THE INSTRUCTIONAL PRACTICES AND PERSPECTIVES OF HIGHLY EFFECTIVE TEACHERS OF BLACK STUDENTS: CASE STUDIES FROM MATHEMATICS CLASSROOMS

By

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To Matthew

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The purpose of this dissertation was to understand how teachers who are successful with low-achieving students of color living in poverty supported their students in learning mathematics. Standards-based instruction and culturally responsive teaching (CRT) have both been suggested as pedagogical approaches that may support traditionally underperforming students of color living in poverty to succeed in mathematics. Some research indicates, however, that these students may struggle with elements of standards-based instruction such as the open, contextualized nature of problems and classroom discourses (Lubienski, 2002; Zevenbergen, 2000). This dissertation extends prior research by examining the potential of both standard-based instruction and CRT to support students to succeed mathematically. This collective case study examined the perspectives and instructional practices of two mathematics teachers identified as highly effective with students of color and whether their instruction aligned or did not align with standards-based instruction and CRT.

One seventh-grade mathematics teacher and one high school Algebra I teacher were identified through a nomination process as highly effective with traditionally

underperforming students of color. Data collection methods included observations, interviews, and the collection of documents. Data were analyzed using qualitative methods to identify themes both within and across the cases.

Each case study describes the teacher's goals, psychological environment of the classroom, and the daily classroom practices and beliefs of the two teachers. The cross-case analysis examined similarities and differences between teachers and how their beliefs and practices aligned or didn't align with standards-based instruction and CRT. Both teachers were found to have strong, caring, and respectful relationships with their students. There were elements of both teachers' instruction that aligned with CRT, and one teacher adopted a warm demander pedagogy. That teacher's instruction was also aligned with standards-based reform. The other teacher's mathematics instruction was procedurally based and adhered to a pedagogy of poverty (Haberman, 1991). Implications for these results as well as limitations of this study and further research are discussed.

CHAPTER 1
INTRODUCTION

The National Council of Teachers of Mathematics (NCTM, 2000) emphasizes that all students can, and should, learn mathematics. Unfortunately, many American students are not learning at the level at which they are capable. Schools in America are failing students who grow up poor or who fall outside the racial categorization of “white”; there is a gap between the achievement of students of color and students living in poverty and the achievement of their white, middle class peers (Rothstein, 2002). This gap is especially evident in mathematics, where students of color and students who live in poverty are persistently placed into low-track courses (Kelly, 2009) and perform at particularly low levels on standardized tests (Davis & Martin, 2008; Dewan, 2010). Such issues and their effects are problematic, partially because mathematics, and particularly algebra, is a gate-keeping subject (Kelly, 2009; National Research Council [NRC], 1989; Schoenfeld, 2002; Thompson & Lewis, 2005). Students who do not perform well in mathematics are less likely to attend college and gain the skills – mathematical or otherwise – needed for success in our globalized society (Friedman, 2005; NCTM, 2000; NRC, 1989). In an era during which the economy is unstable (Harrington, 2010) and students of color are gaining in numbers (Banks et al., 2005), quickly becoming the majority in some parts of the nation (Dewan, 2010), the issue of the underachievement of these students is persistent and unacceptable. This dissertation will explore the potential of both standards-based mathematics instruction and culturally responsive teaching (CRT) for ensuring an equitable education for all students. Of particular interest is whether these two teaching approaches intersect in the classroom. The study described examined the teaching practices of successful secondary mathematics teachers of students of color living in poverty.

A Comment About Terminology

In examining the issues underrepresented students face related to mathematics, cultural differences, and social class, I use the phrase *students of color* to describe non-Asian students of color, which includes (but is not necessarily limited to) blacks, Latinos and Hispanics, and Native Americans. Other terms often found in the literature, including *minority* and *non-white,* imply a deficit perspective that I seek to avoid. Similarly, *students living in poverty* and *students from low-income families* are more appropriate phrases than *poor, disadvantaged,* or *low class* students. Finally, I recognize that labels are imperfect: not all students of color live in poverty, not all students living in poverty are also of color, and not all students in these categories struggle in school. The life experience of each child is unique, and there exist many examples of people who are the exception and become quite successful despite the constraints placed on them because of their heritage or social class (consider, for instance, the cases of Barack Obama, Frank McCourt, and J.K. Rowling). Because children of color are more likely to come from low-income families than white children (Rothstein, 2002) and because they often face similar challenges, students of color and those living in poverty will mainly be referred to jointly in this paper. Again, the intention is not to “lump together” these students but rather to highlight the struggles, challenges, and promising lines of research in education affecting their achievement in mathematics.

