looking to Delpit's (1986, 1988) vision for the teaching of marginalized students, in what ways are the particular decisions that teachers made at Railside aligned with Delpit's call for a balanced approach between critical thinking and skills? More needs to be understood about how teachers, like those at Railside, can support marginalized students to see these benefits, particularly for students who have experienced struggles in mathematics. Further, it would be helpful to know how the teachers handled particular dilemmas, especially related to students' engagement with the mathematics register.

In this review of the literature, the sample sizes are small, often with only one or two cases. This research gives insights and raises questions about the ways in which whole class discussions might afford or constrain marginalized students' opportunities to learn mathematics. Before delving into the data and analysis for this study, I consider first my positionality in this work.

## Am I Qualified to Contribute to a Conversation on Doing Right by Black Students?

Delpit (1986, 1988) contends that, when it comes to designing education for marginalized students, researchers and educators who come from the same backgrounds

as the students should be at the head of the table. I agree. As a White Woman conducting research with Black students, I want to make sure that I am not in any way suggesting that my understandings are more valid than those who come from the same cultural backgrounds as my students and who know firsthand the lived experiences of being Black in the United States (e.g., Clark, Frank, & Chazan, 2013). Given the limitations of my background as a White middle-class woman, I think it is important to share what it is that makes me feel I might be able to contribute to an important conversation about how educators can do right by Black students. I share several reasons here.

First, in this practitioner research study design I bring a critical eye to the ways in which my language choices, as a White woman, and the ways the suggested language in a reform-oriented curriculum impact Black students' OTL. More specifically, I problematize my use of language in discussions, as well as, consider how the intended curriculum assumes language should be used in light of questions around access and equity. I think this is important because too often White educators and researchers come to view Black students through a deficit lens and from this they search for solutions to the deficient-Black child rather than assessing oppressive structural and ideological factors (e.g., Orr, 1987).

For example, Orr (1987), a White teacher-researcher who focuses on language usage among Black students, argues that Black English Vernacular (BEV) is culpable for Black students' struggles in mathematics. She conducts her research at an elite private school in the District of Columbia. She specifically claims that the particular structures in BEV impede Black students from understanding certain mathematical concepts and communicating effectively with mathematical language. While I applaud this teacher's

diligent work at trying to support and guide Black students in their college-bound quests, I wonder if her findings around Black students' struggles with mathematical language in high school is more about a collective experience with inferior primary schooling as compared to their White peers, including poorly trained teachers and lowered expectations. Also, I wonder if Orr (1987) considered limited access to a culture of power as an explanatory factor, a characteristic that frames unequal access in terms of social class hierarchies and exclusionary practices. By looking to a native language as an explanation for struggles in school, Orr (1987) is inadvertently labeling African American students and their cultural heritage as deficient.

I am concerned with research that positions African American students' language as deficient. Coates (2015) reminds me that shared language among Black people brings a sense of belonging in a land that at times feels foreign. Coates (2015) describes this feeling as "private rapport that can only exist between two particular strangers of this same tribe that we call black" (p. 119-120). He argues that this shared language makes him feel "part of a world" (p. 120). An alternative to viewing BEV as a deficiency that must be overcome, would be to focus on how to help African American students adopt the academic language of mathematics by thinking of this effort as "trilingualism" (Baker, 2002, p. 52). Delpit (2002) contends that "If students are to acquire a second language form in school, teachers must not only see their students as non-deficient, they must understand their brilliance, and the brilliance of their home language" (p. 42). For research to effectively inform practice, I believe researchers too need to come from a strength-based approach in which they are not blaming students for disparities that stem from systemic inequities.

Another reason I feel that I may be able to genuinely contribute comes from my awareness of what it might mean to be an ally as a White educator wanting to do my best to avoid doing harm to Black students and believing that more needs to be done to know how educators can do right by Black students. I have learned and continue to learn about institutional racism and systemic inequities, and importantly about dismantling White privilege and White hegemonic ideologies, in part through my experiences in multiracial familial and social spaces, in my work with Black students and their families, as well as, through reading, observing, and listening (see Chapter 0 for more on my background and positionality). I bring these understandings to my inquiries into teaching and learning. By approaching research with a willingness to address Whiteness and to work at being anti-racist, I intend to focus on observations and questions that I believe are in the best interest of Black students, even if this means calling into question methods/approaches that I have come to believe are ideal. Also, in terms of grappling with what constitutes Black students' best interests, I look to Black educators and researchers who have spoken and written about these matters (e.g., Delpit, 1986, 1988, 2012; Ladson-Billings, 2006; Leonard, 2008; Martin, 2000, 2009). Further, I draw on a conceptual framework for students' opportunities to learn that is based on sociocultural perspectives at the heart of which are concerns for equitable learning experiences. I describe this framework in the next section.

## Conceptual Framework: Defining "Opportunities to Learn"

There are a number of different conceptions of opportunities to learn (OTL) in the mathematics education literature. Some researchers focus on exposure to content by measuring students' OTL through written curricular analysis, surveys asking for self-

report from teachers of curricular use, and number of mathematics courses taken (see McDonnell, 1995 for a review of the OTL concept in research). Yet, there are explanatory limits with this particular conceptualization as this cannot adequately capture the complexities of students' experiences. Some researchers have expanded the OTL concept to account for the resources available to support the teaching and learning of mathematics, such as technology or fiscal resources, and the pedagogical practices that teachers employ (e.g., Harris & Anderson, 2012). Still more research, importantly, considers equity in a reconceptualized operationalization of OTL by incorporating an analysis of the depth of instruction and access to higher-order tasks, as well as, the quality of the pedagogical practices (e.g., Tate, 1995). Similar in some ways to Tate's (1995) notion of OTL, Gee (2008) focuses specifically on classroom practices that relate to interactions and language in his conceptualization of opportunities to learn. For this research project, I adopt Gee's (2008) notion of OTL as this allows me to use a microscopic lens in looking at discourse in whole class discussions to better understand the ways in which talk can foster or inhibit students' OTL.

Coming from a sociocultural perspective, Gee (2008) views interactions as central to learning. In the following argument, Gee (2008) makes it clear that he believes learning the language of mathematics occurs through application and discussion:

Learners can only come to see how words and signs fit particular patterns of experience if they see these words used in specific situations in ways that make clear how they apply. Thus, models of language in use in specific situations from masters and more expert peers is crucial for learning how to situate the meanings

of words and signs in specific ways – otherwise, learners have only general verbal definitions as meanings that are hard to apply in specific situations (p. 94). However, not all discussions provide the same opportunities to learn. Gee (2008) contends that "different forms of talk and social interaction lead to different affordances and constraints for different learners," which is "a key concern for thinking about equitable opportunities to learn." (p. 94). In this way of thinking about OTL, Gee (2008) emphasizes the role of the particular language that teachers and students are using. Further, he is referring to not only if academic words are used, but how they are being used. In particular, he stresses the importance of the how the speakers convey the meanings of words and make connections among concepts. By using Gee's (2008) conceptualization of OTL in this research, I take into account not only the mathematics vocabulary, but also the ways in which I am using particular language choices and how these choices open or close doors for students to access big mathematical ideas. I do this while using the Connected Math Project (CMP), a well-known middle school reform curriculum, in a low-track mathematics classroom with all Black students.

## Methods

### Data

I recorded whole class summary discussions for eleven days of instruction in the spring of 2015 (mid-March through the end of April). I selected this time of year in part because I wanted to make sure that as a class we had adequate time to form a discourse community in which norms had been constructed and practiced for a significant amount of time. I also wanted to avoid holidays as these often create a disjointed feel and require

time re-establishing norms. The video recordings of discussions are from my low-track seventh grade mathematics class in which I was the teacher of record for the entire school year (2014-2015). Five of the seventeen students I had taught previously as sixth graders during the 2013-2014 school year. One of these five students opted not to participate in the study; therefore, I did not include her dialogue in the transcripts of the video recordings from whole class discussions. Each video is around 20 minutes in length, and I captured discussions from two units in the Connected Mathematics Program (CMP). More specifically, I recorded summary discussions during three lessons in the last two investigations of the Accentuate the Negative (ATN) CMP unit, a unit that focuses mainly on understanding and operating with integers, and eight lessons in the first two investigations of the Comparing and Scaling (CS) CMP unit, which focuses on representing real-world situations using ratios and proportions and developing proportional reasoning. Lesson plans for the lessons associated with the video recordings of whole class discussions were used as a data source, as well.

**Selection criteria for discussions**. I decided to analyze three classroom discussions that capture different types of experiences that students have on different days. By using discourse analysis, it makes the most sense to analyze no more than three videos in that this method is an extensive, in-depth process from which I can speak to students' opportunities to learn (OTL) particular language and meanings of concepts. By including conversations that feel different, I am able to speak to some of the complexities around teachers' language choices in facilitating discussions. The differences in the conversations across days are likely influenced by the tasks and how my students' experienced the tasks, including the matches or mismatches between my students'

readiness and the assumptions of the curriculum materials, by my decisions in facilitating the discussion and my reactions/responses to students' engagement, as well as by my obligations to attempt to balance wanting my students to have access to the problem-based curriculum and wanting my students' ideas to drive the conversation. Given that I attend to some of the differences in the conversations over three days, I have decided to only use conversations from the *Comparing and Scaling (CS) unit* from the CMP curriculum. This way I am not including the additional variable of mathematics topic from a different unit, for example CMP's *Accentuate the Negative*, this would mean considering language around operating with positive and negative numbers, in addition to language about ratios and proportional reasoning. Here is how I went about selecting three discussions from the eight videos from the CS unit.

First, I chose to remove two of the eight videos for the following reasons: (a) one of the videos gets cut off due to technical difficulties and (b) one of the videos is a combination of a summary and a launch (summary from the previous day and launching into the next lesson). I think it is important to exclude the latter video because I want to focus only on conversations that are truly summary discussions as indicated by CMP, that is, occurring after students have had a chance to explore the problem and attending to some of the goals and ideas from the lesson. This leaves me with six videos. I sorted the six videos into three categories. The three categories that I created can be summarized in the following way: (a) Discussions in which I overwhelmingly attempt to give students access to the content by addressing prerequisite language, understandings, and skills, (b) Discussions in which I focus primarily on mathematical procedures and computation skills, and (c) Discussions in which I incorporate the mathematical practices, such as,

asking students to share justifications and to critique the reasoning of others. In Figure 1. I offer brief descriptions of what the students and I are doing in the conversations within each of these three categories. Of the six discussions, there are two conversations that fall into each of the three categories. In the conversations in category one, I do most of the talking due to my interpretation that students are confused and struggling with comprehending what is being asked of them and what the various components of the task mean. I also see uncertainty with the mathematical language in the problem. In the second category, there are two videos in which I focus the conversations on students' approaches for solving the problems. This means we are talking about steps they took in computational processes to come up with a solution. In category three there are two conversations in which I am focusing on students' ideas and fellow students' critiques of one another's reasonings to drive the conversations.

From here I watched the six videos and I selected one conversation from each of the three categories that could serve as interesting cases of language usage, when thinking about how language influences students' opportunities to learn. In particular, in these videos there are instances in which I am deviating from the language in the intended curriculum in ways that speak to my desire to give students access to mathematical concepts. Further, by selecting both discussions from problem 1.1 (one video from category one and one video from category three) allows me to speak to how our classroom talk about this problem compared with the recommendations in the CMP teacher's guide. Further, my selection of the discussion from problem 2.1 means that the conversations I am analyzing are the entry into a new investigation. This brings

interesting considerations in that students may not be as familiar with the mathematical language as say the end of a 5 to 7 day investigation.

| Cat # | Category Name | Number of Videos | What do I see from students? | What do I see from me, the teacher? |
|---|---|---|---|---|
| 1 | Attempting to Give Access | 2 | Students are listening. There are no volunteers. There is evidence of confusion and uncertainty. | I call on students initially, but resort to talking when students seem confused. I do more talking in these conversations. Seems like I am using funneling questions. |
| 2 | Procedures & Computation | 2 | There are a few volunteers. When students are called on they share procedures/steps. Other students jump in with questions. | I focus on students' approaches. I strategically select students to share. I use some direct instruction. |
| 3 | Mathematical Practices | 2 | There are more volunteers. Students are building on each others' ideas. Students are asking each other questions and using justifications. | I strategically select students to share. I use students' ideas to drive the conversation. I ask open-ended questions and probe for reasoning. |

*Figure 1.* Descriptions of Six Video Recorded Whole Class Discussions

**Analysis**

To address the research question, I began by creating "clean maps" of the ideal language in a conversation that the authors of CMP might intend based on the teacher's guide. I draw from a part of the thematic analysis conducted by Herbel-Eisenmann and Otten (2011) to carry this out. Essentially a clean map is an ideal picture of the OTL in the language and associated meanings that can serve as a rubric from which to compare the observed language in the enacted conversations. I then create maps of the language

from the transcripts of the videos from the three classroom conversations (see Appendix A). From these maps, I am aiming to gain an understanding of what central mathematical ideas are discussed and how these are discussed, specifically, the language used, what meanings of the mathematics concepts are afforded, and the connections made among ideas. I also draw on some of the tools in Gee's (2014) approach to discourse analysis. Specifically, I look to his tool called, "why this way and not that way" (Gee, 2014, p. 55) which allows me to consider why I, at times, deviated from the ideas of the CMP authors that are intended for the summary discussions (p. 55). This part of the analyses that attempts to understand the particular use of subjects, including how and why it may differ from CMP, can also be examined using another one of Gee's (2014) tools for getting at the purpose of the subjects in speech, specifically, "the doing and not just saying tool," which is used to make sense of "what he or she (the speaker) is trying to do" by using particular words and ways of talking about ideas (p. 42-45). By using aspects of thematic analysis and Gee's (2014) tools, I anticipate making claims that are supported by the evidence from these different, yet related approaches to making sense of the language usage in light of students' opportunities to learn and with an eye toward wanting to do right by Black students.

Further, I returned to the data for a second round of analysis, in which I used Gee's (2014) "situated meaning tool," which asks "what specific meanings do listeners have to attribute to these words and phrases, given the context and how the context is construed" (p. 153). I did this in order to make sense of some of the particular meanings that words and phrases seem to take on in the conversations based on contextual factors (e.g., applying numerator and denominator to describe the top and bottom of ratios after

having just used these terms with fractions). In addition, with a practitioner-researcher study design, it is crucial to recognize my insider status in the school, but not in the Black communities served by the school, as I need to have a way to analyze the data so that I do not miss the situated meanings because of the shared understandings and assumptions embedded in my thinking due to my role as practitioner. Knowing this, I apply the "making strange tool" as this gives me a way to try to unearth what might otherwise seem strange or unclear for someone who was not part of our classroom. This tool forces the researcher to consider what assumptions or knowledge might be taken for granted within a context. With this tool, I will be attempting to, as Gee (2014) states, "bring your unconscious and taken-for-granted knowledge to the consciousness," which comes from looking at the data as if I was an outsider and asking questions about the data that would normally seem obvious or trivial (p. 20). Using this tool helps me get at some of the shared understandings that my students and I have about the language and mathematics concepts, the contexts within the problem-based curriculum, and the broader contexts outside of the school that affect students' lives. Using this information, I can speak to how and why my students and I use (or do not use) particular language.

## Presentation of the Data & Analysis

Given that mathematical words are part of a conversation, talking about my students' and my use of the mathematics register separately to address the two parts of the research question feels disjointed. Instead, I address both parts of the research question together, the first part about my language usage and the second part about my students' adoption of mathematical language. By examining how my students and I

interacted through co-constructed language and by comparing this language to that in CMP teacher's guide, I feel confident making interpretations about students' opportunities to gain access to the content, to grapple with and construct new ideas, and to formalize their understandings through my and their use of particular language.

I organize the data in this section according to the CMP Investigations, specifically, Problems 1.1 and 2.1 in the *Comparing and Scaling (CS)* unit. This allows me to consider what language usage looks like in two distinctly different lessons in the same school year, one at the very beginning of the unit and one about a third of the way into it, with both lessons serving as entry into new investigations within the unit (see Data subsection in the Methods section for selection criteria). Also, I examined the two days of classroom discussions for 1.1, giving me three discussions in total to compare to the intended curriculum. In the methods section I have already presented some of the differences between these three conversations, which informed the selection of these discussions. I identify and analyze the language adoption and deviations from the intended curriculum across these Day 1 and Day 2 of Problem 1.1 discussions and separately in a presentation of the Problem 2.1 discussion.

There are descriptions of the CMP unit and lesson structures in Chapter 1; however, I think it is helpful to revisit here what activities are going on in our classroom prior to the whole class summary discussions. In following the CMP lesson structure, I begin with a launch into a problem. This involves a brief discussion with the class about the context of the scenario given in a problem. Usually we read the scenario together. Most of the time, the launch involves me giving some background information and asking questions to try to stimulate a connection to the scenario, and to clarify

misunderstandings or confusion. In the case of both Problems 1.1 and 2.1, the launches were brief. For Problem 1.1 (see Figure 2), I went along with the CMP assumption that students would be familiar with additive and multiplicative comparisons in advertisements. I asked my students questions as to whether or not they had seen a percent in an advertisement, a ratio like 3 to 2, or a statement about how many more. However, I did not consider my students' experiences in working with a data set to make comparisons. In Problem 2.1 (see Figure 3), the launch was very brief, as well, as I asked students questions about the pictures of the tables, and then quickly moved to the exploration.

The second part of a CMP lesson is a chance for students to work in small groups and make sense of the mathematics in the tasks together. During this exploration time, students are expected to talk to one another and every student is recording ideas and solutions for the tasks in the student text. I circulate while students are exploring. I attend to groups who have questions to assist students who might need scaffolding to gain access to a task, as well as, trying to make my way to every group in order to gain a sense of how each group approached the tasks. I often use this time to identify students who I want to share at particular times in the discussion based on their solutions. I also ask students questions to help me understand their thinking and to push their thinking. In the exploration time for Problem 1.1 on Day 1, I found my students were doing a lot of off-task talk, which is rare. This was a sign to me that there was confusion, and students might be struggling to make sense of the problem. This was not the case for Day 2 of Problem 1.1 or Problem 2.1. We come together for the last 20 minutes in class, and I facilitate a whole class discussion.

Here I begin by sharing details about Problem 1.1 from the CMP curriculum. Next, I present the data around language usage when discussing the one additive comparison given in the problem. I follow this with the way in which my students and I talk about the three multiplicative comparisons in Problem 1.1, and I conclude the subsection on Problem 1.1 with an analysis of the deviations from CMP. I then present a detailed description of Problem 2.1 and the data on my students and my usage of mathematical language in the summary discussion for this problem. Again, I share the analysis of the ways in which we did not follow the curriculum and what this means for my students' opportunities to learn. In both analysis subsections I attend to how my considerations of language are relevant to wanting to do right by Black students.

By making language comparisons between the intended and enacted curriculum in the whole class discussions, I find there are assumptions embedded in the teacher's guide about students' prior knowledge and experiences, as well as, the facility with which they will adopt the mathematics register. Further, the ways in which I deviate from the intended curriculum can be explained by my active attempts to help students feel comfortable talking about the math and to create access to the mathematical ideas in the problems, based on what I believe are my students needs. From the assumptions in the curriculum and my decisions, students' opportunities to learn the mathematics register are constrained. Following the presentation of data and analysis, I offer a more detailed conclusion and implications.

**Problem 1.1**

Problem 1.1 in Investigation 1 gives four comparison statements that represent different ways to think about survey data. The data for the scenario comes from a taste

test capturing people's preferences for two different kinds of cola. The online *Comparing and Scaling* teacher's guide specifies that three of the statements introduce the language of ratios "as simply a way of phrasing comparisons." One of the statements, specifically, statement number two, is an additive comparison for which the guide indicates the teacher should play a role in offering "guidance moving beyond finding difference as the method of comparison." Figure 2 presents the four comparison statements that students consider for Task A in Problem 1.1. As I wrote my lesson plan, I kept re-reading the statements with my students in mind, wondering if they would feel confident in addressing the first part of the task, which is to "Describe what you think each statement means." The teacher's guide states that, "The setting (for this problem) is typical of preference data from advertisements. Students are likely to be familiar with advertisements such as these." I was not certain this was true for my students. I went forward though, open to the possibility that maybe CMP was correct in assuming students have a certain knowledge about these types of comparisons from their daily lives. Together as a class we read the scenario about the taste test and the four statements, then students engaged in group work to address part one of Task A before coming back together for the first summary discussion in this unit on ratios and proportional reasoning.

Problem 1.1. Here are four statements about the cola taste-test results.

1. In a taste test, people who preferred Bolda Cola outnumbered those who preferred Cola-Nola by a ratio of 17,139 to 11,426.
2. In a taste test, 5,713 more people preferred Bolda Cola.
3. In a taste test, 60% of the people preferred Bolda Cola.
4. In a taste test, people who preferred Bolda Cola outnumbered those who preferred Cola-Nola by a ratio of 3 to 2.

*Figure 2.* Comparison Statements from Problem 1.1 in CMP's Comparing and Scaling Unit.

In the teacher's guide, the CMP authors provide suggested questions that the teacher should ask during the discussion and possible student responses, as well as possible follow-up examples or alternative scenarios that a teacher could present. The guide suggests focusing the summary discussion for Problem 1.1 on what each statement means, with particular attention given to whether or not the original data is lost or preserved, and whether or not a statement gives a good sense of the comparison. According to the guide, this conversation should stay on the surface, meaning that the teacher does not need to probe deep to get at all of the possible conceptual understandings from each statement or all of the connections among statements. The aim is only to give an introduction to the comparisons within a real-world scenario. This is what I attempted to do. On the first day we considered what we learn from each statement, starting with the first one and making our way through to statement four. In many ways I stuck closely to the teacher's guide, yet there were some differences in the particular language I used, and I gave some additional information and examples. Also,

the teacher's guide suggested spending only one day on Problem 1.1; however, we spent two days. The second day I devoted to the second part of Task A, namely, making arguments around which statement was the most convincing for advertising Bolda Cola.

I now present details about the specific language that is used in the intended curriculum and in the two discussions (i.e., from the enacted curriculum). I do this by moving back and forth between what is given in the teacher's guide and what is said on Day 1 and 2 in the classroom discussions. I organize these descriptions in two subsections, specifically, one focusing on the additive comparison given in Statement 2 and a second focusing on the multiplicative comparisons in Statements 1, 3, and 4. The majority of the classroom discussion time was spent both days on Statement 2. This was mainly because the teacher's guide describes the importance of moving students beyond the difference as a comparison, and this is the only lesson in which the teacher's guide explicitly includes an additive comparison to consider. In this unit students are expected to use multiplicative comparisons to solve the problems. The second subsection focuses on language used to talk about the three multiplicative comparison statements in Problem 1.1. Following this subsection is an analysis of some of the deviations that I made from the intended curriculum in light of wanting to address the needs of my students with an eye toward creating access to the content

**Language usage around an additive comparison.** It is assumed in the teacher's guide for Problem 1.1 that the discussion will begin with statement one; however, here I discuss first the language usage around statement two because it is the only additive comparison made about the survey data. According to the guide, the aim in addressing this statement in class is to eventually move students beyond additive thinking. I share

the intended language around each areas of focus (e.g., data preservation, sense of the data, connection to other statements) in the guide and what actually happened.

The CMP authors indicate that students will recognize the comparison in Statement 2, specifically, 5,713 more people preferring one type of soda, can be referred to as the "difference" between the amount of people who prefer one type of soda and those who prefer the other type. On both days of the 1.1 enacted discussion, only I use the term "the difference" to refer to this comparison. See Figure 3 for a summary of the way in which mathematical language is used in the teacher's guide compared to classroom, with attention given to both word choice and who is saying the words. As previously mentioned, the guide suggests focusing the conversation on whether or not each comparison statement preserves the original data and the strength of preference indicated. I discuss next how this happens as compared to suggestions in the intended curriculum.

In terms of the expectations in the teacher's guide and how the conversation about the original data unfolds in the classroom, in both, the students are asked to pretend that they are only given statement two as they consider what the difference tells them. In terms of the specific language, the guide directs the teacher to ask "Do you know from this statement how many were surveyed?" I use slightly different language as I ask, "Do you know how many people were actually surveyed? Do you know how many chose Bolda Cola or how many chose Cola Nola?" (1.1A1, line 65-66). I worried though about my students being asked to pretend they did not know the information given in statement one, when making sense of whether or not the original data is preserved in statement two. Again, the task is asking students to think about a hypothetical situation, specifically, to act as if they do not have certain information when they have it right in front of them. As

I had anticipated, this becomes an issue in the classroom, as Bobby says, “They gave us the number, 17,139 and the other number, 11,426, like, it’s right there” (1.1A1, line 77), as he points to the data given in statement one. The guide does not suggest that this could be a challenge for students. In fact, the CMP authors assume that students will readily recognize that the number of people participating in the survey is not known from statement two.