Theoretical Perspective

Vygotskian sociocultural theory emphasizes the importance of students' cultures in the learning process (Forman, 2003; Gee, 2008; Lubienski, 2002), something reform pedagogy does not inherently do. Some students face challenges in discussion-rich, standards-based classrooms (Lubienski, 2000a, 2000b, 2002; Zevenbergen, 2000) that are not due to students' inabilities to succeed or problems with reform per se, but are instead the result of teachers not integrating knowledge of students' cultures into their instructional practices. According to Goodnow (1990, as cited in Forman, 2003), "failure to learn may indicate an unwillingness to identify with a particular teacher; a mismatch among the motives, beliefs, norms, goals, and values of teachers, students, and their families; or cultural or linguistic barriers to effective communication" (p. 336). Gee (2008) additionally argues that social, emotional, and cultural issues must be attended to when considering how knowledge is acquired. For instance, for deep learning to occur, new knowledge must be integrated with old, but what of those learners in the same instructional setting who have different prior knowledge bases, such as students with different cultural and economic upbringings? Are they receiving the same opportunity to learn (OTL) if the teacher doesn't address that dilemma? Another example highlighted by Gee is the input/intake problem, which contrasts what one is exposed to with what one actually processes (i.e., learns). Not everyone takes up the input they are given, often because their "affective filter" is raised. When the learning situation itself is what is causing the affective filter to rise, students will not intake the intended information. Furthermore, academic language builds on students' already-acquired vernacular language; it is the same with culture. Students have a culture they bring to school with them, and the school culture must build upon that. If school culture resonates with one’s “vernacular” culture, learning is enhanced. If it conflicts with or fails to connect to the vernacular culture, however, one’s affective filter may rise and intake doesn’t occur. This is particularly important when considering issues of equity because the vernacular culture of middle class students tends to overlap with school culture (Gee, 2008). Underrepresented populations (e.g., students of color and students who live in poverty) are often still very smart and capable, and they engage in poetic and complex discourse, yet they may struggle academically because their vernacular culture is in conflict with that of the school (Gee, 2008; Lubienski, 2000a, 2000b, 2002). In standards-based mathematics classrooms, then, teachers can’t expect to engage students in deep mathematical learning without also attending to the diverse knowledge and histories of their students. To date, and despite calls for socioculturally based research that addresses the role of culture within reformed classrooms (Gee, 2008; Lubienski, 2002), there is little literature that specifically addresses the interplay between culturally responsive and standards-based mathematics teaching. This dissertation seeks to fill that gap. In the next section, some of the challenges students of color living in poverty face that may affect their academic success will be explored in further detail.

Opportunity and Culture: Explanations of Failure

Students of color and students who live in poverty often do not receive the benefits from schooling that their white, middle class peers receive (Banks et al., 2005; Brantlinger, 2003; Gutstein, Lipman, Hernandez, & de los Reyes, 1997). These students face disproportionately high suspension, expulsion, and incarceration rates (Books, 2007; Banks et al., 2005; Dewan, 2010; Tutwiler, 2007; Wald & Losen, 2007), causing frequent absences that limit one’s OTL. Additionally, these students drop out of school more often (Banks et al., 2005; Books, 2007; Dewan, 2010; Tutwiler, 2007), with many of them reporting feeling “pushed out” by teachers and other school personnel (Hondo, Gardiner, & Sapien, 2008). The lack of academic success faced by students of color and students living in poverty, and particularly their struggles in mathematics, are not the result, as some might suggest, of racial differences, incompetence, laziness, disability, or uninvolved parents (Corbett, Wilson, & Williams, 2002). Some authors (Burdell, 2007; Hinchey, 2004; Tatum, 1997) argue that contrary to popular opinion, America is not a *meritocracy*, so that “working harder” in school does not always result in higher levels of achievement. Rather, there are certain political, societal, and belief structures in place in American schools that make high levels of mathematics achievement difficult for students of color and those living in poverty to attain (Brantlinger, 2003; Hinchey, 2004). These include inequitable access to a quality education and a disconnect between students’ home cultures and the culture of their school.

Inequitable Access to Education

Gaps in the mathematics achievement of students from low-income families and students of color may result from inequitable OTL. Schools in impoverished neighborhoods receive less funding because of the economic base of the neighborhoods in which they are located, and thus the schools are typically of lesser quality and lack adequate resources in these neighborhoods (Banks et al., 2005; Brantlinger, 2003; Flores, 2007). Additionally, they tend to be staffed by less experienced or less effective teachers (Banks et al., 2005), meaning students who need the most qualified teachers are the least likely to have them (Flores, 2007). Parents living in poverty who send their child to the neighborhood school often don’t possess the financial means to provide the tutoring, after-school care, or even the supplies needed to compensate for the low teacher quality and lack of school resources (Brantlinger, 2007). At the same time, teachers, who tend to be white and from the middle class (Banks et al., 2005; Burdell, 2007; Hagiwara & Wray, 2009), often hold low expectations for their students (Corbett et al., 2002; Thompson & Lewis, 2005), focusing on students' failures rather than their successes (Thompson & Lewis, 2005).

A major contributing factor to the low mathematics achievement of students regarding OTL is tracking systems. Tracking is the practice of grouping students of similar achievement levels together. Decisions about tracking are often made based on standardized test scores on which students of color perform poorly (Dewan, 2010; Post et al., 2008; Rothstein, 2002; Tutwiler, 2007) and which may be biased against them (Davis & Martin, 2008), as well as on factors unrelated to academics, such as behavior and race (Berry, 2005; Kelly, 2007). The result is that students of color, and particularly black students, are disproportionately tracked into low, non-college bound mathematics courses so that upper-track courses are available predominantly for white, middle class students (Banks et al., 2005; Boaler, 1997; Kelly, 2009; Williams, 2000).

Low-track courses do not provide students with the same opportunities to learn mathematics that they may have in higher tracks. The instruction in low-level mathematics courses is typically oriented toward skills and procedures rather than concepts, invention, creativity, and experimentation (NCTM, 1999; Webb & Romberg, 1994; Weiss, 1994). There exist critiques of mathematics instruction that is skill-oriented for all students, as this instructional approach does little to support deep conceptual mathematical knowledge (Boaler, 1997; Davis & Martin, 2008; NCTM, 2000). Such a skill-oriented approach may be more problematic, however, for students of color than for white, middle class students. For instance, the practice of “teaching to the test” common in lower-track courses may contribute to the oppression of underrepresented groups (Davis & Martin, 2008). In fact, teachers of struggling students have been found to “dumb down” content, making it more procedural, rather than pushing students to develop conceptual understanding and mathematical thinking (Watson, 2002). Thus, once placed in a low track, students will likely never move out of it (Balfanz & Byrnes, 2006; Kelly, 2009; Schoenfeld, 2002), but will instead fall even further behind (Balfanz & Byrnes, 2006). This becomes particularly problematic at the high school level, where algebra is typically a requirement for graduation (e.g. California Department of Education, 2010; Florida Department of Education, 2007) and is a key component of the recently adopted Common Core State Standards for Mathematics (CCSSM) (Common Core State Standards Initiative [CCSSI], 2010). Algebra serves as a gatekeeper to higher-level mathematics courses, overall school success (Kelly, 2009), high school graduation, college attendance, technological literacy (NRC, 1989; Schoenfeld, 2002) and mathematics and science careers (Thompson & Lewis, 2005). As a result, the policies and practices that exist in schools and which prevent some students from reaching their potential as learners of mathematics – and particularly algebra – may have long-term negative consequences on their opportunities for success in school as well as in college and their future careers. Compounding this problem of inequitable OTL is the issue of culture, the topic of the next section.

The Home-School Cultural Disconnect

Tracking, discrimination, poorly funded schools and low expectations have all been cited as reasons for the low achievement in mathematics of students of color and students living in poverty. Even when these issues are not at the forefront of one's experiences, however, mathematics achievement is still persistently low for these students. This may be because the cultural and racial identities of students of color and those living in poverty are not valued in most schools (Brantlinger, 2003; Ladson-Billings, 1994, 1995a; Tate, 1995; Tatum, 1997; Tutwiler, 2007; Wald & Losen, 2007). Intelligence, the language of mathematics, and what counts as legitimate mathematical knowledge are socially and culturally constructed (Sternberg, 2007; Zevenbergen, 2000). The social norms, practices, behaviors, ways of speaking, and skills valued in school are consistent with those of white, middle-class Americans (Brantlinger, 2003), and students who are unfamiliar with that culture often struggle to succeed (Banks et al., 2005; Brantlinger 2003; Tatum, 1997; Tutwiler, 2007; Wald & Losen, 2007; Zevenbergen, 2000). For instance, a common discourse pattern in the mathematics classroom follows the Initiation-Response-Evaluation (IRE) pattern (Herbel-Eisenmann & Breyfogle, 2005; Zevenbergen, 2000). In this exchange, the teacher poses a question (e.g., "What is the slope of the line $y = 2x – 4$, Quantavius?"), the student responds ("Two."), and the teacher evaluates the response ("Correct."). Should the student respond incorrectly, the teacher typically gives the answer to the class or initiates another cycle of the pattern (e.g. "Not quite. Julia, can you tell me the slope?"). IRE not only perpetuates a power structure with the teacher holding all the knowledge in the classroom, but these practices are rarely taught to students explicitly (Gee, 2008). They must instead learn appropriate ways of communicating through observation and participation, which can be difficult unless the discourse patterns one learns at home are somewhat congruent to those used in school (Gee, 2008; Zevenbergen, 2000). In an observation of mathematics classrooms in the middle grades, Zevenbergen (2000) found that middle class students complied with the IRE discourse pattern. In contrast, students from working class backgrounds frequently challenged the teacher's authority, broke the IRE pattern by calling out, and otherwise did not conform to the expected norms of discourse, ultimately preventing the teacher from completing the lesson in the way she intended. This suggests that behavior problems such as speaking out of turn may be due in large part to a misunderstanding of the linguistic norms of the classroom, not to intentional misbehavior. The result is that students from low-income families "may be excluded from significant mathematical knowledge" (Zevenbergen, 2000, p. 216). In contrast, researchers have found that when teachers use the language patterns similar to those of students' home languages, their mathematics performance improves (Mohatt & Erickson, 1981; Peterek, 2009). Thus, connecting students' vernacular cultures (Gee, 2008) to the school culture holds potential for improving achievement levels.

Another example of the influence culture can have on student achievement is related to what is taught in mathematics courses. Mathematics is portrayed as something created by white Europeans (e.g., Newton, Gauss, Pythagoras and Fibonacci). Students of color don't see their histories represented in what is taught in their classes, which may prevent them from feeling connected to the subject or from perceiving themselves as capable (D'Ambrosio, 2001), ultimately contributing to low engagement and achievement. While the issues of cultural incongruity will be explored in further chapters, these examples highlight the disconnect between the mainstream culture valued in schools (i.e., that of white, middle class Americans) and that of students of color and who live in poverty.