The guide moves on to have students consider if the difference gives a “good sense of the strength of preference.” Like the guide’s suggestion, I ask my students on Day 1 about their sense of the comparison. However, I again use slightly different language than the guide, asking the question in the following way: “Does that (pointing to *5,713 more people* written on the board) automatically give you a sense of whether Bolda Cola is really that much better or that much more liked than Cola Nola?” (1.1A1, line 89). Keontay, raises his hand and asks, “Um, did, um, Cola Nola lose votes?” (1.1A1, line 91). He follows this statement, asking a series of follow-up questions about this notion. It seems he is uncertain about what the difference represents. When I ask other students if they would like to respond to Keontay’s questions, there are no volunteers. I attempt to explain by indicating it is not that votes were lost per se, but rather that one cola received more votes than the other cola, specifically, 5,713 more votes.

The teacher’s guide does not suggest possible questions the students might ask, but it does offer an example that teachers could use if they felt students needed additional guidance to recognize that the strength of the preference according as indicated by the difference is dependent on the size of the survey data. Specifically, the guide suggests a

teacher could ask students to think about surveying “15,000” versus “500,000” with a difference of 5,713, for which the former would indicate “considerable strength” and the latter would suggest “the difference would not be anywhere near as noticeable.” That is the extent of additional support for teachers around this topic provided by the guide. This example assumes that students know we are considering a difference of 5,713 and how the difference was calculated, meaning that it results from subtracting the amount of people preferring one type of soda from the amount of people preferring the second type. Further, it assumes students understand that 15,000 and 500,000 are each a sum of the amounts of people indicating their preferences for each of the two types of soda from two different surveys. There is a lot of information to keep track of in this hypothetical example. To me the example is not likely to result in clarification of the concept of strength of preference simply because there is too much cognitive load involved to hold on to all of these numbers and to know where they come from and what they mean, while considering the strength of the comparison from a difference of 5,713.

Instead of using this example to help students understand that the original data is not preserved and how the strength of preference changes depending on the size of the survey data, I deviated from my lesson plan, and hence from the teacher’s guide. In hindsight, I wish I would have planned for this challenge prior to the lesson; however, the previous year of teaching this particular lesson I did a lot of talking and explaining, while this particular year I was aiming to rely more on what was given in the guide, trying to adhere to my intentions of curriculum enactment with more fidelity. I had specified in my lesson plan the example and the language given in the guide; however, I quickly decided the example would not likely be helpful given the uncertainty that I sensed from my

students and the assumptions embedded in the guide's attempt at offering clarity. In the moment, I quickly come up with an example in which a large number of people participated in a taste test. I describe how this episode of deviating from the intended curriculum unfolds.

I say to the students, "Okay, so I'm gonna have you pretend something. Let's pretend that we surveyed this many people (writing on the board 2,005,713). What's this number?" (1.1A1, lines 111 & 112). I remind students that I am making up data in which a certain number of people have participated in a survey. Specifically, I state, "One million people preferred Cola Nola" and "1,005,713 preferred Bolda Cola," followed by, "What's the difference between the two?" (1.1A1, lines 119-124). I then call on Talib who states the numerical value "5,713" and I point out, "Which is exactly this statement right here (pointing to the board where she had recorded *5,713 more people preferred Bolda Cola* earlier in the discussion)" (1.1A1, line 128). Further, I emphasize, "they surveyed over two million people. So, if they just give you the difference, you have no idea how many people were actually surveyed" (1.1A1, lines 130-133). Here, I am trying to establish that just given statement two, which indicates 5,713 more people preferred one type of cola over another, we do not know how many people participated in the survey. Immediately, Bobby raises his hand and points out that the differences for the real data and for the example "match" (1.1A1, line 134). I respond, "yeah, these are the actual numbers (pointing to statement one), but if we didn't know the actual numbers, we could've surveyed about two million people and that could have been the difference" (pointing to "5,713 more people liked Bolda Cola" that was written on the board; 1.1A1, lines 141-143). Again, I am trying to point out that we can survey a different number of

people than what was given, and yet still get a difference of 5,713. I did not want to assume that students would know just from a total number of people surveyed, how the difference of 5,713 relates to that number of people in the taste test, and what this says about the strength of preference.

I continue with the example, stating "Now, let me show you something" (1.1A1, line 147). I ask the students, "This is about how much?" (pointing to the 1,005,713 written on the board; 1.1A1, line 148). After some more prompting, including me saying, "Like, if we are estimating" (1.1A1, line 154), Malik responds, "About one million" (1.1A1, line 158). I revoice and then remind the class, "We're estimating here" (1.1A1, line 164). The following is an excerpt of how the conversation continues:

Line 167 T: Like, this is about a million (pointing to 1,005,713),

Line 168 Students: Yeah

Line 169 T: And this is how much? (pointing to 1,000,000)

Line 170 A few students say "a million"

Line 171 T: So because you surveyed *so* (emphasis) many people

Line 172 (pause)

Line 173 T: What you actually find is this difference (pointing to 5,713) doesn't even really matter.

Line 174 T: It's still about one million people prefer each.

Notice I am asking for estimates to show that the amount of people who preferred each of the two types of soda is about the same. In contrast, the guide does not indicate that the

teacher should have students estimate to make sense of the survey data. I ask students "what conclusion would you make if these were the actual numbers?" (line 175), Malik shares "Like, both of them have the same, like, amount of people who like them" (1.1A1, line 179). Further, I ask another student, Jada, if she heard what Malik said, as he said it very quietly, and if she knows what he means. Jada concludes, "Yeah, they probably taste the same" (1.1A1, line 183). I am attempting to help students see that the difference is negligible considering there is a large number of taste test participants relative to the difference between the number of people who prefer one type of cola and the number of people who preferred the second type of cola.

Next, I bring the conversation back to the data given in the student pages. I indicate that "This is definitely not the same," as I point to statement one projected on the board, specifically, 17,139 people preferred Bolda Cola and 11,426 people preferred Cola Nola (1.1A1., line 188). I ask the students, "About how much?" are each of these amounts of people. The class establishes that it is about 17,000 people and about 11,000 people. Here is how the conversation unfolds:

192 T: About how many people is this?

193 Many students say 17,000.

194 T: It's about 17,000 people (confirming their response).

195 T: And about how many people is this? (pointing to the other number)

196 A few people say 11,000.

197 T: Are those the same amount?

198 T: 17,000 and 11,000?

Several students in the class respond, “no” to my question, from which I conclude: “So it depends, the difference, you gotta be careful with it. Knowing whether Bolda Cola is *really* (emphasis) liked over Cola Nola depends on the number of people taking the survey” (1.1A1, lines 203-206). Unlike the enacted discussion, the guide suggests students would make this conclusion in the following way: “the strength of preference depends on the number of people surveyed.”

On Day 2, as I continue to think about the emphasis in the guide of moving students beyond using as additive comparison, I ask students, “Does anyone think the difference statement is helpful?” when thinking about advertising for Bolda Cola (1.1A2, line 130). Before a student directly addresses this question, Keontay points out that the other statements are saying the same thing, but that the difference is somehow different. This is the same student who on the previous day had been asking questions about the difference, as to what it is saying. In summarizing this student’s articulation of the difference, I use the phrase “the difference is different” to capture the student’s notion that the other three statements are saying the same thing, but information gleaned from the difference is somehow different from the other three multiplicative comparisons (1.1A2, line 142). I then return to the hypothetical example from the previous day, highlighting that the difference does not preserve the original data and that without knowing the number of people surveyed the difference does not indicate the strength of preference. I use the same language I had used the previous day. For example, during one point in our discussion on the difference in Day 2 I say, “that’s the problem with the difference statement here, is that you don’t know the total number of people who were

surveyed, you don't know how many people liked each kind of soda, so would you be convinced just by this statement? (1.1A2, line 214).

On Day 2, students still do not use the word "difference," yet they do refer to the concept and in two instances it is clear a misunderstanding about the difference has emerged. Specifically, during distinctly different times in the conversation, Michael and Keontay say "It's an estimate" in reference to the difference (1.1A2, lines 179 & 228). After the second time this happens, I respond by explicitly stating, "It's not an estimate. It's an exact number." (1.1A2, lines 230). Here students' responses to the example in which estimating was used shows an unintended consequence of overgeneralizing the mathematical term "estimate" to describe the difference. This situation feels like a dilemma in that using estimation to unpack an example, and in doing so draw on number sense, is not incorrect and can be beneficial in supporting students' learning, yet by relying on estimates of the hypothetical and real data an additional problem arises. I try to address students' misunderstanding by pointing out how the difference is calculated. I explicitly state that the process for finding the difference, that is, "the difference we get from subtracting those who like it (referring to Bolda Cola) and those who like the other soda" (1.1A2, line 232). To which Michael, one of the students who called the difference an estimate, responds, "Oh, that's how you get it?" (1.1A2, line 233), and I affirm, "Yes, that's how you calculate the difference" (1.1A2, line 234). In Figure 4, I provide a summary of the mathematical language, looking across the intended and enacted discussions and noting who the teacher's guide suggests will use the words and who actually used the words in the classroom conversations.

| Terms & Phrases | 1.1A CMP | Who is intended to say it? | 1.1A Classroom | Who says it? |
|---|---|---|---|---|
| difference | "Statement 2 is the difference between the number of people who preferred Bolda Cola and those who preferred Cola-Nola." | student | "What's the difference between the two?" | teacher |
| Sense of strength of preference/ sense of BC…much more liked than CN | "Does this statement give you a sense of the strength of preference**?**" | teacher | "Does it automatically give you a sense of whether Bolda Cola is really… that much more liked than Cola Nola?" | teacher |
| How many people surveyed/ actually surveyed | "Do you know from this statement how many were surveyed?" | teacher | "How many were actually surveyed?" | teacher & students |
| it depends (in reference to strength of preference) | "Strength of preference depends on how many surveyed" | student | "it depends, the difference…. Knowing whether Bolda Cola is *really* (emphasis) liked over Cola Nola depends on the number of people taking the survey" | teacher |
| subtracting | | | "that's the difference that we get from subtracting those who like it and those who like the other soda" | teacher |
| about, estimate | | | "This is about how much?" | teacher |

*Figure 3.* Examples of Mathematics Phrases About the Difference & Who Uses Them in Problem 1.1 Discussions

Here, I summarize the language and concepts available around additive comparisons in the Problem 1.1 enacted discussions. First, students have the opportunity to learn that statement two represents the difference between two quantities and a process for calculating it. They also have the opportunity to learn that the difference does not indicate how many people participated in the taste test. Further, students are given an opportunity to hear an example that shows how the same difference can represent a comparison in multiple data sets, including a large number of survey participants, as well as, a much smaller number of participants, which in this case is the survey data given in Problem 1.1. From this, students have an opportunity to learn that if the number of people surveyed is not given, then conclusions cannot be made about which cola is more preferred just based on the difference alone. Further, in the discussion students establish that when the difference is small relative to the total amount surveyed, the preference for one soda over another is negligible, and they are told that when the difference is large relative to the total number of participants then one cola is significantly more preferred than the other.

The teacher's guide intends for students to develop, and particularly to demonstrate, these understandings, using particular terminology. As evident in Figure 3, there are differences in the language and some of the mathematical concepts discussed. In an upcoming sub-section, I analyze and discuss some of the language usage against the backdrop of the intended curriculum and in light of access and equity for Black students, but first I present data around the language used to discuss the remaining three statements that make multiplicative comparisons.

**Language usage around multiplicative comparisons.** As you can see in Figure 4 with the presentation of Problem 1.1, Statement 1 compares the exact number of people who preferred each of two types of cola using the term "ratio." Statement 3 offers the percent of people who preferred one particular type of cola. Statement 4 is written with language identical to Statement 1, and a ratio equivalent to that given in Statement 1. Both the intended and enacted discussion begin by discussing Statement 1. Again, I share the intended language around each area of focus from the guide (e.g., data preservation, sense of the data, connection to other statements) and what actually happened in the classroom discussion.

In considering the first multiplicative comparison, the teacher's guide suggests asking the following question: "From the first statement, how can you tell how many people took the taste test?" and asks for students to state the number. Further, the guide anticipates that students will likely respond by saying, "add the exact number of people who preferred (each of the two types of cola)," and they will establish that "28,565 people" participated in the taste test. I begin the discussion by asking students what they learned from Statement 1, a much more open-ended question than what was given in the teacher's guide. I wonder though if students are uncertain as to how to answer this question, as only one hand goes up. I call on Talib and he reads the statement verbatim. Through probing, Talib then uses the phrases "more people" and "less people" to describe his understanding of statement one and the comparison being made (1.1A1, line 47). Through observing groups work during the exploration part of the lesson, I knew that several students had identified what the numbers in this statement represent; therefore, I call on this group to share. Like the teacher's guide, Kayla, uses the phrase "exact

number of people surveyed" to refer to the information given in statement one (e.g., 1.1A1, line 50). However, my students and I do not explicitly use the terms add or sum, and we only identify the total number of participants when discussing statement three.

The teacher's guide also provides questions that attend to the relationships between statements with an intention of discussing how to get from one form of comparison to another, such as, "How is Statement 2 related to Statement 1?" In our discussions on problem 1.1, I do not explicitly ask how statements one and two are related, although over the two days of discussion on 1.1 I do refer to the data in statement one repeatedly as we talk about the difference, and on Day 2 when I indicate how to calculate the difference I again use the exact number of people who indicated a preference for each of the two types of cola, which is given in statement one.

On Day 1, the discussion on statement one is brief. We only establish that this gives us the original data from the survey and then we move on to discussing Statement 2. On Day 2 though we discuss Statement 1 again, when Bobby argues why he thinks this would be the most convincing statement for advertising Bolda Cola. In this dialogue Marcia makes a connection between Statements 1 and 4, in response to a wrong idea expressed by Bobby. The connection that was made in our classroom unfolds in the following way. Here you can see students attempting to use ratio terminology. In reference to Statement 1, Bobby states "I think statement one, cuz, it's like giving us like how much people likes it, like, against the people that don't like it, so like, 17,139 against the 11,426. And that's (pointing to statement four) the ratio. We don't really want the ratio, cuz, like, it's telling you something but that's not really giving you good evidence about it." (1.1A2, lines 51-54). After I re-voice what Bobby shares, Marcia responds with

the following argument: “It (referring to statement one) says the ratio of 17,139 to 11,426 and number four (referring to statement four) says the ratio of 3 to 2, so they’re both ratios” (1.1A2, line 59). Keontay chimes in, “I don’t get what she said.” (1.1A2, lines 60). I ask if someone could summarize, to which Marcia jumps in and restates her thinking. She does this by reading each statement and emphasizing the word “ratio” in each. I ask the class what it is that Marcia is claiming about Statements 1 and 4, and several students in the class respond in unison “both are ratios” (1.1A2, line 64).

The teacher’s guide for CMP does not mention this connection, potentially because it is viewed as obvious since both statements one and four use the same wording. Yet it feels important to identify explicitly. Also, the guide does not mention how students and a teacher would address writing the ratio in statement one as the equivalent ratio in statement four. In general though, the guide suggests that students will be “dividing by a common factor” to rewrite one form of each multiplicative comparison in another form. Our class attends to this relationship by identifying specifically how to write the ratio in Statement 1 as the equivalent ratio in statement four. I specifically ask, “How do we get from the ratio in statement one to the ratio in statement four?” (1.1A2, line 72). Sasha states, “convert it to a fraction,” (1.1A2, line 73), which for her seems to mean writing the number of people who preferred Bolda Cola over those who preferred Cola Nola for both statements one and four (1.1A2, lines 74-99). I refer to this as “writing a ratio in fractional form,” that is, writing a ratio as a/b (1.1A2, line 103). Then, in response to me repeating the same question, several students state the process is to “divide” (1.1A2, line 120) and I re-voice using the phrase “divide by the same number

here and here" (pointing to each of the two numbers in the ratio in statement one; 1.1A2, line 122). As the class is talking about the connection between statements one and four,

The first consideration of Statement 4 was extremely short, lasting only two minutes at the very end of our discussion. What I found in the brief dialogue about statement four is that unlike the teacher's guide, students do not use the term "ratio," except as previously mentioned when they identified it is a ratio like statement one. I repeatedly refer to this comparison as a "ratio," yet there is not enough time to unpack Statement 4. We consider whether this statement gives a good sense of the comparison and a wrong idea surfaces about what the numbers represent. Specifically, in response to me asking, "What do we learn from the ratio of 3 to 2 in this statement?" (1.1A1, line 274), Sasha responds "It's close," and when I ask how she knows, she repeats, "3 to 2" (1.1A1, line 275). On the board I draw B B B and N N to represent "a ratio of 3 to 2," and ask if that gives others a "sense of the comparison" (1.1A1, line 278-279). Malik responds, "Yeah, 3 people like Bolda Cola and only 2 people like Cola Nola" (1.1A1, line 290). In an attempt to identify that we lose the original data, I then ask "So, how many people were actually surveyed" (1.1A1, line 291). Malik responds, "5 people" (1.1A1, line 292). I hesitate to correct Malik and instead say "That's interesting. So, people could assume that only 5 people were surveyed." (1.1A1, line 293). I bring us back to statement one and indicate that "Here they happen to tell us how many people were actually surveyed (pointing to statement one) and was it only 5 people?" (1.1A, lines 295-296). Several students respond "No" (1.1A1, line 297). I end the discussion about problem 1.1 and move on to logistical items as class is about to end.

In terms of the particular mathematical terminology the guide suggests in reference to statement four, the authors state that from a “ratio 3 to 2,” students will identify the “fraction of people” who prefer particular types of soda by using the total number of people in the ratio, specifically, 5 people. From here the guide indicates students will use the phrase “3/5 of those surveyed prefer Bolda Cola” to capture the fraction representation. Further, the guide suggests that teachers make a connection between Statement 4 and Statement 3. In terms of establishing this connection and shifting to statement three, the guide suggests asking “How are the 60% and the 3 to 2 statement related?” Here the guide assumes students will establish that “40% of people preferred Cola Nola,” given that “60% preferred Bolda Cola,” and state that “60 to 40 is equivalent to the ratio 3 to 2" Earlier in the guide’s overview of Problem 1.1, the authors indicate that for students a percent is an “easy-to-understand number” within an advertisement. Therefore, the guide suggests that when teachers ask “Does knowing that 60% preferred Bolda Cola give a good sense of the comparison,” students will reply “yes” and will recognize that “the percent tells you the comparison regardless of the number of people taking the survey.”

Unlike the CMP author’s anticipation about students’ readiness to make conclusions around the percent, I see there are no hands raised to volunteer to share when I ask what Statement 3 expresses. I call on Sasha, even though she has not volunteered, and she shares that the statement tells us, “in a percentage, how many people liked Bolda Cola” (1.1A1, line 217). When asked what that means, Malik responds “60 out of 100, umm, wait, like, yeah, it said BC out of 100, instead of having two numbers” (1.1A1, lines 220-221). I ask the students to consider if they were only given Statement 3 would

they know how many people were surveyed, to which several students say “no,” and I follow up by asking “How many people were actually surveyed?” (1.1A1, lines 224-225). Students are responding with numbers given in Statement 1, specifically, 17,139, and 11,426 (1.1A1, lines 226-227), to which I follow-up by asking, “What is the total number surveyed?” (1.1A1, line 228). Talib responds “28,565 people” (1.1A1, line 229). I conclude by saying, “If they just have this (pointing to Statement 3), we would have no idea how many people were surveyed.” (1.1A1, line 232). The time spent on Statement 3 is rather brief. I recognize we are running out of time, and I quickly move us to Statement 4. However, we return to the percent again the next day.

On Day 2 of the discussion of Problem 1.1, Tasha shifts the conversation from Statement 2 to Statement 3 by making a claim that the difference and the percent are somehow the same. Specifically, she states that they are “the same,” explaining that she thinks this because they are both “without the actual numbers” (1.1A2, lines 243 & 247). Marcia questions this claim and a conversation unfolds about what information the class learns from the percent. Specifically, the class establishes the percent does not maintain the original data, when the class responds “no” to my question of “From the percent, do we know how many people were actually surveyed?” (1.1A2, lines 257 & 258). I also ask the class “What might they have done to get the percent?” (1.1A2, line 259). Several students shout “divided” (1.1A2, line 261), and I respond “yeah, they might have simplified” (1.1A2, line 262). At this point, I am trying to guide students in establishing how to get from Statement 1 to the percent in Statement 3; however, I do not refer explicitly to the specific ratio given in statement one. I move on to ask the students “Does the percent give you a good sense of the results from the taste test?” (1.1A2, line 272).

None of my students volunteer a response. I then ask if they are able to picture one hundred people. Several students respond “no” (1.1A2, line 274), so I ask the class to consider a situation in their everyday experiences at the school to be able to picture what the percent represents. Specifically, I indicate there are “100 people in your seventh grade class” and I ask them to picture their advisory lines in the morning when they are lining up to come inside (1.1A2, lines 275-281). I indicate that “60 of them would drink Bolda Cola” and “40 of them would drink Cola Nola” (1.1A2, lines 282-283). See Figure 4 for a summary of the language in the intended and enacted discussions.

In summary, in the Problem 1.1 enacted discussions on the multiplicative comparisons, students have opportunities to learn particular understandings of three related ways of writing ratios. First, on Day 1 students learn from a fellow classmate that statement one gives the exact number of people participating in the taste test. Further, on the second day, students establish that statement one and four are both ratios, and division by the same number can be used to move from the ratio in statement one to that in statement four. The idea of converting the ratios to fractions is stated by a student, although I clarify by using the phrase fractional form to refer to the ratio of the number of people preferring Bolda Cola to the number of people preferring Cola Nola written as a/b. There is no further discussion around what is meant by this fraction language. Students hear from a fellow classmate on the first day of the discussion about the strength of comparison in statement four when she indicates the numbers are close. On Day 2, a student indicates that Statements 2 and 3 do not give the exact number of people surveyed. Due to some uncertainty around visualizing a percent, I do not ask about their sense of the comparison from the percent. Instead, students listen to an example that

relates to their morning routine at Applegate as a way to picture what the percent represents. Similar to talk about Statement 2, when facilitating the dialogue about the multiplicative comparisons I sometimes use different language than that suggested in the guide, and my students do not always take up the mathematical language in the same way that the CMP authors anticipate (see Figure 4 for a summary of this data). In the next sub-section, I analyze and discuss some of the ways that I deviated from the curriculum while attending to concerns around wanting to do right by Black students. After this analysis and discussion, I share a second lesson, specifically, Problem 2.1 as a way to consider language usage at a later point in time during the unit, and with a different type of task.

| Terms & Phrases | 2.1A CMP | Who says it? | 2.1A Classroom | Who says it? |
|---|---|---|---|---|
| exact number of people | "exact number of people" | student & teacher | "exact number of people surveyed" | student & teacher |
| add (to determine the number of people surveyed) | "add the exact number of people who preferred (each of the two types of cola)" | student | | |
| ratio | "ratio 3 to 2" | student & teacher | "both are ratios" (in reference to statements one and four) | student & teacher |
| divide | "dividing by a common factor" | teacher | "divide"<br>"divide by the same number here and here" | student<br>teacher |
| Good sense of the comparison/good sense of results from taste test | "a good sense of the comparison" | teacher | "Does the percent give you a good sense of the results from the taste test?" | teacher |
| It's close (Sense of the comparison from statement four) | | | "It's close. I know because 3 and 2" | student |
| out of 100 | | | "60 out of 100" | student & teacher |
| 40% preferred/would drink Cola Nola | "40% of people preferred Cola Nola" | student & teacher | "40 of them (out of 100) would drink Cola Nola" | teacher |

| | | | | |
|---|---|---|---|---|
| Get from/related | “How are the 60% and 3 to 2 statement related?” | teacher | “How do we get from the ratio in statement one to the ratio in statement four?” | teacher |
| equivalent | “60 to 40 is equivalent to the ratio 3 to 2" | student | | |
| fraction | “3/5 of those surveyed prefer Bolda” | student | “convert it to a fraction” | student |
| | | | “ratio in fractional form” (in reference to statement four written as 3/2) | teacher |

*Figure 4.* Examples of Mathematics Phrases About Ratios and a Percent & Who Uses Them in Problem 1.1 Discussions

**Analysis of deviations from CMP in Problem 1.1.** I found some key differences as I analyzed the language in the teacher’s guide as compared to the enacted conversations. Some of my whole class statements are more casual than the technical language used in the teacher’s guide. This is evident when I discuss with students the strength of preference that can be gleaned from the comparisons. For example, when the difference and the number of survey participants are known, I ask students if they have “a sense of whether Bolda Cola is really that much better or that much more liked than Cola Nola?” I feel the phrases “strength of comparison” or “strength of preference,” for which the guide assumes teachers and students will use, can be a confusing, especially when it is detached from the particular data that we are addressing. The terminology that I tended to use around this understanding feels more direct and accessible to me. I am trying to talk about this scenario in a way that feels comfortable and is not going to cause confusion as to what is meant.