Summary

Students of color and students who live in poverty tend to struggle more in school than their white, middle class peers (Banks et al., 2005; Brantlinger, 2003; Gutstein et al., 1997). For example, these students often perform poorly on standardized tests (Dewan, 2010; Rothstein, 2002; Tutwiler, 2007) and demonstrate lower levels of problem-solving ability than their peers (Post et al., 2008). Furthermore, students of color students tend to enroll in advanced high school mathematics courses at much lower rates than their white peers (Kelly, 2009; Thompson & Lewis, 2005). There are many reasons for these disparities in enrollment and achievement, including out-of-school factors such as poor health (e.g., high levels of stress, malnutrition, greater exposure to violence; Fiscella & Kitzman, 2009); lack of stable housing; and income inequality (Rothstein, 2002) as well as in-school factors such as lack of funding in impoverished schools (Banks et al., 2005; Brantlinger, 2003; Flores, 2007), high numbers of inexperienced or ineffective teachers in low-track courses and high-poverty schools (Banks et al., 2007), biased standardized tests (Davis & Martin, 2008), and the practice of tracking students of color and who live in poverty into low-level mathematics courses (Kelly, 2009). This dissertation focuses on the instruction students of color who live in poverty receive. Prior research indicates instruction for high poverty students of color typically focuses on skills and procedures rather than concepts (NCTM, 1999; Webb & Romberg, 1994; Weiss, 1994), and this low quality instruction is one of the most cited reasons for the persistent underachievement in mathematics of these students. Teachers in low-track classes frequently teach to the test (Davis & Martin, 2008), dumb down content (Watson, 2002), and teach procedurally (Webb & Romberg, 1994; Weiss, 1994). For students, the result of this traditional teaching approach is often a lack of deep mathematical understanding (Boaler, 1997; Davis & Martin, 2008; NCTM, 2000). A second reason often cited for the low achievement of students of color living in poverty relates to the issue of culture: the cultural heritage and racial identities of students of color and students from low-income families typically are not valued or represented in schools (Brantlinger, 2004; Tatum, 1997; Tutwiler, 2007; Wald & Losen, 2007). Instead most schools value skills, behaviors, attitudes, and ways of speaking that are typical of white students (and white teachers) but that conflict with the cultural norms of culturally and economically diverse students. The literature describes strategies for addressing these two reasons for underachievement (i.e., traditional mathematics teaching and the home-school cultural disconnect), and this dissertation focuses on two systems of instruction that may support students in learning mathematics conceptually and promoting equity: standards-based mathematics instruction and CRT. The following sections will briefly investigate the literature on these two areas.

Overview of the Literature

Standards-based Mathematics Teaching

As described earlier, traditional mathematics instruction, the most common teaching method in the U.S. (Hiebert et al., 2005; NCTM, 2000), is characterized by direct instruction, rote memorization (McKinney & Frazier, 2008), an over emphasis on procedural knowledge, and, as a whole, a focus on lower-level mathematical skills rather than conceptual understanding (Hiebert et al., 2005). This type of instruction is prevalent in schools with large populations of students of color and students living in poverty (McKinney, Chappell, Berry, & Hickman, 2009; McKinney & Frazier, 2008; Weiss, 1994) and is problematic for this population because it is incompatible with the way students learn (NRC, 1989) and does not allow them to engage with the mathematics in a meaningful way. In an effort to improve mathematics instruction and the achievement of all students, the NCTM (2000) issued *Principles and Standards for School Mathematics* (PSSM). PSSM describes standards for pre-kindergarten through twelfth grade mathematics, necessitates a way of teaching that contrasts with traditional instruction, and forms the foundation of standards-based mathematics teaching (Schoenfeld, 2002). These standards address content and the processes through which learning should occur. The focus of this dissertation study is on the five process standards, which are: problem solving, reasoning and proof, communication, connections, and representations. These are not intended to be skills taught alongside mathematics content. Rather, they are simultaneously an outcome of learning mathematics (i.e., a product) and a means through which that learning occurs (i.e., a process; NCTM, 2000).

Recently, the CCSSI released Standards for Mathematical Practices (CCSSI, 2010). These standards are based on the NCTM (2000) process standards as well as the five interwoven, interdependent strands of mathematical proficiency (i.e., conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and a productive disposition; Kilpatrick, Swafford, & Findell, 2001). Like the process standards, the mathematical practices describe outcomes of mathematics instruction that differ from pure mathematical content. These practices can be found in Table 1-1, along with the process standards with which they correspond.

Much of the literature on reform focuses on particular process standards rather than standards-based instruction as a whole. For instance, studies have concluded that students' mathematical understanding (Lambdin, 2003; Schoenfeld, 1987), achievement

(Boaler, 1998, 2002; Charles & Lester, 1984; Ginsburg-Block & Fantuzzo, 1998; Silver, Smith, & Nelson, 1995; Verschaffel et al., 1999), and motivation (Charles & Lester, 1984; Ginsburg-Block & Fantuzzo, 1998) can all be improved when instruction emphasizes problem solving.

Table 1-1. General comparison of attention to process in CCSSM and PSSM. Adapted from *Making it happen: A guide to interpreting and implementing Common Core State Standards for Mathematics* (p. 12), by NCTM, 2010, Reston, VA: Author.

CCSSM Standards for Mathematical Practice	*Principals and Standards* Process Standards
1. Make sense of the problems and persevere in solving them.	Problem Solving Communication Representation
2. Reason abstractly and quantitatively.	Problem Solving Reasoning and Proof
3. Construct viable arguments and critique the reasoning of others.	Reasoning and Proof Communication Representation
4. Model with mathematics.	Problem Solving Reasoning and Proof Connections Representation
5. Use appropriate tools strategically.	Problem Solving Representation
6. Attend to precision.	Problem Solving Communication
7. Look for and make use of structure.	Problem Solving Reasoning and Proof Connections
8. Look for and express regularity in repeated reasoning.	Problem Solving Connections

Rather than focusing on one process standard at a time, as is often done in mathematics research (e.g., Davis & Maher, 1997; Turner, Meyer, Midgley, & Patrick, 2003; Verschaffel et al., 1999), this dissertation extends prior research by focusing on all the process standards that manifest during instruction and which characterize mathematical reform.

A common question regarding standards-based teaching is whether it is more equitable and better supports students who live in poverty to develop deeper conceptual understanding of mathematics than traditional instruction (Boaler, 2002). Several studies suggest that it can (Boaler, 1997, 1998, 2000, 2002; Brown, Stein, & Forman, 1996; Post et al., 2008; Silver et al., 1995). Other studies, however, suggest that students may struggle with the open, contextualized problems and discourse characteristic of standards-based classrooms (Lubienski, 2000a, 2000b, 2002). Lubienski (2002) argues that NCTM (2000) makes strong assumptions about what kind of instruction is best for culturally and economically diverse students, and that learning through the process standards will come more naturally to some students than others because of their cultural background. The communication patterns, preferences, and ways of expressing knowledge common to students of color or who live in poverty may vary greatly from what the process standards expect of them (Brantlinger, 2003; Heath, 1983, 1989; Lubienski, 2002; Mohatt & Erickson, 1981). This does not mean students cannot learn to communicate about mathematics, engage in problem solving, and reason mathematically in a way consistent with the process standards, but rather that the appropriate supports must be put into place by their teacher to bridge the gap between the expected school culture and students' home cultures. This study examines the intersection of standards-based pedagogy and instruction that is responsive to students' cultures and how that may support mathematical learning.

Culturally Responsive Teaching

In addition to standards-based mathematics instruction, CRT has been suggested as a main means of overcoming many of the obstacles students of color living in poverty face (Banks et al., 2005; Bonner, 2011; Gay, 2000, 2002; Gutstein et al., 1997; Ladson-Billings, 1994, 1995a, 1995b, 1997; Peterek, 2009; Tate, 1995). In essence, CRT is an approach that empowers, or enables, students to develop intellectually, socially, emotionally, and politically by bridging the gap between home and school culture, integrating students' home culture into the curriculum, and overall making learning more relevant for students (Gay, 2000; Ladson-Billings, 1994). The goal is to not only support students to become academically successful but also to build their cultural identity and their ability to critique the existing social order (Ladson-Billings, 1995b). This teaching approach is thought to be responsible for the high achievement of traditionally underperforming students of color (Bonner, 2011; Ladson-Billings, 1994, 1995a, 1995b; Gay, 2000, 2002; Peterek, 2009). While studies on CRT sometimes include mathematics teachers as participants (e.g., Ladson-Billings, 1994), most of the literature does not explicitly discuss how this construct interacts with, supports, or otherwise influences mathematics instruction (Gutstein et al., 1997; Peterek, 2009). One researcher (Bonner, 2011; Peterek, 2009)[1] has examined CRT within the context of mathematics classrooms to describe a new construct, culturally relevant mathematics teaching (CRMT). She provides a model of CRMT but fails to adequately characterize the nature of the mathematics teaching within mathematics classrooms or how CRMT differs from traditional or standards-based mathematics instruction. It is also unclear

[1] To clarify, Bonner (2011) and Peterek (2009) were written by the same author, Emily Peterek Bonner.

how CRMT differs from broader definitions of CRT. Conversely, Gutstein and colleagues (1997) provide one model of instruction that explicitly connects CRT with reform, but this research occurred prior to the release of PSSM (NCTM, 2000) and the study was conducted with high-achieving students. This study extends research by explicitly examining both standards-based and CRT practices within mathematics classrooms and how teachers draw on these two teaching approaches to influence students' mathematics achievement.