I also at times use everyday words, rather than the technical mathematical terms when talking about the relationships between the ratios. For example, when we specifically discuss the relationship between statements one and four, I use "divide by the same number here and here." (pointing to the two numbers in the ratio from statement one that we have written as a fraction) rather than saying "divide by a common factor." While this might be problematic in terms of students' opportunity to adopt the technical mathematical language of common factor, I also recognize that we are in the first two days of this unit and there will be time to infuse this mathematical language. I also do not use the term "equivalent" during the conversation to refer to the relationship between the ratios; whereas the guide indicates that students will be stating that the ratios are equivalent, such as, the ratios 60 to 40 from the percent and the ratio of 3 to 2 given in statement four. This was somewhat of an oversight. I asked students instead to consider "How do we get from the ratio in Statement 1 to the ratio in Statement 4?" I focused students on the process. Ideally though I would have used the term "equivalent." I think in my attempt to keep the conversation feeling familiar to students as we entered this unit, I at times inadvertently left out certain mathematical terms and phrases, knowing that we will return to these ideas at which point I can incorporate more mathematical terminology.

For some students, my use of familiar language may foster engagement in the discussion and create a pathway for accessing some of the mathematical concepts. Yet, I recognize that using more colloquial language and at times avoiding mathematical terms altogether means I may be constraining my students opportunities to learn, particularly to take up the mathematics register. In thinking about what it means to do right by Black

students, I am critical of my avoidance of some of the mathematical language as I immediately jump to the conclusion that this particular group of students must be afforded a chance to hear the mathematical terminology as there is power in knowing and being able to use these terms. Yet, I step back and consider that the students in my low-track class have all experienced previous struggles in mathematics classrooms. I also see in the first day of our discussion evidence of uncertainty, particularly in the limited number of volunteers. I want to give my students every possible opportunity to hear the academic language and I want to stay true to the intentions of the CMP authors as I believe using this curriculum has many benefits for my students, yet I want to address what feels like particular needs of my students. I want them to feel comfortable as we talk about the content in the lesson, even if they are feeling uncertain. I want them to feel a sense of familiarity as we enter into this new unit and to grasp larger ideas that are being introduced. I also want them to feel that they can freely share without worrying about having the "right" words. As I think about these aims as they relate to doing right by Black students in general, I keep asking myself questions that relate more generally to teachers of mathematics.

First, I wonder in what ways could a teacher's language choices be an access path for Black students? More specifically, are there times when using common language rather than particular mathematical or mathematically-related phrases does not in any way inhibit the learning of mathematics concepts? With an eye toward ensuring that Black students have equitable OTL mathematics, when is it problematic to use common language as opposed to the specific mathematical words specified by a teacher's guide? What if using the exact words from the intended curriculum inhibits students' access to

the mathematics concepts? Moreover, what if the technical language given in a teacher's guide makes students feel intimidated or disinterested, potentially because the language adds a layer of complexity? I return to these questions in the conclusion section, though not with answers, but with further considerations and suggestions.

There is also another significant way in which my language deviates from the intended curriculum in Problem 1.1. Specifically, I use a different example than the pretend data given in the guide. More specifically, in the discussion on the additive comparison given in statement two and what it means, I give an elaborate example involving a large data sample and engage students in an in-depth discussion about the data, in response to what I sense as my students' uncertainty. I deduce this from little to no volunteers and questions students ask around what the data means. I think by giving my students a more in-depth opportunity to try to make sense of this type of comparison than what is given in the guide, I am attending to what I believe my students need. In the example I ask them to estimate in hopes of having them make sense of the strength of preference for one type of soda over the other. I use the same difference from the original data and a large number of taste test participants. However, when I use the term "estimating" and the phrase "about how much," it seems for some of my students I have entered unfamiliar territory. While it is the case that CMP in previous units from grade six suggests using estimation to get a sense of numerical values and potential solutions, it is not known if my colleagues followed the curriculum with fidelity. Therefore, as I ask my students to consider the hypothetical survey data, they may now be faced with uncertainty related to the use of estimation. While this example may have helped some of my students make sense of how the size of the survey data affects the strength of

preference, it also brought an unintended consequence of two of my students incorrectly concluding that the difference is an estimate. In hopes of addressing the students who have come to think the difference is an estimate in this problem, I explicitly tell students how to calculate the difference by using subtraction, even though the guide does not specify this is necessary. It seems that in this opportunity to learn more about the difference and to use estimation to make sense of the specific numbers in the example and what they mean, I am creating opportunities for students to understand the drawbacks of an additive comparison. Also, even as two students mistakenly call the difference an estimate, this creates an opportunity to refer back to the method for calculating the difference and in doing so clarify for students the nature of the additive comparison.

In addition to presenting an example that deviates from the intended curriculum when talking about the difference, I also spend some of our discussion time on Day 2 of Problem 1.1 presenting a scenario related to the percent that is not given in the teacher's guide. I do this with an intent of helping students get a sense of the comparison represented by the percent in Statement 3. The teacher's guide makes assumptions about students' understandings of a percent when they claim that a percent is an "easy-to-understand number" within an advertisement. I feel that they are suggesting that students would readily indicate the percent gives them a good sense of the comparison. However, in my classroom there are no volunteers to share when I ask my students if the percent gives them a good sense of the comparison. Further, when I ask if they can picture one hundred people, students who respond say they cannot. Therefore, I aim to help my students feel more confident in visualizing the representation afforded by a percent. To do this I give an example from their daily experience. I use this example to create an

image of one hundred people and the number of people out of one hundred who would have preferred each of the two types of cola.

I spontaneously include these two scenarios in our discussion as a way to address what feels like students' uncertainty with the CMP task, particularly what the statements mean. I realize that deviating from the curriculum in this way takes up time and I am presenting examples I devised in the moment that could be more refined through adequate time to ponder and evaluate. Also, I use mathematical terms not included in the teacher's guide, such as, estimate and out of one hundred. I share these examples with students in attempt to create access to concepts that CMP assumes students already know or will readily grasp, without needing such in-depth dialogue. From this comparison it becomes clear that the CMP authors have a particular view of the knowledge and experiences that students will bring with them to school. For example, CMP assumes students already have the mathematical language to refer to additive and multiplicative comparisons. Specifically, the guide anticipates that students will use *difference*, *ratio*, and *equivalent* on the first day of this new unit.

In addition to the CMP authors' assumptions about the particular knowledge students bring and the language they will use, there are also expectations around how students will handle hypothetical scenarios in which students are being asked to pretend something. More specifically, the authors see no issues with asking students to pretend statement one is not given when students are deciding if the original data is preserved or lost in the other three remaining statements. However, this seemed to cause confusion for my students. This was evident to me when one of my students repeatedly pointed out that the data is right there (in Statement 1), as if he could not understand why we would

pretend that it is not there. This makes me wonder how well this scenario is reflecting a real-world situation. In talking with a colleague about this task, he suggested having students consider just one statement in small groups, for which they could focus on becoming somewhat of an expert on what that statement means without initially seeing the other statements. The discussion could then be an opportunity for each group to share what they learned about their statement. It seems the task in CMP is written in a way that asks students to pretend certain things because we are in math class and that is what we do in math class, as compared to an ideal task in a reform curriculum that would feel to students like a real mathematical problem they might be solving in their daily lives outside of school.

Finally, the hypothetical examples that the guide offers when talking about the difference, specifically, a large and a small number of survey participants, assumed students would hold in their mind and understand multiple pieces of information at one time without explicitly needing to unpack these ideas. This includes knowing that the same difference can occur in multiple datasets, the strength of the comparison can be determined when we have the difference and the total number of survey participants, and naming the strength of comparison for the large and small amounts of people taking the taste test.

Assumptions such as these have ramifications for students accessing the content. In thinking about some of the prior negative mathematics experiences that landed my students in a low-track class, I worried that the assumed knowledge needed to navigate the intended CMP curriculum may be what is preventing them from participating. I wanted to give my students access to both the understandings that CMP assumed students

already have and to the new content within this unit. By presenting two in-depth examples I aim to do this, although realizing that these ways of deviating from the curriculum require time and include language not given in the guide. In thinking more generally about Black students' experiences, particularly within urban schools, I wondered how assumptions in curriculum around mathematical language and understandings of concepts are further marginalizing Black youth in the U.S. schooling system (e.g., Brantlinger, 2011). Several questions come to my mind around the ways that teachers' deviations from intended curriculum may afford or constrain students' OTL, with an eye toward access and equity for Black students.

Specifically, I wonder more generally in what ways are assumptions in curriculum about students' experiences and previous understandings an obstacle in Black students' OTL particular mathematical language and concepts? In what ways might teachers deviate from an intended curriculum to create access for Black students, particularly those who have had negative schooling experiences in mathematics? What considerations should be made in the mathematical language used in such examples in order to open doors for students who have been marginalized in educational institutions? In the discussion and conclusion I return to these questions as I offer interpretations and implications for creating OTL in light of wanting to do right by Black students. First though I describe language usage in a second lesson in which the topic and the conversation are somewhat different than the two days of discussion on problem 1.1. In this discussion I also deviate from the intended curriculum in particular ways. After the description of the data, I again analyze the differences in my and my students' language as compared to suggestions from the teacher's guide and what this means for students'

opportunities to learn the mathematics register. Prior to the discussion and conclusion section, I devote a subsection to consider some of the similarities and differences across the three classroom discussions examined in this study. With a lens on Black students' OTL, this comparison considers if students are adopting the mathematical language as the guide intends and why or why not. To conclude this project, I provide an overall discussion and conclusion section.

**Problem 2.1**

We began Investigation 2, starting with problem 2.1, on the eighth day of the Comparing and Scaling unit. In this scenario there are "two different numbers of pizzas are placed at tables that seat two different numbers of people." Students are given an image of tables and plates (see Figure 5) and Task A asks students to consider the following:

> The campers at each table share the pizzas equally. Does a person sitting at a small table get the same amount of pizza as a person sitting at a large table? Explain your reasoning.

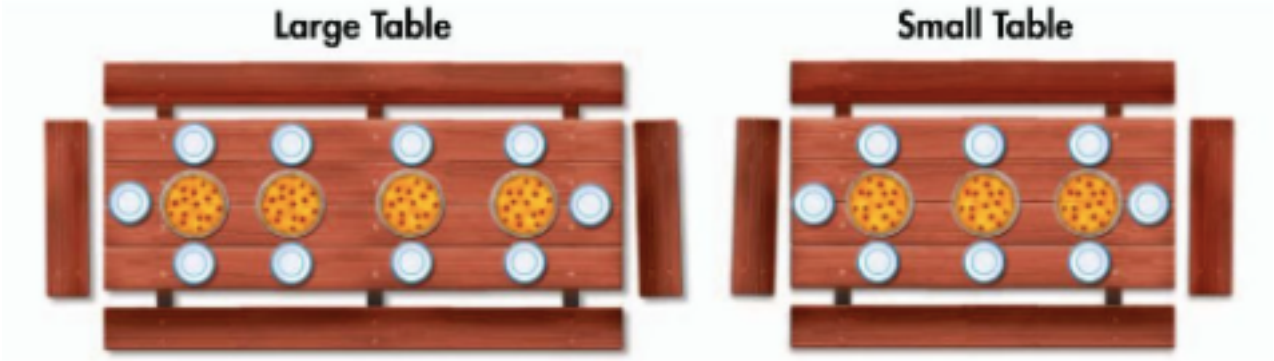


*Figure 5.* Image in the Student Pages for Problem 2.1 in Investigation 2 in CMP

The focus question for this problem asks students, "How can you determine whether two ratios are equivalent or find which of two ratios is more favorable?" This assumes that students will want to sit at the table where they will receive more pizza than if they sat at the other table. According to the teacher's guide, students are expected to come up with a strategy for solving the problem and, importantly, to "explain why they think their strategy is appropriate and effective." For the summary discussion, the intentions of the CMP authors is for teachers to focus on the ratio arguments that students use to solve this real-world task. The suggested questions draw attention to what the ratios mean and direct students to identify equivalent ratios while holding one of the units constant.

As the teacher launches problem 2.1, the guide suggests talking through what students see in the picture, reading through the task, and then asking students the following: "If the campers at each table share the pizzas equally, is the amount of pizza the same for each person?" The guide assumes that "most of your students should answer Question A without too much difficulty, although many students may find it challenging to express their solutions in the language of ratios." As I wrote my lesson plan, I thought

about the challenges I envisioned. I was fairly confident that my students would not use additive reasoning, that is, thinking that more pizzas at the large table means each person receives more pizza. Yet, I realized that most of my students had been relying on percent comparisons to solve the three previous problems in Investigation 1 (not described in this paper). I wondered if they would consider using a percent and if they would readily recognize that the quantities of pizzas and people are different units. In order to use percents appropriately here students would have to calculate the percent of pizza per person, which is a unit rate written as a percent. I did not anticipate that my students would be familiar with unit rates given this concept had not yet come up in any of our lessons. Unit rates are introduced in Problem 2.2. I followed the recommendations in the guide for the launch and had my students work with partners and a few groups of three to explore the problem, then we came together for a summary discussion during which we talked about their strategies and reasonings for task A.

The teacher's guide suggests beginning the summary discussion with an example in which there is a table with 5 pizzas for 30 people and a table with 4 pizzas for 5 people. The goal here is to move students away from additive reasoning by asking if students would "decide where to sit based on which table had the most pizza?" There is a second example given, as well, in which students compare 5 pizzas for 10 people and 1 pizza for 3 people, again to dispel wrong ideas about choosing where to sit based on the fewest number of people. Since none of my students used additive reasoning as a strategy during the exploration, I skipped these questions. I felt this was a big accomplishment in that my students had moved from using additive comparisons to solve problems involving proportional reasoning. The teacher's guide then suggests discussing the ratios

of pizzas to people or people to pizzas, anticipating that this is the most likely strategy students will use. My students did use ratios to make comparisons between the two tables and I followed the guide by focusing on this method in the discussion.

I now present details about the specific language evident in the intended curriculum and in our classroom discussion for Problem 2.1. Just as I did for the presentation of data for Problem 1.1, I move back and forth between what is given in the teacher's guide and what is said in the classroom dialogue. Following this subsection is an analysis of some of the ways I deviated from the intended curriculum with attention given to what this means for students' opportunities to learn particular mathematics. In my analysis of language usage, I share crucial considerations in thinking about how mathematics teachers can do right by Black students in terms of creating opportunities to learn through the use of particular mathematical language.

**Language usage around multiplicative solutions**. The teacher's guide suggests the teacher enter into a discussion about writing ratios as a method to solve this problem by explicitly asking "What is the ratio of pizzas to people at each of the two tables?" and "What do these ratios mean?" I begin the discussion by orienting the class to part A in the investigation. I refer to the picture projected on the board and select Jason to remind the class "What are we trying to figure out?" Jason says, "We are talking about, like, what people have, like, at the table, do they get the same amount." (2.1, line 8). I ask Jason, "Same amount of what?" and the class establishes that we are talking about "the same amount of pizza" (2.1, lines 9-10). I also reword the question by asking students to consider, "Which table would you rather sit at and why?" (2.1, line 11). By doing this, I am trying to make it personal in hopes of creating engagement in our discussion.

The guide anticipates that students will identify the following ratios: “4 to 10 and 3 to 8” and will indicate that “There are four pizzas for every ten people at the larger table, and there are 3 pizzas for every 8 people at the smaller table.” I ask a particular group to share first, even though another group is pressing me to allow them to share. I made this particular selection because I knew they had found equivalent ratios while holding the number of people constant using 40 and 80 as the number of people. I indicate to the class that “They have one strategy. We are gonna listen first to their strategy.” (2.1A, lines 13-14). Kayla begins to share by saying “Well, what me and my group did was we tried to find the common denominator for 10 and 8” (2.1A, line 18). I write on the board 10 and 8 in the bottom of what looks like a fraction. I ask if other students have questions for Kayla. Keontay asks, “Why are you doing 10 and 8?” (2.1A, line 22), to which Kayla responds, “Because that’s the number of seats” (2.1A, line 23). I also ask the class what else they might be wondering about Kayla’s approach and Tykisha asks, “What’s your numerator?” (2.1A, line 30). I revoice, “Okay (pause) What’s your numerator?” (2.1A, line 31). Kayla shares “4 pizzas” and I summarize “So, four pizzas for every ten people. That’s a ratio” (2.1A, lines 38-41). I also write 4/8 on the board. Kayla then shares, “three eights” when I ask “What’s the second ratio?” (2.1A, lines 43-44). I write ⅜ on the board and I ask the class how they might say that as a ratio. Bobby shouts out, “three pizzas per eight people” (2.1A, line 50), and I re-voice “Yes, we say three pizzas for every eight people” (2.1, line 51).

It seems the students are using the terms denominator and numerator to refer to the placement of the quantities. I say this because they use these terms in reference to a quantity missing as we talk about the amounts of pizza and people written as a/b. Also,

they never use the word “fraction” during the conversation. Further, I believe they understand that they are using two different units, as they recognize these quantities represent pizzas and people. However, it is incorrect to use these terms associated with fractions to talk about ratios comprised of different units. I try to clarify this use of fraction language, although without explicitly telling students they are wrong in using this wording. Here is what I say: “You tried to get a common denominator for these (pointing to 10 and 8). So clearly they put 10 and 8 in the denominator. What is your common denominator.” (2.1, line 52-54). I make a decision in that moment not to correct this inappropriate language usage. Instead, I adopt this student’s word choices, hoping that she is simply using it to refer to location. The way in which the students are using the fraction language may be a function of the challenges that the guide is suggesting here. I use the same fraction language to avoid correcting students at the moment and to foster access through the familiar. I eventually addresses this wrong idea in a later investigation, yet I recognize that I may have inadvertently further contributed to misunderstandings by allowing students to misuse these words numerator and denominator when talking about ratios written as a/b in which a and b are quantities with two different units, rather than a/b representing a number as in the case of a fraction.

In response to me asking for the common denominator, Kayla indicates that she uses “80” as the number of people that she held constant. I continue to ask questions to the class to determine the equivalent ratios when using both 80 people and 40 people as the constants, although we never use the word “constant.” As we talk through the procedural steps, I use the language “equivalent ratio” on four occasions, such as, when I ask, “ If you do eighty, the equivalent ratio here is going to be what?” (2.1, line 62). The

class identifies that the ratios 16/40 and 32/80 are equivalent to the ratio of 4 pizzas to 10 people, and that 15/40 and 30/80 are equivalent ratios of 3 pizzas to 8 people. I also use the phrase "scale factor" in a question to students and when re-voicing the number that students state they are multiplying by, specifically, saying, "the scale factor is four" (2.1, line 120 & 122). This talk aligns with the teacher's guide, although the guide anticipates that *both* the teacher and the students will use the phrase "equivalent ratios" and "scaling" when talking about their process of finding, "16 pizzas for 40 people (at the large table)" and "15 pizzas for 40 people (at the small table)." Further, the guide assumes students will share that "Scaling in this way keeps the number of people at each table constant." My students do not use the terms "scale" or "scaling," nor do they use "scale factor" at any time during the discussion. They also do not use the term "ratio" or the phrase "equivalent ratio" to refer to their methods for solving the problem.

What my students are sharing though are methods which the guide suggests should be the focus of the conversation, that is, they are using ratios to compare the quantities of pizza and people at two different size tables. For instance, just as the guide anticipates some students will do, several of my students solve the problem by holding constant the number of pizzas. The guide suggests that the teacher and the students again will use the word "scale" to refer to the process for finding the equivalent ratios. Specifically, the guide suggests teachers ask the following question: "Can you make the comparison easier by scaling the ratios so that the number of pizzas is equal?" to which students are likely to respond using language such as "Yes, you can scale the larger table to 12 : 30 and the smaller table to 12 : 32." In the classroom discussion, Talib states that he uses "12" as the number of pizzas. I ask students questions about the equivalent ratios

for 8/3 and 10/4 when 12 is the number of pizzas, to which students share “32” and “30” (2.1A, lines 143-145). I summarize in the following way: “So, you have thirty people who share 12 pizzas and thirty two people who share twelve pizzas” (2.1A, line 146). I then ask my students to compare the ratios to solve the problem. Specifically, I ask, “Would you rather have thirty two people sharing twelve pizzas or thirty people sharing twelve pizzas?” (2.1, line 148). Jason states, “I would rather have 30 people sharing 12 pizzas,” which is the “large table” (2.1, line 149 & 151). Similarly, when discussing students’ solutions holding constant the number of people, Kayla shared that she would rather, “sit at the large table” because “the small table is only 30 pizzas and nobody likes less pizza,” suggesting that she understood that each person who sits at the small table would get less pizza than each person sitting at the large table (2.1, line 85).

The guide also suggests that some students will use rate tables or unit rates to answer the question, although students will not necessarily use these mathematical terms. The topics of rate tables and unit rates are the focus of other parts of Investigation 2, however, the guide suggests making introductions to these methods in the 2.1 discussion, particularly if a student has used one of these methods. The guide talks about rate tables as something that a teacher could summarize as “a table to model a situation.” There are no examples or further elaboration of this given in the guide. For unit rate, the guide gives an example in which the teacher introduces a hypothetical number of pizzas and people, specifically, 5 pizzas for 10 people and 1 pizza for 3 people. The guide indicates that students will share that “at the table with 10 people each person would get ½ of a pizza and at the table with 3 people each person would get ⅓ of a pizza.” When the guide talks about the actual task, the authors suggest that teachers ask the following question:

"If you want to sit at the table with the most pizza per person, at which table should you sit?" and to this question students will likely respond by stating a unit rate for each of the tables. Specifically, at the large table there will be "4/10 pizza per person" and "at the small table...each person gets ⅜ of a pizza." Further, to compare these unit rates, the guide suggests students may use "equivalent fractions, decimals, or percents." The phrase "common denominator" is given as well to indicate that "If students use equivalent fractions, they might use 40 as the common denominator." Also, the guide uses the terms "numerator" and "denominator" to refer to a process of division for converting the fraction in the unit rate to a decimal, specifically, the guide states, "Some students will divide the numerator by the denominator to write the fractions as decimals." The guide here assumes that students will know how to appropriately use language associated with fractions and to manipulate these numbers to write them in various forms as they solve the problem using the amount of pizza per person.

| Terms & Phrases | 2.1A CMP | Who says it? | 2.1A Classroom | Who says it? |
|---|---|---|---|---|
| ratio | "The ratio of 12 pizzas for 30 people" | student & teacher | "That's a ratio" | teacher |
| for every | "There are four pizzas for every ten people at the larger table" | student & teacher | "Four pizzas for every ten people" | teacher |
| equivalent ratio | "3 to 8 and 15 to 40 are equivalent ratios" | student & teacher | "If you do eighty, the equivalent ratio here is going to be what?" | teacher |

| | | | | |
|---|---|---|---|---|
| Scale/ scaling/ scale factor | "you can scale the larger table to 12 : 30" | student & teacher | "What's the scale factor here?" | teacher |
| Pizza per person | "If you want to sit at the table with the most pizza per person, at which table should you sit?" | teacher | | |
| | the large table there will be "4/10 pizza per person" and "at the small table...each person gets ⅜ of a pizza. | student | | |

*Figure 6.* Examples of Mathematics Phrases About Ratios in 2.1 & Who Uses Them in Problem 2.1 Discussion

In summary, in the Problem 2.1 enacted discussion on methods for solving the problem, my students have opportunities to learn about using ratios to make comparisons between two different size tables at which there are a different number of pizzas. They are exposed to mathematical language associated with ratios throughout the discussion, including establishing the meaning of the ratios. Figure 6 presents a summary of the mathematical language usage across the enacted and intended discussions. Through questions about their methods, students' responses include equivalent ratios that have either the number of pizzas or the number of people in common. This is the approach that the guide suggests teachers should emphasize. Students also have the opportunity to discuss their explanations around choosing a particular table at which they would prefer to sit, based on their desire for more pizza and the comparisons they are making between ratios representing the pizza to people relationship at each table. The teacher and the students do not discuss rate tables or unit rates as possible approaches for solving his problems, even though the guide suggests these methods are likely to come up. None of my students used these approaches, so I held off discussing them, knowing these are the

focal concepts for upcoming lessons in Investigation 2. In the next subsection, I share an analysis of one particular way in which my students and I deviated from the intended curriculum.