Statement of the Problem

It is well known that students of color and students who live in poverty struggle in mathematics (Davis & Martin, 2008; Dewan, 2010; Kelly, 2009; Post et al., 2008; Rothstein, 2002; Thompson & Lewis, 2007; Tutwiler, 2007). Standards-based teaching has been theorized as one way to help them overcome these struggles (Boaler, 1997, 1998, 2000; NCTM, 2000), and there is evidence to support such a theory (e.g., Boaler, 1997, 1998, 2000, 2002; Charles & Lester, 1984; Ginsburg-Block & Fantuzzo, 1998; Post et al., 2008; Schoenfeld, 1987, 2002; Van Haneghan, Pruet, & Bamberger, 2004). Teaching in a culturally responsive way has additionally been suggested as a framework for supporting students of color to succeed academically (Banks et al., 2005; Bonner, 2011; Gay, 2000; 2002; Gutstein et al., 1997; Ladson-Billings, 1994, 1995a, 1995b, 1997; Peterek, 2009; Tate, 1995), but prior studies on cultural responsiveness do not adequately characterize the aspects of CRT that are unique to mathematics, nor do many studies describe the nature of mathematics instruction in culturally responsive classrooms. There are few studies that explicitly focus on both standards-based mathematics teaching and CRT (e.g., Gutstein et al., 1997), and the result is two disparate bodies of literature. There is some literature to suggest that students need more than just, for example, the problem-based instruction and class discussions characteristic of reform to support them to learn mathematics, particularly when the norms, communication and interaction patterns, and ways of thinking viewed as necessary to mathematical success are in conflict with the culture of the student (Gee, 2008; Lubienski, 2000a, 2000b, 2002; Zevenbergen, 2002). This leads one to question whether it is the attention to mathematical process standards, students' cultures, or something else that results in some teachers being particularly effective with traditionally underperforming students. More research is needed to understand what mathematics teachers who are successful with this population of students do to support them to learn, both mathematically and pedagogically. The purpose of this study was thus to understand how teachers who are successful with low-achieving students of color living in poverty supported their students in learning mathematics.

Research Questions

There are four research questions that guided this study:

- How do teachers identified as highly effective with students of color living in poverty help their students to engage with mathematical content?
    - What are these teachers' classroom practices?
    - What are these teachers' perspectives of the practices that are important for engaging their students with mathematical content?
- In what ways do these teachers' practices align or not align with standards-based instruction and culturally responsive teaching?

Structure of the Dissertation

The written presentation of this dissertation will include seven chapters. This chapter (Chapter 1) serves as an introduction and includes an overview of the literature to provide context for the study. Chapter 2 provides an in-depth review of pertinent literature, and Chapter 3 is a formal methods section. The results of the dissertation study will be presented in three chapters: two will be dedicated to a case study analysis of each of the two participating teachers (Chapters 4 and 5), and Chapter 6 will be a cross-case comparison of the perspectives and instructional practices of both teachers and a discussion of the findings as related to the literature on standards-based instruction and CRT. A final chapter (Chapter 7) will consist of conclusions, implications, and possible future research directions. Appendices, which consist of an informed consent document and interview protocols, will be included at the end of the document.

CHAPTER 2
LITERATURE REVIEW

Amidst the issues surrounding the low achievement of students of color and students living in poverty are stories of those who defy the odds (e.g., Thompson & Lewis, 2005) and the teachers and pedagogical strategies that help them along the way (Boaler, 1997, 1998, 2000, 2002; Ladson-Billings, 1994, 1995a, 1995b; Peterek, 2009; Tate, 1995; Ross et al., 2009). The following chapter will synthesize the literature from two perspectives on instructional practices that may help to promote equity and support students to engage with mathematics content. Specifically, research literature on standards-based mathematics and CRT will be examined.

Standards-based Mathematics Teaching

Over twenty years ago, the National Research Council (1989) warned educators about the nature of their instruction: "much of the failure in school mathematics is due to a tradition of teaching that is inappropriate to the way most students learn" (p. 6). Unfortunately, this is still the case. Traditional mathematics pedagogy, which remains the most common teaching method in America (Hiebert et al., 2005; NCTM, 2000), is characterized by direct instruction; rote memorization; infrequent opportunities for group work, conversation, or problem solving (McKinney & Frazier, 2008); mechanical procedures, and an overall focus on lower-level mathematics skills rather than concepts (Hiebert et al., 2005; Van de Walle, Karp, & Bay-Williams, 2010). This stands in sharp contrast to standards-based teaching. Additionally, while traditional methods of teaching can result in procedural knowledge (Boaler, 1998; Schoenfeld, 1988), which is one important aspect of mathematical proficiency (Kilpatrick et al., 2001), students taught traditionally struggle to transfer that knowledge to new settings and tend to display low levels of conceptual understanding (Boaler, 1998; Bottge & Hasselbring, 1993; Schoenfeld, 1988). On the other hand, research shows that when instruction is characterized by elements of reform, student achievement – and particularly that of students of color and students who live in poverty – can improve (Boaler, 1998, 2002; NCTM, 2000; Post et al., 2008; Schoenfeld, 2002; Van Haneghan et al., 2004; see also Kilpatrick, Martin, & Schifter, 2003). This improvement, however, is not guaranteed by standards-based teaching (Lubienski, 2000a, 2000b, 2002), an issue that will be addressed in detail in a later section.

Research indicates that traditional instruction is particularly prevalent in schools with high numbers of students of color and who live in poverty (McKinney, Chappell, Berry, & Hickman, 2009; McKinney & Frazier, 2008; Weiss, 1994) and may limit students' engagement with meaningful mathematics. To address the disconnect between the way students learn and the type of instruction occurring in schools, and to encourage teaching practices that are intended to promote equity and ensure the success of all learners, NCTM (2000) issued *PSSM*. In addition to outlining the content that all pre-kindergarten through grade 12 students should learn, this document lists five processes through which learning should occur: problem solving, reasoning and proof, communication, connections, and representation. The process standards are not skills to be taught alongside other mathematical skills, but instead are both a process and a product of mathematics teaching (NCTM, 2000). Teaching mathematics through these five process standards, which are described in detail below, forms the basis of the standards-based (or reform-based) movement in mathematics education (Schoenfeld, 2002) and teaching mathematics for conceptual understanding (NCTM, 2000).