**Analysis of deviations from CMP in Problem 2.1 Discussion**. Through an analysis of my and my students' language compared to that in the teacher's guide for Problem 2.1, I found in many ways I used the same mathematical terms. However, I deviated from the guide in certain ways. In fact, there is one particular way in which I revoice mathematical language that has been used incorrectly by students. I analyze this particular departure and consider the ramifications this has for students' OTL, as well as, questions to consider in light of what it might mean to do right by Black students.

First, two students used the words numerator and denominator to refer to the quantities of pizzas and people in the ratios they wrote to solve the problem. As I mentioned, it seemed students used numerator and denominator to indicate placement of the numbers *a* and *b* in the ratio *a/b.* The guide uses the phrases numerator and denominator in reference to the fraction of pizza per person at each of the two tables. Also, the guide suggests using the term "constant" to refer to the a common number in the ratios; however, this term is not used in the classroom discussion. Instead, a student uses the phrase common denominator to refer to holding one of the numbers constant when finding equivalent ratios. My and my students' use of fraction language here is incorrect. I knew ideally I should eventually respond to this misapplication of fraction terminology, yet I decided not to do so within the classroom discussion on that particular day. I also revoiced my students' ideas using their words, instead of offering alternative ways to describe the placement of the quantities in the ratios of pizzas to people. Further,

I did not clarify, or ask students to clarify, that reference to the numerator and denominator implies we are talking about a number representing a part to whole relationship, as opposed to what we actually are talking about, which is two quantities, pizza and people, that represent a comparison between two numbers, a and b in a/b.

I acknowledge that this decision impacted my students' OTL accurate mathematical terminology associated with ratios, particularly rates. I could have made different decisions. In deciding what to do, I took into consideration what it meant for students' mathematical learning experiences when they are corrected in a discussion in front of their peers. In the moment, I was concerned about the time involved in addressing the usage of fraction language. Further, I knew that adults struggle with these subtle differences between a number, as in a fraction, and two different quantities, as in a ratio. My awareness of the challenges around these concepts stems from the labored conversations I remembered having in the middle school methods course I taught as some of the teacher candidates grappled with these concepts. These teachers, some of whom had undergraduate degrees in mathematics, were all working toward becoming certified in middle school mathematics (grades 4-9). Also, I was aware that the language of numerator and denominator are primarily utilized in elementary and middle school math classes to capture ideas of fractions. As students move on to algebra this language is often left behind and replaced with symbols, such as, in *a/b*, and methods for defining the symbols. How I chose to manage this situation though is a concern and raises questions in thinking about how the misapplication of language impacts students' OTL.

The two students in the conversation who used the words numerator and denominator when referring to the ratio of pizzas to people probably did so because this

language and notation is familiar to them. In some way this may have served as a springboard into navigating ratios to solve the problem. I think in particular of the first student, Kayla, who used these phrases. In class she is rather quiet. She does not often volunteer and when she has shared, often students have to ask her to repeat what she said because she speaks quietly. I can also remember several times classmates telling her to speak up in a way that made Kayla feel embarrassed. I called on her group to share without any of the students in the group volunteering. When Kayla shares her mathematical thinking, in general, I sense hesitation and insecurities. This was certainly a part of my decision not to correct Kayla in the conversation. I also think revoicing her words, in part, came from me wanting to affirm her. Yes as I analyze this situation in terms of students' OTL, I also know by not addressing this misuse of words, I may deny students an important opportunity in that moment to clarify their language and learn correct terminology and meanings of terms associated with particular content.

Through reflections on the ways that I could have talked with my students about the mathematical terms numerator and denominator, without directly correcting Kayla, I thought about bringing to their attention that the teacher's guide uses these terms differently. I could have shifted the conversation to the language used in the guide around unit rates, specifically, 4/10 pizza per person and 3/8 of a pizza per person. I could have asked students what is different about the way the CMP authors use numerator and denominator when referring to a fraction of a pizza per person. I knew though if I had gone this route, then the unpacking of fractions and associated mathematical terms used to talk about fractions would have likely been the focus of the remaining time slotted for our summary discussion. As I think about what it means to do right by Black students in

these types of instances, I wonder what teachers should take into account when deciding how to address wrong ideas, and in particular an overgeneralization of language from one concept to another related concept. Specifically, when I think of this situation in light of questions of access and equity for Black students, there are certain questions that come to mind.

First, when thinking about the mathematics register as a language of power, how do teachers ensure Black students have access to this language? How should teachers of Black students manage situations in which misapplication of language creates access to or engagement in a dialogue about mathematical problem solving, yet in turn undermines accurate adoption of the language? What role should students' past negative experiences in schooling and their mathematics disposition have in a teacher's decision of how to address the misuse of mathematical language by students? How do teachers ensure a safe space for students to make mistakes in discussions, particularly in how they talk about the mathematics, without discouraging student participation?

## Discussion and Conclusion

Students' OTL mathematics is dependent, in part, on the particular mathematics made available to them, including the ways in which the teacher and the students engage with the mathematics register (Gee, 2008). In a classroom using a reform curriculum, such as CMP, the summary discussions are a time when students can gain exposure to language relevant to the content under study and hear how it is being used, as well as, try out mathematical words and phrases through problem-solving within real-world contexts. Students who have had limited experiences with using mathematics language in dialogue might not have the same ease or knowhow as fellow students who have had more reform-

oriented experiences in mathematics classes. For instance, if we consider the sociocultural and historical realities of systemic and individual racism (see Lozenski, 2017 for further discussion), then the question of 'What are Black students' opportunities to learn through discussions?' is a question of access; that is, access to the words being used in a mathematical context to communicate ideas about mathematical concepts, as well as, access to the context itself. As I considered what words were being used and how language choices were giving or impeding Black students' access, I found that I deviated from the intended curriculum in an attempt to create access. I was letting go of some of the technical mathematical language, as well as adapting the relevant ordinary language used to communicate mathematical ideas. While it is not uncommon for teachers to deviate from the intended curriculum (see Remillard, 2005 for further discussion), by doing so teachers are creating particular opportunities to learn that may be different from the opportunities the curriculum authors created. Based on an analysis of the intended discussions according to the CMP teacher's guide and the enacted language in three summary discussions in my classroom, I discuss here considerations for mathematics teachers using discussions, in general, in light of what it might mean to do right by Black students.

**Sacrificing Precision to Foster Familiarity & Value Students' Thinking**

At times in the enacted discussions, I use more common language when referring to mathematical concepts than that offered in the teacher's guide, and I revoice my students' language, which sometimes includes a misuse of words. While I work hard to give students opportunities to talk about the mathematical concepts for which the guide recommends teachers focus, these instances point to a lack of precision at times in my

academic terminology. However, many of the language choices that I made were aimed at making the conversation feel familiar and accessible. I worried that previous negative experiences in mathematics that my Black students have had might result in feelings of intimidation with mathematics, and particularly the language of mathematics, which can feel to some like learning a foreign language. While I do not agree with arguments that Black students' use of Black English Vernacular is what creates a disconnect with the mathematics register (see Orr, 1987), systemic racism and generations of inequitable opportunities have led to disparities in Black students' outcomes in learning mathematics (see Lozenski, 2017 for further discussion). Also, learning mathematics while Black plays a role in the ways in which Black students may come to have negative feelings about school mathematics (see Martin, 2000). These feelings can lead to disengagement (Delpit, 2012). Specifically, Delpit (2012) states "When we attempt to improve achievement in African American students, we must take into consideration not just academic issues but issues of psychological trauma caused by living in a society in which black people have been stigmatized." (p. 20).

Thus, if mathematics teachers are thinking how they can do right by Black students, then it seems essential to find a balance between mathematical precision and ways to foster access and student engagement through language. For me, this became a dilemma. I know precision in mathematics is important, particularly with language. I also know that hearing the academic register associated with teaching mathematics can preclude student involvement in discussions, particularly if the language induces anxiety or fear. Yet, when a teacher does not use precision in his/her mathematical terminology, there are ways in which students' opportunities to learn are constrained. This is

particularly essential when thinking about equity as it relates to Black students' opportunities to learn mathematics. While there are ways in which using language that feels familiar to a particular group of students, such that students feel they can readily understand and engage in the mathematics, can create access to learning particular mathematical concepts, I am left wondering several questions about forgoing precision to create access. Specifically, I wonder at what times does precision matter more than other times? Are there times when creating access should be the priority? These are certainly questions to consider as a teacher facilitates mathematics discussions while keeping in mind how he/she can do right by Black students. I turn now to a discussion on my interpretations of some of assumptions made by the CMP authors in the two lessons under investigation. I discuss concerns about the way these assumptions may inhibit students' opportunities to learn. I reflect on how teachers might deviate from the curriculum to avoid excluding Black students from learning this particular mathematical content in discussions.

**Overcoming Assumptions Made by the Authors of a Reform Curriculum**

In my comparison of the language in the intended and enacted discussions, I found that the CMP authors made certain assumptions about students' knowledge that may have impeded my students from readily accessing the content. For instance, the authors' assumed that students would be familiar with mathematical comparisons in real-world advertisements, which in their eyes would make problem 1.1, the first lesson in the Comparing and Scaling unit, easy to access. This is not what I found though for my students. The low participation levels as compared to the other conversations and the way my students relied on reading the statements rather than sharing their interpretations led

me to conclude that they did not have the type of familiarity that the CMP authors assumed. Overcoming the negative consequence of exclusion from the mathematical concepts in the lesson, that can occur due to these assumptions, is something I attempted to address. Although maybe not ideal, I took on an explanatory role and did a lot of the talking in the conversation. There are certainly other ways I could alter the lesson in the future to scaffold entry into the problem. I also could alter the context and the way in which students are asked to engage with data in order to foster more familiarity and to get at different types of comparisons in ways that feel more genuine to real-world experiences. Already it feels like much needs to be done to address the assumptions in CMP, and this is not the only alteration needed.

What is more, I found when discussing the concept of the difference, the authors assumed students would readily grasp a simple example involving different sized data sets to make sense of the way in which the meaning of the difference between two quantities changes depending on the size of the data. Further, the CMP authors conveyed a belief that percents are easy to understand, suggesting that students would be able to visualize percents and understand the multiplicative comparison being made in a percent. Finally, in the teacher's guide for both Problems 1.1 and 2.1, the authors' suggestions of the language and justifications students will use to answer teachers' questions indicate assumptions about students' knowledge of the mathematics register.

In order to overcome the assumptions about the difference example and percents, which I felt could hinder my students from accessing the task and the particular mathematical content within the task, I found myself in the moment creating in-depth scenarios in the discussion to explore with my students. This required time, hence

altering at times what we could discuss. And once again, I found myself doing a lot of the talking, particularly in the first discussion on Problem 1.1, not something that is touted as ideal in reform-oriented mathematics teaching (Schwartz & Bransford, 1998). I also abandoned some of the language and ideas from the teacher's guide in order to focus in on the main big ideas of making sense of additive and multiplicative comparisons. I made these pedagogical decisions in hopes of overcoming the CMP authors' assumptions about students' background knowledge that I worried would preclude my students' access and engagement in learning the particular mathematics in the problem.

What does this mean for mathematics teachers using reform curriculum with populations of students for whom the authors' assumptions may not apply? I look to Delpit (1986) who calls into question progressive reforms that fail to take into account the lived experiences of people of color. Delpit (1986) is specifically speaking about progressive writing and literacy approaches, but I think her argument relates directly to reform-minded mathematics curriculum and pedagogy, as well. I see the connection as I consider my interpretations of the assumptions present in the CMP teacher's guide. Granted I only examined two lessons, and I focused primarily on the suggestions for orchestrating discussions. Yet, as the teacher of record for the year, I can say that this situation did reoccur in some of the lessons throughout the year. That is, students at times displayed uncertainty with the tasks and I relied on my own pedagogical and content knowledge, not suggestions in the text, to help my students past the challenges in grasping the contexts and the mathematics in the problems. Also, my students did not readily give the types of responses that the CMP authors suggest. With an eye toward wanting to do right by Black students, particularly in low-income urban schools and in a

low-track class, I conclude that more needs to be done to honor the experiences of marginalized students. While ideally this would occur on an institutional level, such as in modifications to CMP that take into account what are the best approaches for particular populations of students. Most likely though changes to the curriculum and pedagogy will come from individual teachers who see the needs of their students and seek out ways to make adjustments.

**Ownership of the Math Terminology: What Does This Say About Students' OTL?**

Overall my students did not use the mathematics register to the same degree as the teacher's guide suggests they would. There was one discussion that was somewhat of an exception. Specifically, on the second day of the discussion for problem 1.1, when asked to make an argument about the best possible statement to advertise a type of cola, students incorporated mathematical language, and they did this as they critiqued others' mathematical ideas and provided justifications to support their claims. Students' OTL involve not only hearing the mathematics language and meanings in a relevant context, but also having the opportunity to use the mathematics register (Gee, 2008). Knowing this, I worried that my students not taking up the language and representations that CMP assumes they will means the OTL that the CMP authors assume students have are not the opportunities available to my students. This is an issue of equity. I knew though that it could be that it is early in the unit and the students have not yet had enough opportunities to engage with the relevant mathematics register. I acknowledge that it may just take time to develop a familiarity with this new content. Yet, I also think it is important to consider what teachers could do differently to address concerns around students opportunities to use the mathematics register.

I began to wonder about the approach that Ms. Martinez took with her fifth grade ELL students in the study conducted by Khisty and Chval (2002). I know that she relied heavily on doing the talking early in the year, strategically and constantly using mathematics language as a way of enculturation into a language of power. I did not do this. From the beginning of the year, I worked at encouraging my students to do the talking during discussions. I tried to put the ownership of the conversations on them, asking students questions or indicating that they should think of questions to ask each other. I also know that I had a tendency to use language that made students feel comfortable, as if we are just sitting around having a conversation about a fun topic, that is mathematics. I see though how Ms. Martinez approached discussions differently and it seems from this her students likely had different opportunities to learn than those in my classroom.

Knowing that questioning approaches can shift students' OTL (e.g., Martino & Maher, 1999), I wonder if my questioning differs significantly from the guide and because of these differences, the students give answers that deviate from what the guide anticipates. While an analysis of my questioning is beyond the scope of this paper, I do think a cursory glance tells me that at times the questions I asked are different than the guide and hence could possibly explain students' limited use of mathematics terminology. Interestingly, many of the questions I asked are very open-ended and as I glance at the questions in the CMP teacher's guide, it seems many are funneling questions. While the literature attends to focusing and funneling questions (e.g., Wood, 1998), maybe there are types of questions that do not fall into either category. In other words, are there open-ended questions that are too broad and are possibly met with

uncertainty as to how to address the question? This is certainly an important consideration for future research. I turn now to offer some concluding remarks about the lessons learned through this research project. While I cannot generalize what I see in the data with one teacher in one classroom, I can offer considerations for educators and researchers in thinking about what it might mean to do right by Black students.

## Final Concluding Remarks & Implications

Since graduate school, I adopted a belief in using reform-oriented curriculum and pedagogy with marginalized students. I felt that the real-world scenarios would be ideal to engage this particular population of students, in that it could help students see how math is relevant to everyday situations. I also felt it gave students opportunities to develop critical thinking skills within mathematics; thereby shifting what it means to know and do math. Also I thought reform teaching would provide students with opportunities to become experts not only in how to do the math, but also how to talk about mathematics, including ways to justify an idea and to critique others' ideas. However, from this work, my views of reform-oriented instruction have shifted. I see more clearly Delpit's (1986, 1988) argument that White researchers and teachers with progressive ideals for teaching mathematics with marginalized students do not always fully understand what it means to effectively teach minoritized youth. I am not claiming that reform-minded approaches should no longer be used with marginalized students. However, I think researchers and teachers need to consider that reform curriculum are written with a particular type of student in mind. Specifically, the authors of CMP seemingly created the curriculum with White middle-class students in mind. I recognize that me saying this might make people uncomfortable, but I think it is important to

recognize how the assumptions in CMP are in essence showing implicit biases toward White middle-class students from the standpoint of cultural capital and privilege.

In order to continue my quest to be an ally, I think of this research as a lesson in wrestling with Whiteness. More specifically, using a critical lens to evaluate and modify reform mathematics curriculum and pedagogy, with questions of access and equity for Black students in mind, is one step that can be taken. This means addressing the assumptions that can preclude marginalized students from accessing and engaging productively with the mathematics content. Also, this means critiquing the suggested language in curriculum and teachers' language in classrooms, and determining how to draw on language approaches in discussions that do work with marginalized populations to create not only opportunities to learn big ideas but also the mathematics register. Further, this work points to the need for more research and more training for teachers on ways to adjust a curriculum so as to adapt to marginalized students' needs, with a focus on access and equity in students' OTL. Also, there needs to be more community outreach to parents and community members in order for (White) teachers to develop a better understanding of the experiences of parents and students in learning mathematics. In conclusion, Martin (2007) cautions the answer is not White educators attending to what they think their Black students need and, inadvertently, failing to provide students with the necessary access to a language and culture of power in mathematics. Rather, as Delpit (1986, 1988) reminds us and research findings suggest (e.g., Clark, Frank, & Davis, 2013), these conversations need to include researchers and educators of color who come from a strength-based mindset and who understand the sociopolitical and historical realities of systemic and individualized racism and inequalities (Delpit, 1986, 1988).

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# Chapter 4: "You Have to Share the Love": How One Teacher Attempts to Do Right By Black Students in Mathematics Discussions

## Introduction

Leinwand (2014) in an NCTM publication, *Principles to Actions: Ensuring Mathematical Success For All*, contends that the essential elements for creating access and equity in mathematics education involve giving all students an opportunity to engage in a rigorous curriculum. Further, the NCTM in this publication calls for "classroom environments that foster a sense of community that allows students to express their mathematical ideas – together with norms that expect students to communicate their mathematical thinking to their peers and teacher" as this will "positively affect participation and engagement among all students" (p. 66). My research focuses on better understanding the dynamics at play in whole class discussions with an eye toward a teacher's actions to promote equity around participation. As a White teacher-researcher using the Connected Math Project (CMP) in a low-track mathematics classroom in an all-Black urban school, I look at how my practices in facilitating discussions send particular messages to students. By examining how students perceive this messaging, I consider how a teacher mediates the relationship between students' perceptions of their mathematical ability and their participation in discussions.

In a reform-oriented middle school mathematics classroom, there will be variability in students' participation in the whole class discussions. Lampert (2001) speaks of this variability as something a teacher manages as she attempts to teach the whole class while also attending to individual students' learning needs. Turner and Patrick (2004) find that students' participation occurs as a result of "the interaction of

both characteristics of students and of the learning environment" (p. 1759). Also, when I think of equity in discussions, I do not take it to mean that each student has the same experience. Even though I use equitable participation, giving all of my students opportunities to engage in both listening and talking about the mathematics, how they experience the discussions feels different depending on various other factors. One such factor that I investigate is students' perceptions of their mathematical ability.

I also conduct this work with an eye toward "doing right by" Black students. I use this phrase to capture a way of thinking about creating opportunities and experiences for Black students learning mathematics that go beyond the notion of equity. I aim to consider how educators can treat Black students in an ethical, just, honorable, and empowering way. It is a phrase for me that I have heard used in Black spaces, particularly by African American middle-aged women and older, as well as, in Black literature. I adopt this phrase in my dissertation to emphasize the importance of looking beyond a White middle-class agenda in teaching Black students, and to come at questions of equity with an awareness of the lived experiences of Black people.

In considering what it might mean to do right by Black students when managing participation in whole class discussions, I examine how my actions foster particular experiences for students whose relationship with mathematics varies. In particular, I look at my students' perceptions of my decisions to call on everyone equitably in whole class discussions. I analyze the way they see these decisions, as well as, how I see their engagement in the discussions, to make sense of how I afford particular experiences in whole class discussions, and I consider the ways in which this relates to how I understand my students. I focus on two students whose participation is in some ways quantitatively

the same (i.e., both share about once per conversation) and yet qualitatively different, while also considering how I see their perceptions of themselves as mathematics learners. I attempt to address the following research question: How do a teacher's actions in whole class discussions mediate the relationship between students' perceptions of their mathematics ability and their participation in the discussions?

Participation takes on many different forms in a classroom. In this project, I am focusing on participation in whole class summary discussions. Seeing students with their hands up can look like participation in that students are indicating they have something to say. In whole class discussions, in particular, students' might also be viewed as participatory in their body language, as they make eye contact with the speakers and maybe even nod their heads in agreement or make a face to show disagreement. Students may also look like they are listening and thinking about the mathematics while pondering something entirely unrelated. While I recognize these various different ways of conceptualizing participation, for my research I define participation as students orally engaging in a mathematics conversation. By verbally participating, students have an opportunity to share their ideas, which can be a means for students to construct mathematical understandings, clarify wrong ideas, and practice expressing mathematics through talk about the content.

## Literature Review

Participation, in all its definitions, is a necessary part of learning, and it seems in most classrooms variability in participation is inevitable. Lampert (2001), during a year of facilitating mathematically productive whole class discussions, found that there was not the same type or level of verbal participation from every student. Also through a

practitioner research study design, Chazan (2000) speaks about the variability in students' willingness to participate. There are various reasons why some students are willing to verbally contribute in mathematics classrooms more than other students, and why students typically engage in different ways. For instance, students come to a classroom with different backgrounds and experiences, beliefs and dispositions, and different views of themselves as mathematics learners, all factors that are related to students' participation (e.g., Jansen, 2006, 2008; Lubienski, 2000; Martin, 2000). Relatedly, students' social groups and interactions with classmates can explain how students participate in mathematics conversations (e.g., Civil & Planas, 2004; Lampert, Rittenhouse, & Crumbaugh; 1996; Silver & Smith, 1996). Additionally, being at the middle school level brings a host of variables related to developmental tendencies that likely influence students' willingness to verbally contribute in a whole class discussion (e.g., Harter, 1990, 1999; Wood, 2007). In addition, students' participation is affected by how students experience a particular curriculum (e.g., Brantlinger, 2013). Finally, students' participation in conversations is shaped by teachers and their decisions, particularly, their practices in establishing norms, selecting who talks and when, and the ways in which they respond to students' ideas and questions (e.g., Black, 2004; Lampert, 2000; Turner & Patrick, 2004; Turner, Dominguez, Maldonado & Empson, 2013; Yackel & Cobb, 1996; Yamakawa, Forman, & Ansell, 2005). I review this body of literature and consider how my work attends to and builds on some of the current understandings about students' participation and the ways in which a teacher may influence a relationship between how students see themselves as mathematics learners and how they verbally take part in whole class discussions.

**Students' Backgrounds & Beliefs in Relation to Participation Variability**

**SES.** In the mathematics education literature socioeconomic status (SES) is a student characteristic that has been found to influence participation variability. In an examination of her seventh grade mathematics classroom using CMP, Lubienski (2000) found that engaging her students in a discussion-oriented mathematics class in which she took a non-authoritarian role had different effects on students depending on their SES. More specifically, she found that lower-SES White female students were less likely to participate and when they did they were more likely than their higher-SES White female classmates to share procedural-based responses. Further, the low-SES students also found it confusing when lots of ideas were shared in a conversation whereas their higher-SES classmates viewed discussions as helpful in their learning. Low-SES students also tended to refer to the context or even non-mathematical things, such as logistical items, rather than sharing mathematical ideas that could be generalized beyond the context.

It seems that some students are "better positioned to gain what was intended from reform-minded pedagogy" (Lubienski, 2000, p. 398). Based on students' background characteristics, they may find themselves struggling to partake in and to see the benefits of whole class discussions as compared to their more affluent classmates. These negative experiences are likely to shape how these students come to see themselves as mathematics learners.

A relevant consideration of Lubienski's (2000) work in relation to my study is the heterogeneity of her classroom, with female and male students coming from different SES backgrounds, as well as having students from different ethnic backgrounds. In order to reduce confounding variables, Lubienski only drew on white female students, with

SES differences as the object of her study. Unlike Lubienski's classroom, the students in my class are all African American in a school wide Title I school. Further, they have all scored at least two grade-levels behind on the nationally normed NWEA MAPs test. It is possible that the relationship between students' SES and the ways in which they experienced mathematics discussions in Lubienski's classroom may have been due in part to the mere existence of a large amount of variability in SES backgrounds within the classroom. Students bring certain cultural ways of being that are associated with SES (e.g., Black, 2004). Students and the teacher are likely to pick up on these differences, and this may shape the ways in which students see themselves as compared to others, the way that teachers interact with their students, and the ways in which students interact.

In fact, in a study conducted by Black (2004), there is evidence that cultural capital plays a role in the differential participation in whole class discussions. Specifically, she found that "a pupil's possession of symbolic forms of cultural capital may be a crucial factor in determining who gets to experience what type of interaction in the classroom, since it informs teacher expectations regarding pupils' ability and, subsequently, their behavior" (Black, 2004, p. 50). Similar to the work conducted by Lubienski (2000), this classroom was heterogeneous in terms of students' SES backgrounds and the cultural capital that students displayed.

**Race.** Race is salient when considering participation variability, in that, the context of a classroom and whose thinking is valued in discussions can impact when and how students of color participate (Delpit, 2012). The racial composition of a mathematics class matters in terms of marginalized students' comfort level in participating, particularly when considering Black students in predominantly White learning spaces

(e.g., Delpit, 2012; Chazan, Herbst, & Clark, 2016). Clark writes in Chazan et al. (2016), about the experiences of an African American girl, specifically, he saw her shift from an active participant and standout student in his exclusively Black and Latino general Algebra class to a silent and inconsistent mathematics student in an overwhelmingly White advanced Algebra class. It seems that teachers though can disrupt patterns of disengagement in discussions, which I return to in an upcoming subsection on teachers' practices. I share here just one example that shows when teachers have students of various academic abilities sharing in discussions and in a safe space where students do not feel judged, they are sending a message that everyone's thinking is valued. In classrooms like these, in which teachers strategically draw on equity practices, White (2003) found Black and Latino students feel comfortable participating.

Context matters, and particularly in shaping students' experiences as a function of their particular classmates and how they view themselves in relation to their peers, as well as how they are viewed relative to others. By conducting research in an understudied context, specifically a school in which all of the students are African American, this research study contributes to the literature by considering how students in this particular context experience whole class discussions. Further, by using a particular approach in attempting to limit the variability in verbal participation, this research investigates how certain other differences among students in this context, specifically, how they see their math ability, relates to the way in which they experience whole class discussions and how a teacher's messaging might inform both how students see their mathematics ability and their participation.

**Beliefs.** Sharing verbally in front of a whole class can be difficult for students as they may view it as a risk (Jansen, 2006, 2008; Turner & Patrick, 2004), particularly in middle school when students are becoming more aware of and concerned with what their peers think of them (Harter, 1990, 1999; Wood, 2007). Some researchers find students are constrained in their willingness to verbally share their thinking because they associate putting themselves out there with negative emotions (Jansen, 2006; 2008). On the other hand, students who do not have these associations have no problem volunteering and sharing their thinking (Jansen, 2006; 2008). Jansen (2006, 2008) found these differences among students in two seventh grade classrooms that were using CMP in a predominantly White, rural school. She concludes that students' beliefs about whether or not participation poses a risk either constrains or supports students' willingness to participate.

In addition, Jansen (2006) found that out of those students who had negative feelings about participating, some of them overcome their fears of the risk involved in order to meet social goals, particularly, being able to help others. This finding speaks to the teacher's role in messaging to students about the norms of the classroom and the extent to which there is a sense of community and helping each other versus competition. Understanding students' disposition toward sharing in mathematics discussions is certainly important as it helps teachers know which students may need more encouragement, and speaks to the need to create an environment that can support students who otherwise would be constrained in their participation. Further, this research speaks to a possibility of a relationship between how students perceive their mathematics ability and how they feel about sharing in whole class discussions.

This work builds on Jansen's (2006, 2008) research by examining the role of messaging in influencing participation with an all Black student body. The aim of this work though is not to study beliefs in the same way as Jansen. Instead, the focus in on how students perceive their mathematical ability in anticipation that there is a relationship between this particular student belief and students' participation.

**The Role of Interactions with Classmates in Classrooms in Participation Variability**

Certainly, the middle school age is very different from the elementary or the high school level, as there are distinctive developmental challenges for schools and teachers to consider. The range of grade levels that comprise middle school varies in different locales across the United States. In some places middle school ranges from fifth to eighth grade, yet in other areas middle school begins in grade six. Given that in some spaces fifth grade is part of middle school, this literature review attends to research involving fifth grade students. In particular, there is research that examines the influence of peers on how students participate (e.g., Civil & Planas, 2004; Lampert, Rittenhouse, & Crumbaugh, 1996). It is possible that the social influence might be even more drastic for upper-grade middle school students.

For students in the age range of eleven through fourteen, there are particular social considerations that need to be taken into account. First, "the primary developmental issue at twelve is the confusing struggle for identity," particularly social identity (Wood, 2007, p. 144). Part of identity development involves making and keeping friends, as this becomes central, moving in front of students concern for their relationship with teachers or parents. Further, middle school students are more self-aware and self-conscious than their elementary school peers, which often results in them caring more

what their peers think of them than previously. Students at this age are also in a nascent stage of new identity formation while also dealing with physical and emotional changes associated with puberty, which results, for some, in self-confidence issues (Harter, 1990). Below is a description of some findings around the relationships between social dynamics and participation in whole class discussions.

In particular, Civil and Planas (2004) found in a fifth grade classroom within a bilingual school that students' participation was affected by their social status, particularly, the subgroups to which they belonged that determined where they fit in the social milieu of the classroom. The authors indicate that their research shows "To change the patterns of participation may be very difficult when certain students have high status and their contributions are valued for who they are and not for the content, while other voices are not heard." (p. 8). Relatedly, Lampert et al. (1996) found that fifth grade students at the beginning of the year, coming from traditional classrooms into a discussion-oriented class, disliked talking about the mathematics as a group and particularly the disagreements. Her students shared that they sometimes felt embarrassed when others disagreed with their answer and they realized their answer was wrong. Lampert et al. (1996) conclude that her students were inevitably seeing disagreements as "personal assaults" (p. 744). Imagine how students in seventh grade at the age of twelve and thirteen must feel about discussions and disagreements in math class, given their heightened concern about identity and relationships. Next in this literature review is a focus on the teacher's role in shaping the participation in a mathematics classroom.

## A Teacher's Role in Participation Variability

Using a reform-oriented approach, and particularly engaging students in meaningful discussions about mathematics has been shown to be challenging for teachers (e.g., Hufferd-Ackles, Fuson, & Sherin, 2004; Sherin, 2002). Teachers' messaging within whole class discussions comes from many different decisions that a teacher makes, from how she structures the environment through the classroom norms and relationships that she establishes with her students to the actual teacher moves within the conversations that designate a certain valuing of students and their ideas. Patterns of participation in a classroom are shaped, in part, by the classroom norms that the teacher and students have constituted. Social and sociomathematical norms are typically established and maintained from a teacher communicating them directly as explicit statements of expectations for students and indirectly through modeling and in her responses to students that assign value to certain ways of being or practices that are used (Seeger & Waschescio, 1998). Further, students contribute to the construction and maintenance of such norms in a mathematics classroom by how they take up and engage with the intended expectations, therefore, together with the teacher they interactively constitute the social and sociomathematical norms (Yackel & Cobb, 1996). The ways in which a teacher interacts with and relates to her students can shape her students' views of the classroom environment, and how they engage in classroom conversations.

**Teacher as the power player**. There is a power dynamic at play in classroom discussions. Even in a reform-oriented classroom, teachers typically assume the role of controlling much of the interactions within a classroom discussion. Taking on the lead role is not inherently a bad thing (Cazden, 2001), yet it is important to consider a

teacher's actions as a facilitator given that it can impact how students individually and collectively perceive their ability to contribute to the mathematics discussions and when and how they participate in such conversations. A teacher's decision-making communicates certain messages to her students, specifically her actions around deciding who talks and when, what types of questions particular students are asked to answer, and whose ideas are taken up by the classroom for further discussion. These messages influence students' participation (e.g., Black, 2004). Participation variability likely shapes students' perceptions of their mathematical ability.

Black (2004) argues, "patterns of unequal participation in whole-class discussions may lead to the construction of different types of pupil identities within the classroom" (p. 34). Further, Black (2004) contends that, "Pupils who are consistently involved in productive interactions come to see themselves as full participants or learners, whilst those involved in non-productive interactions find themselves marginalized from the practice of classroom learning" (p. 34). The relationship between participation and mathematics identity is likely reflexive in that one influences the other, with students' perceptions of themselves as mathematics students influencing how they participate and their participation shaping how they see themselves, mathematically speaking.

We know that teachers call on students and respond in certain ways for a variety of reasons, some of which students may not always understand. It is a difficult balancing act that teachers undertake in facilitating whole class discussions as they try to use students' ideas in an equitable way while attempting to engage students in a productive discussion about particular mathematical concepts (Sherin, 2002). Lampert (2001) shares that teachers sometimes call on students to assess their understanding, to ensure students

are paying attention, to build students' confidence or to protect students from embarrassment, or to ensure that particular ideas or solution strategies are shared in a particular order. There may be other reasons, as well, depending on the time of year and where a teacher is in the process of working together with students to constitute social and socio-mathematical norms for their conversations. What is of concern, though, is that researchers have found that typically teachers call on the students who are viewed as more articulate and more capable (e.g., Ball, 1993; Baxter, Woodward, & Olson, 2001); thus, resulting in differential outcomes for students in a host of ways, including how students view themselves and how students view each other in the mathematical space and what students gain in their mathematical understandings from the conversations.

In an ideal classroom a teacher is able to send messages that value all students and their ideas equally, however, this is not typically what happens. More likely to occur are mixed messages, often which are based on which students a teacher is addressing and how a teacher interacts with each student. As might be expected, Yamakawa, Forman, and Ansell (2005) found variability in how a teacher responds to different students. The authors focused on how a teacher's revoicing communicates inconsistent messages about the classroom norms. In a detailed examination of the interactions with two students during whole class conversations about mathematics, they found differences in the ways the teacher responded to each student; thereby, communicating in front of the whole class different messages about what is acceptable in the ways in which they participate and who she believes the students are as mathematics learners. It may be the case that differences in how a teacher communicates to each of her students is based on her perceptions of students' ability (Cooper, Hinkel, & Good, 1980).

**Evaluative messages**. In addition to the inconsistencies in establishing and maintaining norms within a reform-oriented classroom, Turner and Patrick (2004) have found that teachers' messages about expectations for students varied across students. By communicating different expectations, a teacher positions students in different ways within the classroom community. The authors used goal theory as a way to better understand how teachers' decisions in structuring their classrooms, along with students' personal goal mindsets, can shape how students participate in classroom activities. Their findings indicate that "student participation is malleable rather than stable," and there is "the potential of teacher practices to both support and undermine the development of student work habits," specifically in the case of participation (p. 1759).

In their literature review, Turner and Patrick (2004) indicate that "research in goal theory has found unequivocally that the most positive student outcomes occur in classrooms with high mastery goal structure," which refers to a teacher messaging to students that their learning and understanding is more valuable than performance, and that success is determined by effort and improvement instead of by getting the right answer with a certain rapidity. In their research, though, the authors found that "teacher practices, particularly patterns of calling on students (e.g., unequal calling, volunteers vs. non-volunteers), can attenuate those positive messages by limiting opportunities for some students to participate and be involved in the learning process" (Turner & Patrick, 2004, p. 1782). Therefore, structuring a class in a particular way does not guarantee equity in students' experiences. Teachers must also consider who they call on, when, and why, as this too affords or constrains students' participation and how they view their ability to participate in the mathematics.

What is more, when teachers attempt to use a reform-minded curriculum and practices, research shows that often teachers are still communicating evaluative messages in whole class discussions, specifically, telling students when they are right or wrong, which results in some students viewing participation in conversations as a risk, for fear of being wrong (e.g., Jansen, 2006, 2008). Evaluative messages that communicate disappointment or blame students have also been shown to constrain students' willingness to participate. Turner, Meyer, Midgley, and Patrick (2003) found that students had negative affect and avoidance behaviors around participation in a classroom in which their teacher used negative discourse toward students as compared to another sixth grade classroom in which a teacher, using the same curriculum and classroom structure, consistently offered motivational discourse, including praise for effort, for supporting each other, and for being willing to make mistakes and to ask questions. Evaluative messaging has a role in students' experiences in a given mathematics classrooms, with the possibility of shaping how students see themselves as mathematics learners and how they view mathematics conversations. Further, evaluative messages communicate to particular students a valuing or devaluing of their contributions; thereby positioning students in inequitable ways.

It is clear that participation variability exists in classrooms and there are many factors that can explain such variability. From here, there is another possible explanation to explore and that is students' perceptions of their mathematical ability. This is one theoretical component of mathematics identity. There is an assumed relationship between this construct and students' participation variability. Below is some of the relevant literature on students' mathematics identity, more broadly, as a function of students'

participation in mathematics discourse, with a specific focus on the role of this construct in the experiences of Black students.

**The Role of Participation in Shaping Students' Mathematics Identity**

Academic identity is a central construct in explaining Black students' success in school (e.g., Perry, Steele, & Hilliard, 2003). In terms of learning mathematics, Black students experiences are impacted by various components of what Martin (2000) refers to as mathematics identity. He defines mathematics identity in the following way:

> Beliefs about (a) their ability to perform in mathematical contexts, (b) the instrumental importance of mathematical knowledge, (c) constraints and opportunities in mathematical contexts, and (d) the resulting motivations and strategies used to obtain mathematics knowledge (p. 19).

Mathematics socialization is how students develop mathematics identities through "sociohistorical, community, school, and intrapersonal contexts" (p. 19). Clark, Badertscher, and Napp (2013) illustrate ways in which teachers', particularly African American teachers', presence and teaching practices shape their students' mathematics identities. Further, Clark et al. (2013) found that even with different approaches of mathematics socialization, teachers' strategic efforts can positively inform students' perceptions of their mathematical abilities. In particular, one of the teacher's in their case study felt that positive feelings about math ability is related to students seeing the classroom environment as a safe space in which they can participate without feeling disrespected. The second teacher saw that by using cognitively demanding tasks she was

sending a positive message about what students are capable of doing, hence informing their perceptions of their mathematical abilities.

In addition, the ways in which students interact with each another and with the content shape students' mathematics identities. Bishop (2012) finds that student discourse has an important role in the enactment of students' mathematics identities. Similarly, the way in which students are positioned by the teacher and each other informs students' development of mathematics identities (e.g., Turner, Dominguez, Maldonado, & Empson, 2013). Further, the learning environment and particularly the way in which students come to see each other as equitable participants informs how students see mathematics and themselves in relation to mathematics (e.g., Boaler & Staples, 2008). I describe now a conceptual framework for one theoretical component of mathematics identity, specifically, students' perceptions of their mathematical ability.

### Conceptual Framework: Students' Perceptions of Mathematics Ability

Within mathematics classrooms in which students are provided with opportunities and expectations to reason, debate, and revise their thinking through discussions, students adopt a particular understanding of what it means to do mathematics (Boaler, 1999), and students form a particular perception of who they are as mathematics learners within this type of learning environment (Black, 2004). Both of these aspects of students' perceptions are part of what Martin (2000) refers to as *mathematics identity.* In recent years, several related conceptualizations of this construct have emerged (e.g., Anderson, 2007; Chazan et al., 2016; Cobb, Gresalfi, & Hodge, 2009; Gee, 2000), and typically include four to five aspects of a student's beliefs as it relates to what it means to do mathematics and how students see themselves in that realm. In this project, the focus is

on only one aspect of students' mathematics identity, and that is how students think of their ability to do mathematics. Drawing on Martin's theoretical framework for mathematics identity, Clark (2016) refers to this one theoretical component as *students' perceptions of their mathematics ability.*

This is a dynamic construct that is continually changing, making it difficult to pin down a way of knowing how students see themselves in relation to mathematics. Acknowledging this ever changing nature of perceptions around students' mathematical ability, interviews may not entirely capture the moment to moment shifts that can occur as students may feel competent or may doubt their abilities within a mathematics lesson. In this research, the intent is to gain a sense of how the students may view themselves, knowing that stability in these perceptions is not expected.

From Clark's (2016) framework, there are four aspects of students' thinking to consider in unpacking students' perceptions of their mathematical ability (see Figure 1). First, group affiliation is one of the areas that relates to how students come to see themselves in relation to mathematics. More specifically, this refers to race, gender, SES, family history, neighborhood, and any other groupings that are salient to a particular individual in regard to their perceptions of their mathematical ability. Another aspect of this construct is students' perceptions of their peers' or classmates' ability levels. This serves as a reference point for students, from which they draw conclusions about who they are, mathematically speaking, in relation to others. This can change if students move to a different school or a different class (e.g., Chazan et al., 2016). Another facet to consider is students' perceptions of the source of mathematics ability. For instance, if students view ability as malleable, something you can alter through hard work, they are

likely to see their own mathematical ability differently from those students who view the origin of their ability as part of genetics. Finally, Clark (2016) includes how students perceive the difficulty level of a particular mathematical task or set of tasks. This speaks to students' perceptions of their mathematics ability because it captures how they view their relationship with particular mathematics.

According to Clark (2016), teachers' messaging plays a role in the ways in which students come to perceive their mathematical ability. Further, Gresalfi, Martin, Hand, and Greeno (2009), find that students' perceptions of competence are constructed through a teacher and her students' interactions in a given classroom. From this perspective, the classroom environment and the interactions play a big role in shaping how students come to view their perceptions of their mathematical ability.

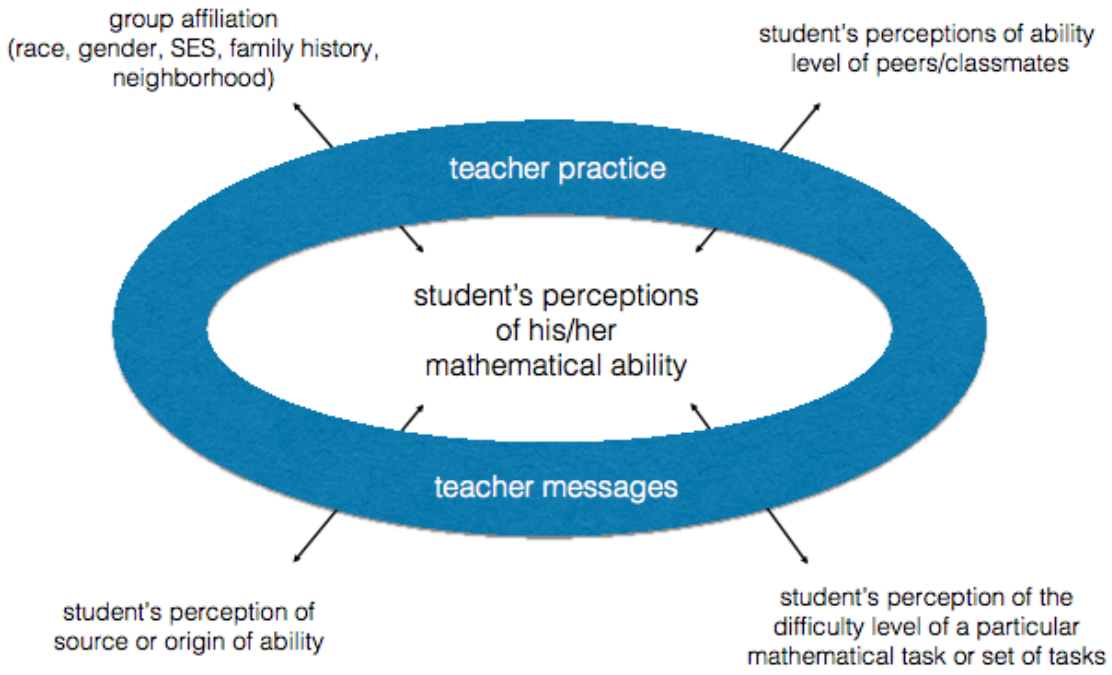


*Figure 1.* Conceptual Model for Students' Perceptions of His/Her Mathematical Ability (Clark, 2016)

## Methods

### Context & Participants

I refer to the school-wide Title I school where this research takes place as Applegate. All of the students at Applegate are Black. In Chapter 1, I shared information about the school and the neighborhood, as well as more detailed demographic details about the students and teachers. Here I describe some of the relevant factors that are part of a particular culture that is evident at Applegate. I do not think this culture, referred to as the Applegate-way, is typical of most urban public middle schools. See Chapter 1 of

my dissertation for an in-depth description of what sets Applegate apart from other schools.

First, Applegate was founded by a group of teachers and a principal. Of the five founding members, only one is Black and she specifically identifies as Kenyan. The founding members request that teachers use harmonicas to signal they want students' attention. They also do not want teachers raising their voices at students. The goal in this is for teachers to model how they want students to treat each other. Also, the founding members implemented an advisory model, in part, to guide students in learning particular social skills, such as, being kind, standing up for what is right, and accepting others' differences. Advisory meets weekly and is a big part of the Applegate culture. I think it is important to point out though that I see middle-class White culture and values, particularly as it relates to interactional styles and language, infused in some of these practices at the school. I say this because I want to be clear that I still think Applegate has a lot of work to do around grappling with Whiteness in some of the messaging that at times devalues Black culture, values, and experiences. With this said, not all of the students respond well to the advisory lessons. There are some students who actively protest advisory, and I think it is, in part, because of these issues.

Using a practitioner-research design, I conduct this research with the students from my seventh grade low-track mathematics class at Applegate. There are 17 students in the class. One of the female student's parents opted for their child not to participate in the research; therefore, I do not include her dialogue in the transcripts. Of the 17 students, 10 are boys and 7 are girls. There are 7 students with individualized education plans (IEPs), which means they receive special education services. The special educator, Mr.

O, pushes into my class two days per week for about half of the class period. When he is present, we often break into small groups and he offers support to not only students with IEPs, but also students who have been struggling with the particular concepts we are studying at the time. He usually works with 5-6 students, whereas, I circulate with the remaining group of 11-12 students who work with partners or in groups of three (see Chapter 1 for more details on the structure of the CMP lessons).

**Data Sources & Selection Criteria for Interviews**

There are two sources of data for this research. The first data source is videos and transcripts of whole class summary discussions from eleven CMP lessons, three from the Accentuate the Negative unit and eight from the Comparing and Scaling unit. The former is a unit on understanding and operating with positive and negative numbers and the latter is a unit on ratios and proportional reasoning. These whole class discussions were recorded in the spring semester of the 2014-2015 school year. Each discussion is about 20 minutes in length, and was transcribed using the MAXQDA software.

The second data source is interviews conducted with six out of the 17 students in my class. These interviews were conducted in the spring of 2016. I interviewed each student once and each interview lasted approximately 30 minutes. These interviews took place one year after the video recordings of mathematics discussions in our classroom. At the time of the interviews, the students had all moved on to eighth grade and I was no longer a teacher at Applegate. This decreases the likelihood of a power dynamic in which students might refrain in certain ways when being interviewed by their teacher who

determines their grades for a class. It still may be the case though that the students felt constrained to say certain things to me given the role of interviewer and interviewee.

In the interviews the students were given an opportunity to view several video clips as a way to stimulate their recall of the classroom dynamics. I also asked questions that allowed them to compare their experiences in current mathematics class to the prior year, as a way to help them reflect on and remember their experiences from our class. I had two primary goals for the interviews. First, to develop an understanding of how students view mathematical ability and particularly how they see their ability in learning mathematics and, secondly, to get a sense of how students view their experiences in the whole class conversations in our class. I audio recorded and transcribed each interview.

I decided to interview six students as I felt this would allow me to hear from three male and three female students, and giving me a range in students' mathematics performance, as well as, in their eagerness to share in whole class discussions. Therefore, I selected who to interview based on students' gender, scores on the NWEA MAPs test, and my perception of their tendency to volunteer in discussions. The NWEA MAPs assessment is given three times a year at Applegate to compare students to nationally normed data intended to identify the grade-level students are performing on in mathematics. I first considered NWEA MAPs scores separately for males and females, and then looked for some variation in the degree to which I remembered students attempting to share in whole class discussions.

Before examining the NWEA MAPs data, I purposefully decided I would not select Stacey because she had only recently joined our class from a self-contained class and of course I could not include the female student who opted out of participating in the

research. Table 1 is a list of the students in the class and their winter NWEA scores. The star by students' names indicates they have an IEP. The grey shading indicates the six students I selected. In making this decision, I looked first at female students, and selected Jada who of the remaining five female students had the lowest NWEA MAPs score and was a student who I rarely remembered volunteering. Next, I selected Sasha who had the highest NWEA MAPs score and consistently volunteered to share. I also chose Tasha. Her NWEA MAPs score was the median when looking across the seven female students in my class. Tasha is a student who I remembered volunteering quite a bit. In terms of male students, I selected Keontay because he had the lowest score on the NWEA MAPs test. He is someone who I felt often volunteered, and he frequently called out questions when he was confused about something in the discussions. Next, I selected Malik given he had the highest NWEA MAPs score for male students. I remembered that he too volunteered quite a bit. In selecting a third male student to interview, I looked at the median male score and this brought me to Michael and Nate. I wanted to have someone who did not frequently volunteer. I chose not to select Michael as he was a student who often volunteered to share. Instead, I selected Nate. He rarely volunteered except in the Accentuate the Negative unit. I felt though by including him, this gave me more of a range in the types of participation that I saw in my class.