- **Problem solving.** Students engage in solving problems for which no solution method is known in advance. These problems help students to build new knowledge, and are mathematical as well as come from both other disciplines and the real world. Students invent, apply, and adapt multiple solution strategies. Additionally, they monitor and reflect upon their solution processes and understand and critique the strategies used by their peers.

- **Reasoning and proof.** Students develop mathematical argumentation skills in addition to understanding the importance of formal proof in mathematics. They think critically about the mathematics presented to them, ask questions, make conjectures, and generalize patterns. Another key aspect of this standard is explaining and justifying one's reasoning, and particularly, one's use of strategies.

- **Communication.** Students communicate about mathematics as a way to organize and clarify their thinking. They share their thinking with their teacher and peers, and interpret, analyze, and assess the ideas and strategies of others. Finally, students acquire and use mathematical language.

- **Connections.** Students connect mathematical ideas to informal mathematical knowledge, other mathematical ideas, their own experiences, varying contexts, and disciplines outside of mathematics. Students also build conceptual understanding and link concepts to procedures rather than viewing mathematics as only a set of formulae and rules to be followed.

- **Representation.** Students develop an understanding of multiple types of representations, how and when to use each one, and the benefits of each. They additionally are able to represent a concept in multiple ways.

NCTM (2000) argues that these process standards should be integrated throughout all mathematical content areas. Standards-based instruction emphasizes the five processes, as well as social interaction and building on students' formal and informal mathematical knowledge. As a product of standards-based instruction, students should be able to problem solve, reason about mathematics and prove conjectures and theorems, communicate mathematically, connect mathematical ideas, and move fluidly between different mathematical representations. In order to achieve instruction aligned with the NCTM Standards, certain conditions must apply: classroom norms must be set and teacher-centered instruction is exchanged for a more student-centered approach. Moreover, the processes outlined in PSSM (NCTM, 2000) are not mutually exclusive, as each supports and builds upon the other. To illustrate this notion, consider the case of problem solving.

An Example: Integrating the Standards Through Problem Solving

A problem-solving situation is one in which students must struggle to find a solution; there is no known solution strategy at the onset of the process (Hiebert, 2003; NCTM, 2000). As students problem solve, they must therefore go through iterative cycles, during which they invent, adapt, test, revise, and carry out a plan (i.e., strategy) for finding the solution (Lesh & Zawojewski, 2007). One important aspect of problem solving is peer collaboration (Schroeder & Lester, 1989), and students who work with their peers on problems tend to perform better (Charles & Lester, 1984; Dees, 1991; Ginsburg-Block & Fantuzzo, 1998). The type of task in which students engage during problem solving is also an important consideration for teachers. Problems should be challenging for students, but not to the point of frustration (Hiebert, 2003). Additionally, they should integrate multiple mathematical topics, relate to other disciplines as well as the real world, and they should be open, allowing for a variety of entry points and strategies (NCTM, 2000). This latter requirement is perhaps the most crucial and difficult to attain, as one of the main goals of problem solving is for students to develop multiple solution strategies (Hiebert, 2003; Hiebert et al., 1997; NCTM, 2000; Polya, 1985; Schoenfeld, 1987). The point, however, is not only to develop these strategies for the purpose of solving problems. Rather, much of the time devoted to problem solving must also be centered on developing, discussing, explaining, and justifying those solution strategies (Lesh & Zawojewski, 2007; NCTM, 2000; Polya, 1985; Schoenfeld, 1987; Van de Walle, 2003; Van de Walle & Lovin, 2006). This explicit discourse about strategies is intended to facilitate conceptual development by allowing students the opportunity to explain their thinking, make their methods explicit, learn from others, develop more efficient methods for solving problems (Hiebert, 2003; Schoenfeld, 1987) and understand how to interpret new problem-solving situations (Lesh & Zawojewski, 2007). A later section will explore the nature of discourse in more detail. Studies indicate that problem solving as described here poses many benefits to students, including increases in mathematical understanding (Lambdin, 2003; NCTM, 2000; Schoenfeld, 1987), achievement (Boaler, 1998, 2002; Charles & Lester, 1984; Ginsburg-Block & Fantuzzo, 1998; Silver, Smith, & Nelson, 1995; Verschaffel et al., 1999), and motivation (Charles & Lester, 1984; Ginsburg-Block & Fantuzzo, 1998).

A classroom focused on solving problems provides a context in which the other four process standards can be developed. The notion that problems should integrate multiple mathematical concepts and reflect real-world issues is intended to allow students to build on the knowledge they already hold and make connections between mathematical concepts and experiences outside of school. This speaks directly to the Connections process standard. Additionally, encouraging students to invent and adapt strategies in a problem-solving context may support the development of multiple representations (Bostic & Jacobbe, 2010). Finally, the heavy emphasis placed on peer collaboration and explaining and justifying one's solution strategy integrates the standards of communication as well as reasoning and proof. The following problem will be used to illustrate these points:

> There are many vehicles in the parking lot. Some, like motorcycles, have 2 wheels. Other vehicles, such as cars, have 4 wheels. There are even some vehicles, such as school busses, that have 6 wheels. If there are 46 wheels in the parking lot, how many of each type of vehicle might you have?