Table 1

*Winter NWEA MAPs Scores*

| Name | Score |
|---|---|
| 1. *Keontay | 191 |
| 2. Eddie | 202 |
| 3. *Talib | 203 |
| 4. *Stacey | 203 |
| 5. Female student who opted not to participate | |
| 6. *Lamar | 207 |
| 7. *Nate | 207 |
| 8. *Michael | 208 |
| 9. Jada | 208 |
| 10. Tasha | 210 |
| 11. Kayla | 211 |
| 12. Devon | 213 |
| 13. *Bobby | 214 |
| 14. Marcia | 216 |
| 15. Jason | 220 |
| 16. Malik | 221 |
| 17. Sasha | 232 |

**Preliminary Analysis & Selection Criteria for Case Studies**

I deductively coded the interview transcripts using the following codes from Clark's (2016) framework on perceptions of mathematics ability: group affiliation, perceptions of peers' mathematics abilities, origin of mathematics ability, and difficulty level of mathematics content. From this I wrote an analytical memo that comprehensively captured the ways in which I saw my students' perspectives on these four aspects that informed how I understand students' perceptions of their mathematics ability. I also examined the eleven videos to look more closely at the participation of the six students. In four of the videos, the positioning of the camera kept me from viewing all six students. Therefore, it was not possible to use these four videos to capture the participation of the

six students. Also, in two videos it was evident that two or more of the six students were absent, therefore I excluded these discussions. This left me with five classroom discussions with video recordings, one from the Accentuate the Negative unit and four from the Comparing and Scaling unit. From these videos I tabulated the frequency of times each student volunteers and how often each student shares. See Table 2 for this frequency data.

Based on (1) the way I interpreted how my students talked about perceptions of mathematics ability in the interviews and (2) the participation data, I decided to select two students who I felt were interesting cases in regard to how students' perceive my practices in whole class discussions. There were some common themes in all of the interviews, although these two cases when compared to each other illustrate a teacher's role in both affording and constraining students' opportunities to participate in her attempts to create equity in whole class discussions. These two students were Jada and Sasha. As Table 2 shows, I selected Jada four times and Sasha three times to share across five discussions, yet Jada only volunteered once and Sasha volunteered 18 times. Further, in my preliminary analysis of their interviews I saw related themes when they talked about my practice in facilitating discussions, and yet as I began to unpack these themes their descriptions of their experiences are qualitatively different. More specifically, it seemed they had different views of themselves as mathematics students and how they saw their engagement in learning mathematics, in general, and in mathematics discussions specifically.

Table 2

*Frequency Table of Participation From Students Participating in Interviews*

| | ATN 2.3D | | CS 1.1A day 1 | | CS 1.1A day 2 | | CS1.3A | | CS 2.1 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | # of times volunteered | # of times called on | # of times volunteered | # of times called on | # of times volunteered | # of times called on | # of times volunteered | # of times called on | # of times volunteered | # of times called on |
| Keontay | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 1 |
| Jada | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 |
| Nate | 5 | 2 | absent | | 0 | 0 | 0 | 1 | 1 | 1 |
| Tasha | 3 | 1 | 2 | 0 | 5 | 2 | 2 | 1 | 2 | 1 |
| Malik | 7 | 2 | 3 | 2 | 3 | 1 | 5 | 1 | absent | |
| Sasha | 3 | 1 | 5 | 1 | 3 | 0 | 6 | 1 | 1 | 0 |

## Data Analysis

From the five videos, I selected one video to use as an example of how Jada and Sasha might engage in a whole class discussion. I chose the video of the discussion from Investigation 1.3 in the Comparing and Scaling unit from the CMP curriculum. In making this decision, I excluded three videos for the following reasons: (a) in the Accentuate the Negative (ATN) video Jada is sitting up tall the entire conversation and volunteers to share at one point, which was not common, (b) in the Comparing and Scaling video for Investigation 1.1 on day 2, I do not select Jada or Sasha to share in this discussion, so I felt this could not serve as an example of how they participated and (c) in the CS discussion from Investigation 2.1, Sasha only volunteers once, which was rare for her, and I do not call on Sasha to share. This left me with Problem 1.3 or 1.1 day 1 from the CS unit. I have already written extensively about the whole class discussion from problem 1.1 in another project (see Chapter 3), and I felt I should exclude it based on the nature of that discussion. Specifically, it was the first lesson in the unit and I did a lot of the talking due to what I perceived to be students' uncertainty with the task. Further, when students did share, they often would read the comparison statements verbatim from the student text. I felt that the summary discussion from problem 1.3 could serve as a nice

example of the experiences of Jada and Sasha in whole class discussions. I examined this video closely and wrote a narrative description of what I saw in their body language, including when they raised their hand to volunteer, and how I saw them listening or attending to other speakers, as well as, what their posture and body language suggested in terms of engagement. I also examined the type of question I selected them to answer and what they shared.

As I previously mentioned, to get at how I understand students' perceptions of their mathematical ability I used MAXQDA software and deductively coded the interview transcriptions for all six students using the following codes from Clark's (2016) framework: group affiliation, perceptions of peers' mathematics abilities, origin of mathematics ability, and difficulty level of mathematics content. I also inductively coded what students said about my teaching practices and students' experiences in whole class discussions. The following themes came up: in our class we help each other, everyone has a chance to share ideas, it is okay to be wrong, and feeling frustrated when I'm not called on. I wrote analytical memos on how I understood students' perceptions of their mathematical ability. I then wrote separate analytical memos for Jada and Sasha. From these memos, I felt I could make claims about what I was seeing based on what Jada and Sasha were saying. I followed the same process for how I thought each student views my teaching practices and students' experiences in whole class discussions. By looking at what was happening in our classroom discussions from the videos and transcripts, alongside students' reflections on their relationship with mathematics and their recollections of experiencing whole class discussions in our class, I make claims about

how I mediate a relationship between students' perceptions of their mathematical ability and their participation.

## Data Presentation & Analysis

Unlike other classrooms in which teachers call on the students who are the most likely to share correct solutions or important ideas, I took a different approach. I tried to ensure there was equity in students' opportunities to participate. I did this by giving different students a chance to engage in the conversations. Sometimes I selected students who were volunteering, but often I did not. This is evident in the quantitative data on students' frequency of participation (See Table 2 in Methods section). I aimed to give opportunities to students who might not typically be called on to contribute in a math conversation, because of how they are perceived or how they perceive themselves. For instance, I selected Jada, a student who rarely volunteers and who would be considered a low-performer, to share more often than I selected Sasha, the top student in my class who volunteers quite frequently. Further, I tried to make sure students were experiencing a variety of different types of questions while holding the same expectations for students regardless of performance level. For instance, I asked both Jada and Sasha questions that require a numerical answer and questions that require explanations.

While there is quantitative equity in students' opportunities to participate, how students experience whole class discussions is not necessarily the same. There are likely many factors at play, informing qualitatively what students' interactions are like as they share their thinking in discussions and how they perceive their experiences. It is understood that a teacher makes decisions as to who speaks, when, and how they respond to their students' ideas. In making these sorts of decisions, the NCTM (1991) contends

that teachers "convey messages about whose knowledge and ways of thinking and knowing are valued, who is considered able to contribute, and who has status in the group" (NCTM, 1991, p. 20). When a teacher is equitable in her distribution of opportunities to participate, these practices and the associated messages inform students' experiences as mathematics learners in particular ways. Here I use two case studies to illustrate how a teacher's actions can mediate a relationship between the way in which students perceive their mathematical abilities and how they participate. First, I share the case of Jada, a student who has struggled with mathematics and rarely volunteers, and, secondly, Sasha, a top performing student in a low-track mathematics class who volunteers often. Both students are Black and are in an all-Black class. As a White teacher attempting to do right by Black students by fostering equitable opportunities to participate, I analyze the data with an eye toward the racialized experiences of learning mathematics while Black.

**Jada: "You Gave Us Chances To Get Ideas"**

I share first how I understand Jada's perception of her mathematics ability according to Clark's (2016) framework. Here I provide my interpretations of four considerations in Jada's thinking as I use these to understand Jada's view of her mathematics ability (Clark, 2016). Specifically, I am looking at how Jada sees her group affiliation, her peers' abilities, the origin of mathematics ability, and the difficulty level of particular mathematics. Next, I share the ways in which I interpret Jada's experiences in our whole class discussions, in light of what I now understand about her perceptions of her mathematics ability. I describe how I see her engagement in a discussion and a particular interaction in which she is given an opportunity to share. I focus in on my

particular actions, as well, in the interaction. Specifically, I highlight the ways in which I am caring, encouraging, and scaffolding as I help Jada navigate a question that she at first is not sure how to answer. Finally, I aim to capture some of the ways in which Jada views my teaching and her experiences, paying attention to themes that inform how my actions with embodied messages shape her participation in whole class discussions. The two themes I address are her view that "everybody has a chance to speak" and a student will "give ideas...even though, he's not always right." I posit that based on the particular decisions I make that contribute to these messages, I afford Jada, a student who perceives herself as someone who easily gives up in math class, a chance to share and hear ideas and in doing so, she feels that she too can learn mathematics.

**How I Understand Jada's Perception of her Mathematical Ability**

I have a separate subsection for each of the four components that instantiate my sense of what makes up students' perceptions of their mathematical abilities, specifically, group affiliation, perceptions of ability levels of peers/classmates, source or origin of mathematics ability, and difficulty level of mathematics content. Within each of these subsections, I share how students' statements inform my interpretations of their perceptions of their mathematical abilities.

**Group affiliation**. Just like the other middle school students who I interviewed, when I asked questions that I hoped would get at Jada's identification with particular groups, such as gender or race, Jada uses adjectives to describe herself. Specifically, she indicates that she's "moody" and that even though she's "a nice person and...easy to talk to," she states "I'm not for everybody's personality" (J; Lines 10-12). Jada not bringing up race could be because I did not ask her explicitly about race. It could also be a

function of being in an all-Black school and being at the middle school level. Specifically, by being around only Black students race is potentially not as salient in schooling experiences and at this developmental stage students might not yet have the words to express racial affiliations. It is possible too that me being White is part of why she did not talk about race in the interview. Although, Jada knew I had a multiracial family as she has asked questions about the pictures on my desk and phone, including pictures of my niece and husband, who are both Black.

I shifted my questions to ask about social groups at Applegate and in our class. This was based on my understandings that social group affiliation, such as being a jock, can shape the particular ways in which students and their friends talk in school and the decisions they make (e.g., Eckert, 1989, 2000), and, in particular, can influence students' participation in mathematics classrooms (e.g., Chazan, 2000; Civil & Planas, 2004). In response, Jada indicates there are cliques and she is part of "the popular group" (J; Line 20). In response to me asking if she gets along with, or can be friends with, other groups, similar to what her five other classmates shared in the interviews, she responded that, "everybody relates somehow" (J; Line 24). While cliques at Applegate do not get in the way of students getting along, Jada suggests that wanting to fit in could prevent students in her current eighth grade class from actualizing their mathematics potential. Specifically, she states, "People in my class, they do, they really smart but they don't use it. Like I feel like some people try to fit in" (J; Line, 206). In summary, it seems Jada has a certain social identity at the school and recognizes that some students' desire to fit in precludes them from using their math knowledge. I think for Jada, caring about what her peers think might be part of the reason she does not volunteer to share, but I think it is

also her uncertainties and at times confusion about the mathematics that impede her participation. This comes up as she talks about the type of math student she is relative to her peers.

**Perception of ability levels of peers**. As I interviewed the six students I had certain predictions about how students perceived their mathematical ability, especially in relation to their peers' abilities. In particular, I assumed that Jada might not feel very positively about her mathematical abilities, at least in my class, and that she would perceive other students as much more capable than her. I say this because she had failing grades at the end of the school year and she rarely ever volunteered to share in discussions. She was also one of the few students who would put her head down in class. As Jada talks about how she sees her mathematics abilities and that of some of the students in our class, there is a consistent theme of Jada seeing herself as the type of student who easily gives up when she does not understand and compares herself to another student in our class who is like this. Specifically, she states the following:

> "When people don't understand it, they give up. That's the kind of people me and Tykisha was. But like, in the end, like in the closing, we really tried to help each other. If she didn't understand I tried to understand. And if both of us didn't understand, we'd ask you" (J; Line 233).

In comparison, she talks about her classmates as being "really smart," which is what I had expected, although in reference to peers in her eighth grade class she says that "they don't use it" (J; Line 206).

What surprised me though is when Jada shares, "I feel like I can be good at math" (J; Line 92). She says this as she speaks about how when I helped her with the math, then

she felt the math was “easy” and that she was “good at it” (J; Lines 96 & 98). For Jada, being good at math means you “understand it real well,” and “can help others with it” (J; Lines 69-70). She also names two students, Devon and Nate, from our class who she sees as “good at math.” Both of these students’ performance was consistently C’s all year in our low-track class, yet she does not seem to adhere to views of mathematics performance as indicators of ability. Instead she sees these two students as being good at math because they share even when they are “not always right,” and further, “when they is wrong, they still explain” and “learn from their mistakes” (J; Line 86).

In summary, it seems that Jada has an overall positive view of her peers’ mathematics abilities. She seems to have no awareness that she is in a low-track mathematics class. Further, she really believes that “everybody’s capable of doing it (being good at math), if they believe in their self” (J; Line 236). Although, without the right support, Jada sees some students like herself as likely to disengage.

**Origin of mathematics ability**. It seems Jada views everyone as having the potential to learn math. This is evident to me when she states that, “...everybody’s capable of doing it, if they believe in their self” (J; line 236). However, just before she says “like Jason, he’s just real good at math. Then there’s people like me and Tykisha. Jason, he was really lazy, but he still get it” (J: Line 236). From this, it seems there are some inconsistencies in how Jada views the origin of mathematics ability. It seems that she might think that some people are innately good at mathematics without needing to work at it, yet she also sees everyone as having the potential to be good at math. I see this latter thinking about the origin of ability again when I explicitly ask Jada if she thinks

people are “born good or not good at math” or if they “develop it,” and she replies, “They develop it” (J; Lines 199-200).

In addition, Jada emphasizes the importance of teachers and the classroom environment in students learning mathematics. At one point, she explicitly states, “the environment you in” determines whether or not students “develop it,” with “it” meaning becoming “good at math.” (J; Lines 202, 200, 199). For Jada, I think she sees some students as people who understand math quickly, therefore, those students do not need as much support and do not need to put forth as much effort. However, she sees other students, like herself, as people who can become good at math given the right level of support. Here is an excerpt of our conversation where she describes this process for herself:

Jada: I feel like I can be good at math but I give up on myself too easy. Like if I don't understand I just quit and don't do it.

Teacher: Okay.

Jada: Yeah (inaudible) Sometimes I be asking people for help like if my teacher don't give help, I just don't do it because I really don't understand and I feel like there’s not enough help.

Teacher: Okay. What about in my class? How did you feel you were in terms of math?

Jada: Every time I needed help, you was, you look at it, explain, broke it down, which made it easy for me to realize so it was easy.

Teacher: Okay.

Jada: And I felt like I was good at it.

Teacher: Okay.

Jada: But then when I get in eighth grade, it was like so different.

(Lines 91-100)

I move now to how Jada views the difficulty level of mathematics.

**Difficulty level of particular mathematics**. As I attempted to understand how Jada views the difficulty level of particular mathematics, I found in our dialogue about her family that math is something she helps her siblings with and it might even be something she likes. Specifically, when I ask Jada about her family and how they feel about math, Jada tells me that in terms of her younger sister, "She like it. It runs in the family" (J; Line 106). This is interesting because Jada had just stated that for her mother and grandmother "math wasn't really a strength for them" (J; Line 102). Therefore, when she says "It runs in the family," I believe she is saying that she too likes math. Then, we talk about Jada helping her siblings with math, and she indicates that she is able to explain to them her understandings, in particular with concepts like long division. Below is how this transpires:

Teacher: Does she go to you for help?

Jada: Sometimes, yeah.

Teacher: Okay.

Jada: In my, I got two more, two siblings under her. They always come to me for like division and stuff. I'm able to help them with long division cause that, remember you taught us that.

Teacher: Yeah.

Jada: So I can understand it and I be like, you gotta do this, and you gotta do this, and they be like thank you. So it's like okay.

(J; Lines 113-118)

While Jada does not explicitly state that she viewed division as hard, I felt that students in my sixth and seventh grade classes consistently over the years referred to long division as a difficult concept and procedure. Further, Spencer (2009) refers to his dissertation research conducted in 2006 in which he finds from interviewing 32 middle school students in urban schools that "numerous students" indicated "they were not good in mathematics" and used evidence such as, "they did not know how to do specific mathematical computations such as long division" (p. 223). Given how Jada seems to conceptualize what it means to be good at mathematics, I saw in this exchange that Jada at times feels even difficult math, like long division, is something she can do and she can help others with. I can also imagine times when Jada feels that there are particular mathematics topics and tasks in seventh grade that are very difficult. For instance, she states at one point that "Like some lesson I really get so confused" (J; Line 228).

Overall, for Jada, I think what makes her feel that she can do difficult math is the support she has around her. For instance, she states that in my class she felt "it (math) was easy" for her because of how I "broke it down" (J; Line 96). This theme is evident throughout the interview. Having support matters to Jada in terms of how she views the mathematics and her ability to be good at it.

**Jada's Experiences in Whole Class Discussions**

As I mentioned Jada is not a student who eagerly raises her hand in discussions. In fact, she rarely volunteers. There is only one instance in which she signals that she has the answer, and it is to the question "What is negative five plus five equal to?" A third of the class also raises their hands for this question. More often than not though, Jada has

her head resting on her arm on a desk. She seems tired, although never asleep. I share now what I saw in one particular discussion from problem 1.3 in the Comparing and Scaling unit from CMP. I include the ways in which I saw Jada engaging or not engaging in the conversation and how the interaction unfolds when I call on her to share.

In this particular discussion, Jada's head is down on the desk about half of the eighteen minute long discussion. This behavior is rare for students overall in our class. In fact, in this particular discussion, there are no other students with their heads down. Also rare is for students to not track whomever is speaking. Yet, Jada only at times follows who is speaking with her eyes, but other times the back or side of her head is facing a student who is sharing. She also seems distracted, by the tissue in her hand, her chapstick, her hair, basically anything that she can fiddle with seems to be an item for her to focus on. Around fifteen minutes into the eighteen minutes of discussion, I call on Jada. I initially ask her a question that requires her to explain. We interact for 65 seconds, going back and forth six times. Within the dialogue, given in Figure 2 for Problem 1.3, there is evidence of me showing caring (Noddings, 2013), specifically, me using "hun" and "sweetie" at times and softing my voice when I realize she may not know how to answer the question. In this exchange, Jada eventually shares an idea, yet it is incorrect. I immediately jump to scaffolding. When I refer the entire class back to the information in the student text and share a related example, Jada then jumps back in, revising her initial idea. Her idea is on track, but she uses the wrong units. I ask the class to ponder what she shares. My hope is that we can collectively figure this out, as a class.

I see Jada's effort to share as something that goes beyond Jada the math student. I could envision for students like Jada, who have had prior negative experiences in learning

mathematics and who typically shut down in mathematics classes, a teacher calling on them to explain something they are unsure about would likely result in some form of disengagement or resistance. So why does Jada not shut down? Why does she not resist? This is one example, but I know that throughout the year it was rare for her to avoid answering a question when I call on her in discussions. Yet, there is so much there that might suggest she would disengage. In the next subsection I describe how I understand Jada's perspectives on our classroom discussions, and particularly how she sees my particular teaching practices and aspects of students' experiences in our discussions.

**Accentuate the Negative Unit, Investigation 2, Problem 2.3**
**Teacher:** Why is your (referring to the class) answer negative? I'm confused by that. (pause) Jada, why is your answer negative? (Two students raise their hands)
**Jada:** Cause the (pause), which one?
**Teacher:** Number five.
**Jada:** Oh. Cause it's the number with the larger absolute value.
**Teacher:** I don't agree. (pause) You're just, you're just spouting out algorithms. But, look at the problem. The two numbers they added together, what do you notice about them? (long pause) The negative twenty five point six and the negative four point four that are being added together. What do you notice?
**Jada:** They're both negative.
**Teacher:** Yeah, they're both negative. What happens sweetie when you add two negatives?
**Jada:** You still get a negative.

**Comparing and Scaling Unit, Investigation 1, Problem 1.1, Day 1**
**Teacher:** About a million people prefer each type of cola. What conclusion would you make if these were the actual numbers (in the taste test)? If it's about the same, what could you say about the two different types of soda? (Sasha raises her hand. She is the only student with a hand raised. Jada has her head resting on her arm on the desk. She is looking at me and the board as I ask the question and point to the board. Malik answers the question without raising his hand or being called on.)
**Malik:** Like both of them have the same number of people who like them.
**Teacher:** Did you guys hear what Malik is saying? Jada can you say it?
**Jada:** They probably taste the same.

**Comparing and Scaling Unit, Investigation 1, Problem 1.3**
**Teacher:** Michael and Keontay just said multiply by 12. Jada, summarize that for us. Why are we multiplying by 12, hun?
**Jada:** (Starts to say something, but it is inaudible)
**Teacher:** Cause why hun? (pause) Do you know why they're multiplying by 12? (pause) Or no?
**Jada:** Umm
**Teacher:** What sweetie?
**Jada:** Kinda
**Teacher:** Kinda. Why do you think they might be multiplying by 12? (long pause) Why do you think they might be multiplying by 12? Any ideas? (pause) What are we trying to figure out here hun? (Up to this point other students have been sitting silently, looking at Jada and me. Malik now raises his hand.)
**Jada:** What gets you to 12.
**Teacher:** Is it what gets you to 12? (pause) Well, back to the top of the page. It says a typical can of orange juice concentrate holds 12 fluid ounces. So, if this is my can of concentrate (holding up my water bottle). Just pretend. How many ounces does this hold?
**Students:** 12
**Teacher:** 12. One can is equal to 12 ounces. Just like one foot is equal to 12 inches.
**Jada:** Oh, so
**Teacher:** (Interrupting, and whispering to Jada) Sweetie, don't write on the desk. Okay, say it again.
**Jada:** (Let's out a giggle) How many cups it takes to fill it (the pitcher).
**Teacher:** Do you guys know what she means? (pause) Michael, what does she mean?

**Comparing and Scaling Unit, Investigation 2, Problem 2.1**
**Teacher:** If you do 80, the equivalent ratio here (pointing to 4/10 = /80 written on the board) is going to be what? Jada, can you just tell us real quick?
**Jada:** If you do 80?
**Teacher:** Yeah, if you do 80, what's the equivalent ratio here? (pause) You have it on your paper.
**Jada:** 32

*Figure 2.* Dialogue in the Four Instances of Jada Sharing in Classroom Discussions

**How I Think Jada Saw My Teaching Practices in Whole Class Discussions**

**"Everyone had a chance to speak."** Jada talks about our seventh grade mathematics class, and particularly whole class discussions, as a space where every student contributes. This speaks to her noticing the participation equity that I strived for. Further, she identifies how I call on students in our discussions even if they did not volunteer. This says to me that Jada did not feel singled out. Jada has internalized some of the messages that I had hoped to convey, specifically, that everyone's mathematical thinking is valued in our classroom. Here is what Jada says about this as she is responding to my question of "What's different?" about our class as compared to her eighth grade mathematics class:

> You gave us chances to get ideas from, like, how to do this, how did somebody do this. Everybody, you gave, even if they didn't want to, everybody had a chance to speak and give their opinion on a lesson or like what they thought about it. And what they got and how they got it. So everybody knew what was right and what was wrong and how to get it, basically (J; Line 198).

By giving everyone opportunities to participate even if they did not volunteer to share, for Jada, this gave students "chances to get ideas." For me, Jada is referring to the equity, and accountability, in my practice of calling on students who do not have their hands raised. This was something I did frequently, in fact, more often than not. By giving more than just the high performing students or only those who volunteer, a chance to share, I equitably distribute opportunities to engage in speaking about the math, affording

opportunities to learn the math to more than a select few. For Jada, this is part of the support she indicates she needs in order to understand the mathematics.

Also, in looking at the interactions between Jada and me in the instances in which she shares in discussions, there is scaffolding available when needed, as I give her access to the mathematic. For Jada, I think these are the types of supports that help students learn and from this she sees me as "a good teacher for math because you really help all us understand" (J; Line 228). Further, in Jada's descriptions of the experience of "everybody" being able to share their thinking and how this helps the class, I see a connection to culturally relevant practices for Black students (e.g., Delpit, 2012; Ladson-Billings, 2009; Leonard, 2008) and research that specifically attends to how positioning all students as capable can impact marginalized students mathematics identities (e.g., Turner, Dominguez, Maldonado, & Empson, 2013). I speculate that my role as a "warm demander," in which I expect everyone to verbally contribute in whole class discussion while also providing encouragement and support (Berry & McClain, 2009; p. 142), leads to Jada staying the course and not resorting to giving up when called on.

**"Give ideas…even though he's not always right."** Jada also brings up how it is okay to be "wrong." In fact, she describes a student who she previously referred to as "good at math" as someone who shares their ideas even when they are wrong. Here is what she says:

> "Devon, kind of like Nate, he give ideas, and if you, like, even though, he's not always right, when they is wrong, they still explain how they, what they thought, and what, what did they learn from their mistakes, and how they understand it now" (J; Line 86).

By students being willing to share when they are wrong, this speaks to ways in which the whole class is afforded particular opportunities for learning. Specifically, students know that being wrong is okay and this opens up the possibility for students to feel comfortable talking about the mathematics. Additionally, from these types of exchanges students can unpack wrong ideas and clarify their thinking, both of which for struggling learners can be integral in helping them develop particular understandings of the math. Further, given the tendency for middle school students to care deeply about what their peers think, being wrong in front of classmates is not something that many students are comfortable with (e.g., Harter 1990; Wood, 2007). For instance, Jada even mentions students not using their ability in her eighth grade class because they want to fit in. This is what I would think is typical in most middle school classrooms as middle school students tend to emphasize social identities over academic pursuits or teacher-student relationships (Wood, 2007).

In our seventh grade classroom, it seems though students share even when they might be wrong. This suggests to me that there is something about our classroom environment that makes students feel they can do this, without some of the social ramifications that middle school students might typically fear. While, I cannot say for certain this is why Devon and Nate share even when they are wrong, I know that I strategically tried to communicate this message. In fact, I would daily say things like "The best way to learn math is to make mistakes and learn from them." I hear my words in Jada's description. The culture of the school too may play a role. Specifically, I can see how a focus in advisory lessons on being kind and respectful can translate to students'

experiences in their content classes. While Jada did not see this in her eighth grade class, it could be that her eighth grade mathematics class is an anomaly at Applegate.

By making certain decisions, such as who to call on and how to respond, teachers send messages about who they think is capable in learning mathematics and what it means to learn and do mathematic. For students like Jada who perceive their ability to understand mathematics as being dependent on whether or not someone can help them if they are struggling to grasp a concept, it seems in a reform-oriented class with whole class discussions there needs to be a way to give students that support. Martin (2000), in particular, finds that when Black students at this age and in similar circumstances have difficulty adjusting to the workload and expectations in a mathematics classroom, the likely result is negative perceptions about mathematics that then leads to disengagement (Martin, 2000; p. 181). Further, Martin (2000) contends, "I know that when students received the attention and assurance they apparently wanted, they often proceeded with their work and demonstrated the levels of understanding that were expected of them" (p. 181). In our classroom, part of the support came in students having opportunities to "give" and "get ideas," knowing that even if they are wrong, it is a safe space to share. Support also came through caring and scaffolding, when needed, in the whole class interactions. By "sharing the love" (M; Line 120), something Malik points out in reference to giving everyone a chance to share in whole class discussions, I mediated a particular relationship for Jada between how I understood her as a mathematics learner with a fragile perception of her ability and her participatory actions in conversations in which she has equitable opportunities to engage with the mathematics. I share now the case of Sasha.

**Sasha: "I Wanted People, Other People To Raise Their Hands"**

I use the same structure for the second case. I begin with my understandings of Sasha's perception of her mathematics ability according to three of the four considerations in Clark's (2016) framework. Next, I speak to Sasha's experiences in our whole class discussions. I describe how I see her engagement in a discussion and a particular interaction in which she is given an opportunity to share. I focus in on my particular actions, as well, in the interaction, and consider the differences as compared to the dynamics I previously describe in calling on Jada. In particular, Sasha does not need the same support as Jada, and instead she sees her role as a helper. I also bring in the voices of some of the other students who I interviewed when relevant. Finally, as I look to Sasha's views of students' experiences and my teaching, there are particular themes that I see that inform how my actions and words shape the way she views her limited participation in whole class discussions. Specifically, I use the following quotes to capture the themes I discuss: "everybody wanted to help," and "I wanted people, other people to raise their hands." I also touch on Sasha's brief mention of frustration around my decisions of who shares and when, although her feeling, "oh my gosh, she didn't pick me," was not a theme in the interview. I posit that by making certain decisions embodying particular messages, I make Sasha feel that she has a role to play in helping others and letting others have opportunities to share. This does not mean that she does not feel frustrated at times by the limited participation opportunities, but she has other opportunities to learn about equitable social dynamics in the discussions, and this likely informs how she sees her peers as mathematics students and her willingness to open up the space for other students to partake in learning through participation in discussions.

**How I Understand Sasha's Perception of her Mathematical Ability**

For Sasha, I only attend to three aspects in Clark's (2016) framework. Sasha did not speak to the difficulty level of particular mathematics in the interview. My sense from her performance in my class is that she did not find the mathematics concepts covered in CMP particularly difficult, although I think sometimes the contexts and the wording created difficulties even for students like Sasha. I address how I see Sasha talking about group affiliation, perceptions of ability levels of peers/classmates, and the origin of mathematics ability.

**Group affiliation**. In the same way that Jada and the interviewed students did not talk about race, SES, or gender as part of how they see themselves, Sasha too did not bring this up. As I mentioned previously, I also ask students about their social group affiliation at Applegate. Sasha says she would describe the groups she belongs to in terms of "the sports I play" (S; Line 22). She also says that she is "part of a lot" of the cliques at Applegate, and the reason she gives is because "I just talk to everybody" and "hang out with everybody" (S; Lines 26, 28 & 30). From her description, it seems she has the type of personality of someone who gets along with everyone and is well-liked. Interestingly, in my interview with Jada, this is not how Jada describes Sasha. Jada states, "Sasha, she is trouble, she's sneaky. She do stuff behind people's back" (J: Line 48). While this may just be an isolated case of one person not seeing Sasha in a positive light, I bring it up because I think the social dynamics of classrooms are messy and complicated. How students see themselves is not always representative of how other students or the teacher see them. In terms of the interactions between Sasha and Jada in our classroom, I do

remember them working together, thus, Jada's feelings about Sasha did not preclude her from getting along well enough to work with Sasha during group work.

This speaks to a larger theme of "everybody got along" at Applegate (Tasha; Line 179), which I saw across the descriptions the six students gave as we talked about social groups in the interviews. It seems there is a "mutual respect between everyone" (Malik; Line 14), and I would speculate that this stems from the strategic ways in which teachers at Applegate try to create a culture of tolerance and respect for others, regardless of differences, particularly in advisory. This is in stark contrast to some of the other findings in the literature in which students feel constrained by their social groupings in terms of who they could work with and the contributions they would make (e.g., Chazan, 2000; Civil and Planas, 2004). I think as Sasha describes herself as someone who can talk to and hang out with everyone, she is also alluding to what the school culture at Applegate affords students socially. I recognize Applegate is unique and certainly plays a role in the social dynamics in our seventh grade mathematics classroom.

**Perceptions of ability level of peers**. From Sasha being the student in my class with the highest grade each quarter and highest winter NWEA MAPs score, I anticipated she would perceive herself as much better at math than her classmates. She does make one statement alluding to how she sees herself as more capable, yet most of her statements suggest she sees everyone on the same plane. Here is an exchange between us that speaks to how she thinks of her peers' mathematics abilities in relation to herself:

Teacher: So when you think about our classroom last year. Where do you feel like you fit in the mixture of people in that class in terms of being good at math or not being good at math?

Sasha: I felt like almost I was the teacher because like, like after you taught me something I was able to build on it so fast that I'll help people who didn't understand, understand.

Teacher: Okay. And do you feel like there's people in our class who struggled with math or who weren't really good at math?

Sasha: Like in the beginning. But at the time it felt like, they started like, the way you like, I like the way that you understood it. Like not understood, but, like, how you describe stuff and like you made stories so we could understand it, so after a while they really wasn't struggling no more. They was as far as everybody else.

(S; Lines 47-50)

When she compares herself to a teacher clearly she is acknowledging her mathematics prowess. However, as she talks about students in the class struggling, she sees a shift happening, in which students eventually are as "far as everybody else." At another time in the interview she also says "it felt like everybody was on the same pace" (S; Line 82). It surprises me that she sees her classmates as mathematically on the same playing field, yet she might be referring to everyone engaging in the same tasks and being able to address the same questions, rather than speaking to students' performance on assessments. What she sees daily are students working together in groups that I strategically assign to ensure there are a range of abilities and she sees everyone sharing in the whole class conversations.

What is more, in terms of the tracking in the school, I thought Sasha knew that our class is a low-track class, given the communication around MAPs scores determining the mathematics class in which students are placed. In fact, students in the Number Sense

classes (low-track) were explicitly told by their advisors during mid-year conferences that if they score high enough on the end of the year MAPs test, they will be placed in the Number Analysis (high-track) class in the fall. While we do not refer to these classes as low or high, we are honest that Number Analysis classes move at a faster pace and cover more material (an additional unit), and at times extend the depth to which concepts are explored. Sasha never indicates in our interview any awareness that our seventh grade class is a low-track class and while she says that there are different people in her current eighth grade class as compared to our class, she gives no indication that she sees differences in ability levels between these classes.

Interestingly, from what was said in the interviews, the six students did not suggest that they were aware they were in a low-track group. Like Sasha, students talked about how their mathematics classes changed as they went from seventh to eighth grade, yet there was no mention, as I would have thought, about a student moving up to the high-track or that they stayed in the low-track group. There was simply nothing said directly or alluded to, or that I could surmise potentially in how students talked about other aspects of their experiences. It just seemed that being in a low-track versus high-track, and what people might perceive this to mean, was not part of my students' awareness. This may speak to the efforts at Applegate in using uniform language that is sensitive to the negative connotations that come with tracking. It is also possible that certain messages stemming from actions I take in facilitating whole class discussions, which will be discussed later on, are related to my students not recognizing the tracking of math classes at Applegate. It might also be the case that my students are aware of the

tracking of mathematics classes at Applegate, but did not bring it up because I did not explicitly ask or they did not feel comfortable talking about the classes in this way.

**Origin of mathematics ability**. For Sasha, it seems mathematics ability comes from environmental factors. She talks about how being good at math has to do with "how they learned the basics" (S; Line 52). This messaging might come from her mom as she tells me that her mom is not good at math because "she (her mom) said that the way they learned math is different from how we learn math" (S; Line 60). According to Martin (2000), Black parents' experiences learning mathematics inform the messages parents send to their children about mathematics. Another way in which I see Sasha attributing becoming good at math to environmental factors, along with effort, is in her description of how someone gets better at math. Specifically, they would need to review the basics, and she indicates they should use a particular approach, specifically, "like, how we get word problems, like, stories and backgrounds, like, stuff to understand, stuff that they can relate too to understand it" (S; Line 58). I take this to mean that students can learn the basics well, and, thus, become good at math, when the "basics" are made relevant, that is, the learning occurs through relatable contexts. Finally, while Sasha sees herself as someone who thinks "math is easy" because she can "learn real fast" (S; Lines 44 & 46), I am left wondering if, according to Sasha, this is because of how she learned "the basics," or if she also thinks that some people are innately better at mathematics than others. Next, I describe Sasha's participation in discussions.

### How Does Sasha Participate in Discussions

Sasha is a student who eagerly raises her hand in discussions. In fact, in the five conversations I look at, she raises her hand 18 times. The only other student who

volunteers that frequently is Malik, who like Sasha is a top performer in our class. In discussions, Sasha can be seen always sitting up, and she seems like she is intently listening to whomever is speaking. Interestingly, I only call on Sasha three times over the five discussions. This is part of my effort to ensure I have equity in students' participation in discussions. In these three instances I do give her opportunities to answer different types of questions, from a single numerical answer to a reasoning question, and an explanation question, although some might argue that I did not call on Sasha enough. Specifically, I can see how calling on her so infrequently compared to how often she volunteers might create frustration for a student like Sasha and cause her to see me as unfair and to disengage. In one particular discussion from problem 1.3 in the Comparing and Scaling unit from CMP, I do sense frustration from Sasha as she puts her hand down at one point with a huff when I indicate that I am waiting for more hands. This does not stop her though from volunteering again. In this particular discussion Sasha volunteers six times. I finally call on her after the fourth time she volunteers. She answers a question in which I ask her to explain why and she has no problem offering a clear and accurate explanation (see Figure 3).

What is it about Sasha or our classroom environment that makes her continue to engage in the conversations, even though she is not rewarded for her effort to participate? What are the reasons why she carries on with such eagerness as she continues to volunteer again and again? In discussions when she does not volunteer as much, which are rare, such as, in problem 2.1 in the Comparing and Scaling unit, what are the possible reasons for this shift? I attempt to address some of these questions as I look to the way

Sasha talks about students' experiences in discussions and how she sees my decision making in terms of students' participation.

**Accentuate the Negative Unit, Investigation 2, Problem 2.3**
**Teacher:** What is negative five plus five? (pause) Sasha? (Jada and Sasha both raise their hands. Four other students raise their hands, as well.)
**Sasha:** Zero

**Problem 1.1, Day 1**
**Teacher:** What do we learn from that ratio of 3 to 2? (pause) Sasha, thoughts? (Sasha is the only student with her hand raised. Jada is sitting up and looking at the speakers.)
**Sasha:** That it's close.
**Teacher:** Okay. That it's close. (pause) What gives you the sense that it's close?
**Sasha:** 3 to 2

**Comparing and Scaling Unit, Investigation 1, Problem 1.3**
**Teacher:** Why? They both said these are part to part ratios and I'm wondering why? (pause) Sasha? (Sasha is raising her hand. Two other students raise their hands.)
**Sasha:** Because it's not (pause), cause one is water and one's the concentrate, so it's not a total.

*Figure 3.* Dialogue in the Three Instances of Sasha Sharing in Classroom Discussions

### How I Think Sasha Saw My Teaching Practices in Whole Class Discussions

According to Sasha, participating means someone is raising his/her hand in whole class discussions. This way of thinking about participation informs her perspective on the mathematics discussions in our class. My understanding of how she views what it means to participate came from her saying that she "participate a lot" (S; Line 70). In terms of my definition, Sasha did not participate more than anyone else in the class. This is because I gave students equitable opportunities to participate. However, she did raise her hand considerably more than others students in our class. Further, she indicates that at times she decides not to raise her hand because she wants other people to raise their hands. Again, I believe Sasha is thinking of participation in terms of raising one's hand to indicate a desire to contribute to the discussion. In retrospect, I took for granted what I meant by participation when conducting interviews and should have communicated my

view explicitly with students or asked them what participation means to them. I describe here in more detail how Sasha thinks of students' experiences in and my actions as the facilitator of our whole class mathematics discussions. I also at times attend to some of the things Sasha says more generally about our classroom as I believe some of the practices she refers to relate to students' engagement and interactions in discussions. Finally, I share the perspectives of a few other students in order to show how Sasha's view of helping and allowing other students opportunities to share are not just a function of her personality, rather she is attending to aspects of our classroom culture that others see, as well.

**"Everybody wanted to help."** There is a culture in our classroom of everybody wanting to help each other. Here is the dialogue between Sasha and I that captures her sentiments about the helping environment:

Teacher: I know we talked about social groups at Afya but what about social groups in our class from last year? Were there social groups? Did everyone get along?

Sasha: Everybody just got along.

Teacher: Okay cool. Why do you think that is or is there any reason why you thought that was? Was it the particular people in the class? What was it about our class?

Sasha: It was just because like everybody, like when people struggled, everybody would like, it was like a fight to help whoever is struggling. Like everybody wanted to help. So the fact that everybody helped it was like we don't have no type of groups or nothing and everybody was like almost on the same pace.

(S; Lines 61-64)

In this exchange, Sasha describes a space where not only does everybody want to help, but students "fight to help whoever is struggling." This is powerful in that Sasha sees our class as a collective effort to support each other and to learn together. As a result Sasha posits, "we don't have no type of groups or nothing." This speaks to the ways in which students got along in our class; therefore, social hierarchy based on group affiliations was not an issue. This was a common theme for all six students who I interviewed. This may relate also to the culture of Applegate, as the school environment can certainly infuse a particular mindset that students bring with them into a classroom. Finally, as a result of a culture of helping each other, Sasha claims that, "everybody was like almost on the same pace." From working together and giving each other support, the students in our class appear to Sasha to be on a comparable level. Like Sasha, the other students who I interviewed also saw classmates as capable mathematics students, regardless of the varied math readiness evident in the NWEA MAPs scores and quarterly grades.

Students in my class seem to be talking about something Boaler (2008) calls *relational equity.* Specifically, Boaler and Staples (2008) use this term to refer to "the creation of classrooms in which students learn to treat each other equitably" (Boaler & Staples, 2008, p. 625). Note that Boaler and Staples (2008) attend to how students in heterogeneous mathematics classrooms that promote relational equity come to work with students from different ability levels and refrain from passing judgements based on ability. While our class is considered low-track and with that it might be defined as homogenous, I would argue that there are still a range of math readiness levels in our class, and yet with that students still appeared to see their classmates as capable mathematics students. Experiencing a classroom environment that fosters relational

equity is likely to positively relate to how students see each others' and their own capacities for learning mathematic. For Black students, in particular, who too often see themselves as not good at math (e.g., Spencer, 2009), being in a classroom environment in which they are viewed as capable by a teacher and their peers may alter how they see their mathematics ability and their likelihood of engaging in discussions.

Based on what students share in the interviews, all six students did indeed see themselves as capable mathematics students, to different degrees and with different qualifiers, but nonetheless, even Jada saw herself as someone who *could* be good at math. Considering how I hear adults talking about themselves when it comes to math, this finding somewhat surprised me. Specifically, more often than not adults tell me that they were not good at math. I saw this too in the interviews when students shared how family members felt about math. All six of my students told me that their moms either do not like math or are not good at math. Only Keontay talks about how his dad felt about math, and he indicates that his dad likes math and was good at it. I ask students how they know, and the students share that their mom, and in the case of Keontay, mom and dad, told them. Further, I thought back to when I taught an elementary math methods course, in which many of the teacher candidates expressed concern about teaching elementary mathematics as they felt they just were not good at math. It seems that something made my seventh grade students in a low-track mathematics class feel differently.

What is more, I found that related to Sasha's view that everybody helped each other, another student in our class, Tasha, talks in an interview about how everyone struggles in math at times. I thought she might be referring to students in our class since it is a low-track class, but instead she clarified that she means everyone, not just people in

our class, sometimes find some aspect of mathematics to be difficult, but that this does not mean they are bad at math. In fact, she sees Sasha as someone who is good at math, yet sees herself as being on the same pace as Sasha, and shared how Sasha at some point "didn't really know anything" and evolved into a good math student (Ta; Line 146). Being in a mathematics classroom in which it is okay to struggle without feeling judgement, and knowing that there will be support not just from the teacher, but also from classmates, can have a significant positive impact on Black students' learning experiences (e.g., Ladson-Billings, 2009; Martin, 2000). Specifically, this type of environment sends messages about ability that counter the negative stereotypes of Black students as intellectually inferior.

**"I wanted people, other people to raise their hands."** It seems Sasha took on a mindset at times of what I was aiming to do with equitable opportunities to participate, and that is to have everyone ideally engaging in the conversation. From Sasha's viewpoint of participation being about raising a hand, there are times she does not raise her hand specifically because she wants classmates "to raise their hands." Here is our exchange around participation and, specifically, on giving others a chance to participate:

Teacher: Do you remember how your participation was? Like do you feel like you participate a lot? Or a little? Or like…

Sasha: To me when I think back, I think I participate. I may participate a lot, but then like sometimes I didn't raise my hand because I wanted people, other people to raise their hands.

Teacher: Okay.

Sasha: So it, I cause, I knew, I like to get the class moving. I always raise my hand and answer the questions, but then after a while, I be like ohh nobody else answering, so uhh, so I'll just help and then after a while everybody raise their hand.

(S; Lines 69-72)

For Sasha, her role in discussions is not self-centered. She sees herself as someone who participates a lot, but yet she wants her classmates to be a part of the conversation. She even sees herself as someone who can assist others, which then leads to classmates feeling that they too can share in the discussions.

When I consider the ways in which Sasha's views about participation are similar and different from the other students who I interviewed, I find that she attributes classmates having opportunities to participate to her willingness to help and to step back and give them a chance to be part of the conversation. However, two of her classmates who notice a trend of equitable participation attribute it to my practice of not always selecting the students who volunteer, but rather selecting an array of students even if they are not volunteering. In fact, Malik, another high performing student, felt that I do not frequently call on him even though he volunteers quite a bit, and he believes this is because I was trying to create opportunities for other students to participate. He said that, "It took me a while to actually understand," from which I gather that earlier in the year he might have felt differently about not being called on (M; Line 136). He describes this awareness in the following way: "Cause I was like, ohh, wait a minute cause in my mind I'm thinking, okay, she's not calling on me because she wants someone else to answer the question. So, at some point I would just go like, okay, well you gotta pass it along" (M; Line 138). Similar to Malik, Tasha talks about why I did not call on her as often as

she volunteers. Specifically, she states that the reason was “Because you wanted somebody else to have a chance.” (Ta; Line 130).

For Sasha and Malik, two students who excelled on assessments and eventually moved to a high-track class for eighth grade, they began to see their role in our discussions as sitting back and “sharing the love” so that everyone had a chance. Students in my class seem to have internalized that everyone deserves a chance to learn mathematics, and for students like Sasha and Malik they see themselves as part of a process of creating access and equity. I think these types of experiences inform how students come to perceive their classmates and their own mathematics abilities. Also, for students to feel they are part of something greater than themselves can be empowering, particularly when the students who they are impacting are other marginalized students like themselves. This brings me to wonder how my way of approaching participation might have the opposite effect by negatively impacting Black students who are in a predominantly White setting, if the top performers are Black, they frequently volunteer, and yet they are not called on very often. If the power dynamics at play are a few Black students surrounded by classmates who can rely on White privilege and institutional advantages, how would a student like Sasha feel if she volunteers and is not very often given the opportunity to participate? I would contend that the benefits of this equitable participation practice are specific to this context in which the students are all Black, but would not likely extend to contexts in which there are racial power dynamics at play.

**“Oh my gosh, she didn’t pick me.”** I think it is important to share that Sasha she does at times experience feelings of frustration about not being called on as often as she would like. Specifically, Sasha states, “And we would get mad to see like if you

called on somebody else, we'd get mad like ohh my gosh, she didn't pick me." (S; Line 74). I can tell though that her frustration is not something that precludes her from feeling she had an active role in the discussions. I say this because I ask her three times how she felt about me not calling on her very often and the quote above is the only time she mentions any sense of frustration. In the other two out of three times I ask, she shares the benefits to other students. In particular, she shares how "everybody starts to raise their hands," which I think to her means everybody is participating in our discussions. Tasha was also someone who mentions feeling frustration from me not calling on her as often as she would have liked. While she understands that I wanted to give other students opportunities, she still struggled at times to be okay with this. However, like Sasha, she continues to frequently raise her hand. And, like Jada and Sasha, there is no evidence of her resisting or disengaging because of my equitable participation efforts.

## Discussion & Conclusion

This work considers a reflexive relationship between students' perceptions of their mathematics ability and their participation in whole class discussions and the role of a teacher in mediating the relationship between these two constructs. It seems that the relationship from mathematics identity to participation is taken for granted, as the literature does not address this direction of the pathway, maybe because it is obvious that this would be the case. Disrupting participation patterns can impact students' mathematics identity, particularly for students who have struggled with mathematics or who are perceived as less capable (e.g., Boaler & Staples, 2008; Turner et al., 2013). This dissertation research builds on this work by illustrating how a teacher can interrupt the assumed relationship from perceptions of mathematics ability to participation and the

relationship from participation to perceptions of mathematics ability. In a practitioner research study I present two students for whom participation looks similar, yet the differences in their perceptions and experiences speak to my role in altering what otherwise would have been a low-performing disengaged student and a high-performing well-engaged student.

Jada, a student who rarely volunteers in mathematics discussions, is a student who in some classrooms will never be called on to share. In my classroom though, I call on her, as often as one of my top performing students, Sasha, who felt she could not only understand math quickly, but could also explain it to other students, and likens herself to a teacher. In my approach of giving students in my class equitable opportunities to share in discussions, I send a message that gets taken up by students. Jada, in being asked to share in discussions could easily have shut down since she is the kind of student who has this tendency, yet she shares answers, ideas, and explanations. Even if she struggles at first, with scaffolding and encouragement she persists in her participatory efforts. This is, at least in part, because she knows everyone will be called on even if they do not want to be and it is okay to be wrong in our class. The Applegate culture also likely influences her feeling that other students will not judge her attempts to express mathematical thoughts. Sasha, a student who frequently volunteers and who in another class might get called on to share all the time, she experiences some feelings of frustration about me not calling on her more. Yet this seems minimal. Overwhelmingly she sees a role for herself and her classmates as uplifting each other by giving help when needed. Further because she defines participation as raising one's hand, my efforts to ensure equitable participation lead to her volunteering less so that others can participate. Yet she does not

disengage. Instead, she finds a way to conceptualize this experience as her choice to step back so that she can help others. As a student from research conducted by Boaler and Staples (2008) indicates, there is more to learning math content in the learning of math content. Specifically, the student, Janet, shared "here you work socially and you also try to learn to help people and get help. Like you improve on your social skills, math skills and logic skills." (Boaler & Staples, 2008, p. 630).

In an all Black school, fostering equitable participation had the effect of creating a mathematics classroom that is viewed as a space for giving and receiving help, and where everyone is capable of being good at mathematics. For Black students, in particular, finding ways to create more equitable learning opportunities, and not just across racial groups but within too, is key to students' success. This study also raises questions though about dilemmas in practice. While equitable participation was connected to positive experiences, I often wondered if I should have had expert peers doing more of the talking in the mathematics discussions in order for the whole class to benefit from their language usage and ideas. Am I privileging a collective experience over opportunities to hear higher performers/more expert-like peers in the discussions? What does this mean for students' opportunities to learn the mathematics register or to understand mathematics concepts?

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## Chapter 5: Do Right By Black Students: A Reconceptualization of Equity

In this chapter, I assess the contributions of this dissertation to the mathematics education research literature and to practice, and I share recommendations. First, by thinking about the ways that (White) teachers can do right by Black students, I offer insights to a body of theoretical work and commentaries in which scholars are calling for a reconceptualization of equity rhetoric. Next, I share particular themes across the three standalone research projects that address how (White) teachers can do right by Black students. Finally, I share future directions for educators and administrators in practice, as well as, recommendations for mathematics education researchers.

### Reconceptualizing Equity

Equity, a priority in the mathematics education discourse for almost thirty years (e.g., Leinwand, 2014; NCTM, 1989, 1991, 2000), is not reflected in achievement outcomes of Black students (see Martin, 2015, for further discussion). Lozenski (2017), in his analysis of the framing of educational disparities, questions the long-standing rhetoric that calls for equity with a focus on the achievement gap. I identify with his request to reconsider this conceptualization of equity. Lozenski (2017) indicates, "My intent is to challenge progressive educators and those who have deep commitments to racial and educational justice to reevaluate the ahistorical discourse of crisis in black education, which in turn perpetuates the surface-level discourse of the achievement gap as the end-all-be-all of racialized educational disparity" (p. 166). Without taking into account the impact of sociocultural and historical realities, schools and teachers cannot adequately address issues of equity related to the experiences of and outcomes for Black

students (Ladson-Billings, 2006; Lozenski, 2017; Martin, 2000). In this dissertation, I present a way to build on a reconceptualization of equity, specifically, I illustrate ways to think about what it might mean to "do right by" Black students.

The question of what this looks like is at the level of the teacher, a micro level player in a system that by design perpetuates inequalities through institutional and organizational structures. This is not to suggest that teachers are the answer in remedying the educational debt owed to Black students and families (Ladson-Billings, 2006). Rather, within my quest to address this question, I am acknowledging that the notion of "equity" as it is often conceptualized is flawed in that history is ignored and it does not encompass the effort and attention required to right the wrongs that have been and continue to be done to Black people. Actualizing equity would require a revolution of sorts (Martin, 2015), yet the concept of doing right by Black students could allow teachers to rethink how to attend to issues of equity in a way that recognizes history, makes central the realities of racism and inequality, considers the impact of an immediate context on their students, and believes in the strengths, capacities, and potential of Black students, as well as seeing the value in teaching decisions that empower Black students. This is not a prescription of best practices. Rather, I present a concept from the Black lexicon to capture how in teaching, and mathematics teaching specifically, White teachers can "do right by" Black students. That is, how they can use a racialized lens to manage problems in practice with an aim of acting on what is in the best interests of their Black students.

This dissertation is an example of ways in which I, as a teacher, attempted to do right by Black students and what I learned about this in particular instructional situations,

specifically, whole class discussions. Chapter 1 presents why I use the phrase "do right by" Black students and establishes the advantages of practitioner research in addressing particular research questions in three standalone projects. Chapter 2 provides insights into the nature of teaching through an illustration of two dilemmas and the way in which I managed them with a racialized lens from which I take stock of the experiences of Black children and families in my decision-making. Also, by applying a framework from Chazan, Herbst, and Clark, (2016) on the stakeholders who influence mathematics teaching, I present a new way to analyze the competing aims that are part of the role of mathematics teacher and that lead to dilemmas in practice. In Chapter 3, I consider the particulars of language in whole class discussions and how a teacher can afford or constrain Black students' opportunities to learn through language usage choices in the enacted and intended curriculum. This chapter is a lesson in grappling with Whiteness because it reveals how reform-oriented curriculum, touted as ideal in the White progressive movement for mathematics reform (e.g., Leinward, 2014), is not responsive to Black students who are not exposed to the same experiences or language as their more affluent White peers. Further, this chapter raises questions about the taken for granted applicability of reform-oriented curriculum and pedagogical approaches for *all* students. Finally, Chapter 4 provides an example of how a teacher can interrupt the ties between students' perceptions of their mathematics ability and their participation in whole class discussions. More specifically, this particular project illustrates how equitable participation practices (i.e., providing students with equitable opportunities to talk in discussions) and a safe classroom (and school) culture that champions helping each other

are ways that a teacher can mediate a relationship between these two constructs of perceptions and participation.

I am not suggesting that teachers should take up these exact practices as examples of high quality instruction. Instead from my analyses I present more dilemmas to consider, knowing that the role of mathematics teacher is bound up in managing problems of practice within a given context. In each decision teachers have an opportunity to attempt to do right by Black students, knowing that instructional situations often do not always have an ideal solution. Unsolvable problems are best managed through strategic improvisation, and my hope is that (White) teachers will make decisions with an eye toward the possibilities to do right by Black students.

## How Teachers Can Do Right By Black Students

To communicate how the three standalone projects in my dissertation research contribute to understandings that move beyond equity, I present a discussion on how (White) teachers can do right by Black students. I use the following three themes to organize the discussion: (a) develop a racialized lens, (b) use a balanced approach, and (c) recognize that context matters. In my discussion of the recommendation for teachers to develop a racialized lens, I return to my evolution in developing a consciousness about race, as well as looking to the racialized experiences of my husband as an African American boy in school. I also revisit some of my experiences grappling with Whiteness in hopes that this can serve as an example for other White teachers. Next, I present a description of a teacher at Applegate and her decisions in managing problems of practice in her classroom with her intent to do right by Black students. This teacher, Ms. Johnson (pseudonym), uses a balanced approach in a strategic way with her students' best

interests as the main influencer on her actions. Finally, as I consider how context matters, I present several thought experiments to help the reader unpack how the particular context of a school, the students, and a teacher can inform how to do right by Black students.

**Develop a Racialized Lens**

For (White) teachers to do right by Black students requires they understand their students through a racialized lens. In order to develop and apply such a lens, White teachers need to start the process, if they have not yet, of grappling with Whiteness. Seeing teaching through a racialized lens is at the heart of doing right by Black students. Working to be an ally by approaching teaching with an anti-racist agenda takes time and is an ongoing journey. It is essential though. Otherwise efforts toward equity are not always in the best interest of Black students. For instance, using direct instruction to teach computation skills in order to attend to the achievement gap can be problematic if teachers do not have an awareness of the sociocultural and historical ramifications of systemic racism and inequalities. The motivating factor in this instance would be a societal message of fairness, rather than understanding the disparate treatment of Black people that led to the disparate outcomes. With the former perspective a possible accompaniment is deficit-minded thinking about Black students, and teachers as the saviors. Instead, teachers can act on their intentions to do right by Black students, a perspective that sees Black children as capable and having particular strengths, while being in a situation that requires careful attention to address students' academic and social/emotional needs. Through a process of grappling with Whiteness, my hope is that

White teachers begin to see Black students, as well as the curriculum and pedagogy, differently than they may have prior to beginning this work.

I return to my husband's experiences as a child and his detest of learning through menial practice that requires long periods of time sitting still, and rare opportunities for dialoguing with peers about the content, as well as, nonexistent project-based learning that connects to real-world scenarios and brings together skills and big ideas. He experienced what would be categorized as more traditional instruction, and this was coupled with racist labeling of Black boys from White teachers. Here, what might have contributed to better learning experiences for him are opportunities to engage in whole class discussions or some alternative involving argumentation and a chance to be the authority, and to have his thinking valued. I wonder how my husband would have felt being in a conversation such as the ones I described in Chapter 2 in which a group of spontaneous boys talk about mathematics in student-led conversations. Also, I think he might have thrived with challenging tasks that are rigorous and meaningful within seemingly realistic contexts. These are just some of the practices that might have made him feel empowered in his schooling experiences, particularly in learning mathematics. Also, for White teachers to do right by him, they would need to unpack the racism that drove their judgments about his behaviors and consider how the curriculum and pedagogies were communicating low expectations for Black students.

In the case of my dissertation research, I found that I grappled with Whiteness as I realized I had made assumptions about reform-oriented teaching being the ideal for Black students in an urban school wide Title I school without understanding how the curriculum and pedagogical approaches would be received. Also, through my examination of

language usage I found assumptions within the reform curriculum CMP about what students should be able to do and understand. Again, this felt like a lesson in identifying and wrestling with Whiteness, in that these assumptions could preclude students from certain populations from accessing the content.

This dissertation is not a prescription of how to develop a racialized lens. I share my personal journey of developing race consciousness in Chapter 0. Though, I caution White teachers to not think of this as something one accomplishes. Rather, White teachers need to grapple with Whiteness through an ongoing process of constantly being aware of and questioning our assumptions, beliefs, words, and actions, and importantly turn a critical eye to the systems, policies, and procedures in place that marginalize certain populations of students. This includes coming to know the history of oppression in our country and the present day discrimination of certain populations. Forming a racialized lens means being aware of how people's experiences are affected by race. This starts with recognizing White privilege. While White people can never truly understand what it means to experience institutional and individual racism, forming a racialized lens involves finding ways to learn about and sympathize with Black people's negative experiences in this country. From this White teachers can begin to think about how they can do right by Black students. I turn now to ways in which a balanced approach, meaning drawing on both reform-oriented and traditional approaches is part of how teachers might do right by Black students.

**Use a Balanced Approach**

Ms. Johnson, a science teacher, has been teaching for close to twenty years, and teaching at Applegate for nine years. I share ways in which I see her taking into account

what it might mean to do right by Black students as she addresses the various situations that arise in teaching science. I understand that this does not necessarily directly translate to mathematics teaching, but there are enough similarities that make this example worthwhile to use as an illustration of what I have learned about how a teacher can attempt to do right by Black students. First, I offer some background information on Ms. Johnson so that the reader can feel like they know something about her and how she is perceived, prior to sharing some of the ways I see her going beyond the traditional notions of equity in her teaching.

Ms. Johnson is a well-respected teacher at Applegate. I know this from the way administrators and other teachers talk about her. She often is given the title of best teacher in the building by staff, as well as, students. Students often hug Ms. Johnson and their interactions with her usually involve her referring to students with the endearing term "baby" that captures her motherly role in many of their lives. There are students too who do not feel this affinity for Ms. Johnson, particularly in moments when they endure her consequences. I believe this is because she sets high expectations, and is extremely consistent in holding students accountable for their actions, particularly completing work and doing so in the way that she specifies. She is an African American teacher who uses an interactional style with students that is part of a shared historical and cultural heritage with the students. The ways in which this helps her build strong relationships with students cannot be understated, yet I look to aspects of Ms. Johnson's teaching that are considerations for White teachers. I also describe how I came to know Ms. Johnson's teaching and how my views of her teaching have evolved through this dissertation research.

At one point, my principal at the time suggested that I observe Ms. Johnson's teaching to see how she communicates expectations and uses strategic language to provide details about the daily investigation and the science content under study. This was earlier on in my career at Applegate when my principal at the time felt I could improve by being more direct and more strategic in using particular words to communicate particular things. From a casual observation in which I popped into her class for a short amount of time after asking if it would be okay, I remember noticing how direct Ms. Johnson was in everything she said. There were very few questions about what to do or how to do it because she spelled it out. I saw this directness particularly when it came to students learning the academic register, and language in general. Ms. Johnson was known as the teacher who uses big words. She exposed students to advanced level terms and phrases, and not just in her use of science terminology, but also in her ordinary language. What stood out to me is how explicit she was in breaking down these words while the class applied and built their scientific understandings. Further, she was direct in communicating an expectation of students that they are responsible for building their understandings of the academic vocabulary, particularly terms from the science content. Students were expected to define and memorize science terminology on a weekly basis, and I found that students in my advisory were constantly studying their lists of words. From a reform perspective this type of practice is seen as ineffective given the disconnect from the application of the words, yet Ms. Johnson felt her students needed both opportunities to learn terms in a context and through isolated study.

By stating what I noticed, I am not suggesting that this is what teachers should do, but rather, it is through this dissertation that I realize how these experiences create access,

and therefore empower Black students. Ms. Johnson makes strategic decisions in the way she speaks, what she says, and how she approaches each instructional situation to ensure that she is clearly communicating to her particular students the content she is teaching. As I watched Ms. Johnson on this occasion and several other times in a school year immediately prior to conducting my dissertation research, I had conflicting thoughts about her teaching methods. On the one hand, I appreciated her directness. On the other hand, as I thought about reform-oriented teaching in mathematics education and related movements in science education, I worried that she might be doing too much telling, and in doing so, not letting students' construct their own understandings and not building from students' ideas. In other words, I wondered if maybe she was not reform-oriented enough. On one occasion I video recorded her classroom for an interdisciplinary mathematics and science methods course I was teaching. As the class examined the video, I remember pointing out to teacher candidates that ideally Ms. Johnson might adapt some of her practices (to be more inline with reform-oriented teaching). This is not how I see Ms. Johnson's teaching now. My views on her teaching have shifted.

From this dissertation research, I kept thinking about Ms. Johnson's classroom and how much it felt like the way she handled each instructional decision was done with attention to her wanting to do right by Black students. I realize now that through Ms. Johnson's directness within her balanced approach, she is attempting to give her students access to the culture of power (Delpit, 1986, 1988), and striving to build Black students' opportunities for success (Martin, 2006). Ms. Johnson's various practices to develop students' knowledge of the science register makes me wonder about my approach of using more casual language in whole class discussions. I do not necessarily think using

common language, especially early on in a unit is problematic, although I wondered if I did enough to give my students an opportunity to learn the mathematics register. Further, I thought about the limited availability of academic language in the student text within reform curriculum (e.g., Brantlinger, 2011). I juxtaposed the limited exposure in the discussions and text with Ms. Johnson's practices around learning science terminology, and from this began to think again about the idea of a balanced approach to teaching and learning language skills in technical content areas of math and science (e.g., Delpit, 1986).

In terms of Ms. Johnson's directness, I began to think about how this might be related to the outcomes of her mini-science labs/activities and students' written products displayed outside her room. Specifically, I saw students focused and engaged in the highly structured labs. There did not seem to be many questions about how to proceed or overwhelming confusion around what might be happening. Students knew what to do, how to do it, and seemed confident in their understandings about the content under investigation. What I did not see in Ms. Johnson's room is open-ended explorations from which discussions are happening based on different ideas from students that emerged in the investigation. Not to say that these never happened, but this was not the way she typically approached teaching in that nothing was every overly open-ended, rather she preemptively addressed confusion to keep it from derailing students' learning. In other words, she found a balance between the cognitive demand of the hands-on activities and explicitly laying out the procedures, steps, and processes for an activity in an attempt to provide access. In providing this type of scaffolding she may have lowered the cognitive demand of an activity, but in doing this, again access became the priority. This reminds

me of Martin's (2000) findings that Black students' accomplished more when given the support they needed in handling new and challenging tasks, rather than being left to figure it out on their own.

For many Black children, particularly in predominantly minority schools, the chance of having hands-on science activities at an early age is much less likely than affluent White students (Young, 2005). Further, Black students coming from families with limited resources might not have the types of experiences outside of school, such as, at home science experiments or Saturday trips to the science center that more affluent White peers experience. This is not a critique of Black families, but rather a reality that is shaped by countless factors affecting Black parents' and students' perspective on schooling (Martin, 2000), such as, the educational debt (Ladson-Billings, 2006), intergenerational wealth disparities across racial groups (Kraus, Rucker, & Richeson, 2017), and community forces that shape how people see what roles in society apply to them (Martin, 2000) and which institutions, if any, or fields of study offer learning experiences that do not denigrate or require abdicating Black identity and culture (e.g., Coates, 2015; McGee, 2013). My sense is that Ms. Johnson understands this. Her practices give access and create engagement, yet she does not use open-ended investigations that could result in confusion and disengagement.

This brings me back to the summer experiences at the private school in which my students and I were exposed to reform-oriented teaching for the first time. At that time I felt compelled to give my students those types of opportunities. Through this dissertation, my thinking has evolved. I believe this work raises more questions than answers about reform-oriented teaching, and specifically in relation to teaching Black students.

This brings me to another example in Ms. Johnson's classroom in which she handles situations of reading comprehension mismatch, something other teachers at Applegate often complained about. Specifically, Ms. Johnson utilizes texts at different levels and groups students together who have a range of science and reading readiness/performance levels. She assigns each student within each group to a text, and they are expected to use a given text to address questions and become an expert of sorts based on the information in their text. Now, these various texts and the way Ms. Johnson uses them might not be ideal in terms of reform-oriented science teaching, but for Ms. Johnson this does not matter, she bases decisions on her students' academic needs, which to her means attending to different readiness levels with different opportunities that allow all of her Black students to access the content. Students are then given opportunities to share with each other, as well, through strategic activities that value everyone's thinking, so students are learning from each other too.

Ms. Johnson does a balancing act between pedagogical approaches that are often viewed in the literature as distinctly different and contradictory practices. She does not worry about whether she is a reform-oriented teacher versus traditional, she instead worries about what her students need based on how she understands them and their backgrounds. From this dissertation work, and in line with others in the field, I urge educators and researchers to move beyond dichotomous discourse and toward a hybridization of pedagogical approaches, what I refer to as a balanced approach, that can be seen as part of the role of teaching mathematics within a particular context with particular students (Chazan et al., 2016). Next, I share how recognizing the importance of context is part of how White teachers can make decisions to do right by Black students.

**Recognize that Context Matters**

The context of a school and a classroom inform what makes sense and is in the best interest of Black students. Take for example, a class at Applegate in which there are 27 to 30 students and only 65 minutes of instructional time each day. In another class, there are 17 students and extended time beyond the regular class periods (80 minutes as compared to 65 minutes). In which classroom are daily whole class discussions feasible and worthwhile? Decisions about whether or not to use whole class discussions and how a teacher facilitates these should be informed, in part, by context. In my classroom these discussions made sense. For Ms. Johnson, in her 65 minute classes of 27 to 30 students, leading whole class discussion did not necessarily make sense. Also, in addition to shorter class periods and a larger group, Ms. Johnson had students with a wider range of readiness abilities than in the math classes (there is no tracking in science classes at Applegate). Small group discussions were instead a way that students could share their thinking and learn through talk.

In another example in which context matters, I look at the strategic efforts I made through equitable participation to try to positively affect students' opportunities to participate and their perceptions of their mathematical ability. What would happen to Sasha, a high performing Black student, had the context been a predominantly White classroom in which she consistently raises her hand and is only called on to share once per class period? It seems the benefits of this practice are context specific. Equitable participation in a predominantly White class with only a few Black students might send the wrong message to Black students who possibly come to this type of mathematics classroom already feeling insecure and vulnerable to the effects of stereotype threat

(Steele, 1997). Yet, in a class with all Black peers, Sasha came to see equitable participation as part of her role in helping, as she learned to step back to let others have opportunities to learn.

These thought experiments show how the role of context matters at different levels. First, teachers need to be aware of context when thinking about how their teaching decisions affect the whole class, and also teachers need to consider how their actions affect individual students given a particular context. This is something administrators need to take into account as well. I think back to my first teaching experience and the overrepresentation of Black students in office referrals. It was a diverse school with an overwhelming majority of White teachers (only two Black teachers in a school of 700 students). A mismatch in interactional styles, as well as, a limited number of White teachers holding a racialized lens resulted in a negative learning environment for Black students. If equity is something that teachers and administrators want to address, as most would say they do, the context of a school has to inform decisions to do right by Black students. In the case of this school, the administrators should be making strategic efforts to hire more Black teachers, to offer trainings around culturally responsive teaching, and to bring Black parents to the table for discussions around how the school could better serve their children. I share now recommendations for future directions in practice and research.

## Future Directions for Practitioners & Administrators to Do Right By Black Students

Black educators need to be included in the conversations about how teachers can do right by Black students (Delpit, 1986, 1988). Even though Black educators are of a

different socioeconomic status than students in schools serving predominantly low-income students, such as Applegate, they have an important understanding that comes from sharing a lived experience of being Black in the United States (Martin, 2000). These educators were at one time students in the same system of schooling that continues to struggle with the same issues around race and equity. I look to Martin's (2007) conceptualization of the experiences of Black students, and thereby Black educators who were once Black students:

> African American students are indicators of the ways they experience mathematics learning and participation as *African Americans.* To suggest that African American students experience mathematics as African Americans does not imply that there is a singular or fixed African American way of learning. Rather it suggests that societal, hegemonic meanings for blackness as well as African Americans' own internalization of and meaning making for their experiences shape teaching and learning processes (Martin 2007, p. 15).

Through the collective experiences of learning mathematics while Black (Martin, 2012), there are understandings that come with seeing mathematics teaching and learning through a racialized lens. This includes knowing the realities of how Black students will be perceived and what skill sets will be most valuable to them. It means knowing how they themselves navigated schooling and what worked well for them and what would have been better.

I would argue that most White educators I have encountered do not look at teaching through a racialized lens and their experiences in school are not necessarily

relevant to that of Black students. Also, most often White teachers do not have as strong of relationships with Black students and their families as compared to Black educators (Douglas, Lewis, Douglas, Scott, & Garrison-Wade, 2008). From this, Black teachers may know their students in ways that can help inform what it is that would be best for their academic needs (Delpit, 1986). Their contributions are essential in helping (White) teachers determine how to do right by Black students in particular instructional situations. I urge administrators, in particular, to set an example of being inclusive of Black educators in the instructional leadership conversations.

From a leadership standpoint, Applegate has work to do around inclusivity of Black teachers. I saw this when an African American math teacher left shortly after I departed for graduate school because she did not feel valued by the administrators or the new sixth grade mathematics teacher who had replaced me. This particular teacher worked hard to do right by Black students through a balanced teaching approach and taking into account a particular context, and yet the administrators and other colleagues did not see it. Unfortunately, this is a common experience for Black educators (Delpit, 1986).

In addition to a role for Black educators, Martin (2006) contends that "African American parents must become meaningful partners in mathematics education reform" (p. 224). Parents often are central in shaping how students think about and approach the school subject of mathematics, and this is informed by their own learning experiences. By including parents in conversations about mathematics teaching and learning, White teachers, in particular, can come to better understand how to support Black students in learning mathematics. I now share future directions for research.

## Future Directions for Research to Consider How to Do Right By Black Students

This dissertation research illustrates the uncertainty in teaching. Only Chapter 2 focuses directly on analyzing dilemmas in practice, yet in the research in Chapters 3 and 4, what I find are dilemmas that emerge. More specifically, there are dilemmas for mathematics teachers to manage around language choices when facilitating whole class discussions. Certainly, teachers can improve their practice of facilitating discussions by adjusting the way they say certain things and when, but there are also quandaries around using academic terminology versus ordinary language, and considerations for how this changes early on in a unit or an investigation versus later on, and particularly when considering how this affords or constrains Black students' opportunities to learn. In Chapter 4, as well, there are dilemmas in the decisions teachers make about participation. One particular dilemma is whether teachers should use equitable participation or call on high performing students more frequently than low performing students.

Considering that teaching is an uncertain practice and there are countless situations that could be dilemmas, more research is needed around the dilemmas in teaching. I could envision a catalogue of dilemmas in practice with context as an organizing variable. Even though no dilemma is exactly the same in that teachers have different students and bring varied resources, there is much to learn from other teachers facing similar dilemmas, particularly if there is an analytical framework that can capture the broader aspects that influence the nature of teaching mathematics, such as the model put forth by Chazan et al., 2016.

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