Students can use either addition or multiplication to calculate the total number of wheels, and can solve this problem with a wide variety of solution strategies, including drawing a picture, making a chart, trial and error, and acting it out. Even students who have not previously solved this type of problem can draw on their knowledge about and out-of-school experiences with cars, busses, and motorcycles, then use that knowledge to help them understand the context and to devise a mathematical solution strategy. By doing so, they are connecting their real-world knowledge to the mathematical concepts they are learning as they solve the problem. In addition, if the teacher encourages students to share their varying solution method with their peers, the mathematics underlying their solutions is made explicit, which can help students to make connections between different yet related mathematical concepts such as addition and multiplication. By solving this type of problem and discussing and justifying their solution strategies, students are supported to construct connections between and among mathematical concepts as well as to communicate about the mathematics and engage in reasoning and proof. Additionally, by comparing the different strategies used, students may be supported to develop multiple representations. These aspects of problem solving thus demonstrate how the five process standards are intertwined.

In the following section, the role of discourse, a key aspect of standards-based instruction (Lubienski, 2000a), is considered. Next will follow a detailed illustration of the potential of reform-based mathematics instruction to support students of color and lower socioeconomic status (SES) populations.

Discourse

The term discourse refers not only to the communication about mathematical thoughts and information in which teachers and students engage (McCrone, 2005) but also to the ways they agree and disagree about mathematics (NCTM, 1991). Thus, discourse encompasses the Communication and Reasoning and Proof process standards. A prerequisite to discourse includes the rules and norms established in the classroom about how communication should occur and what types of thinking, argumentation, and talking are valued (Cobb, Wood, & Yackel, 1993; NCTM, 1991; Sfard, 2003). Discourse in the mathematics classroom has gained increasing attention over the past two decades (Sfard, 2003; Walshaw & Anthony, 2008) because of the focus on strategies and processes that are an integral part of problem solving (Lesh & Harel, 2003). In fact, problem solving frequently serves as the context in which to engage teachers and students in rich mathematical discussions (e.g., Cobb et al., 1993; Kazemi & Stipek, 2001; McCrone, 2005).

Research indicates that discourse in the mathematics classroom is beneficial to students: it may promote conceptual understanding (Cobb, Wood, Yackel, & McNeal, 1992; Kazemi, 1998; Kazemi & Stipek, 2001; Kilpatrick et al., 2001; NCTM, 2000) and mathematical thinking (Kazemi & Stipek, 2001), as well as support the development of mathematical argumentation skills congruent with the reasoning and proof process standard (Cobb et al., 1992). Discourse also provides an opportunity for students to coproduce knowledge. It allows teachers to observe their students' mathematical reasoning, which can influence their decisions about which approach to take next in their instruction (Walshaw & Anthony, 2008).

It is important to clarify the characteristics of discourse that push students to higher levels of mathematical understanding. In a recent review of literature to describe the pedagogical approaches to classroom discourse that produce desirable results for learners, Walshaw and Anthony (2008) identified four actions carried out by teachers as described below:

- Action 1: Engage students in dialogue about mathematics;
- Action 2: Scaffold students' ideas and talk to further their thinking;
- Action 3: Develop students' technical mathematical vocabulary; and
- Action 4: Develop students' mathematical argumentation skills.

Throughout the first teacher action, Walshaw and Anthony (2008) explained that teachers focused on engaging the entire class in mathematical dialogue and made discourse participation rules (e.g. when and how to contribute) explicit for students by clarifying, establishing, and enforcing those rules. This action is important because it serves to help students come to value dialogue and the sharing of mathematical ideas in the classroom. This is especially important for low-achieving students, who often struggle more with participating in discussions than their peers. Teachers must therefore work to ensure the classroom environment is a safe one in order to encourage all students to participate.

During the second teacher action, teachers focus their attention on the content of students' talk. The goal is for students' ideas to be clearly articulated, and the teacher carefully scaffolds, listens, questions, and revoices students' contributions, as well as utilizes appropriate wait time.

The focus of the third action is on students' use of conventional mathematical language, which is important because specialized discourse is a key part of mathematical competence. The teacher creates a context for enculturation into the mathematics community by modeling the appropriate, precise, and generalizable mathematics vocabulary and language use, as well as questioning students to ensure their understanding of vocabulary. Over time, students take up the conventional language use demonstrated by the teacher. During this activity, teachers must make an effort to learn about their students in order to bridge the students' development of mathematical language with students' cultural or intuitive understandings.

In the fourth and final action, the teacher works to support students to develop their mathematical argumentation skills through the use of the specialized vocabulary and language they've learned. Walshaw and Anthony (2008) suggest that "students should have the opportunity and space to, for example, interpret, generalize, justify, and prove their ideas, as well as to critique the ideas of others in the class" (p. 535). Students must be taught to engage in these practices through the teacher's or a more capable peer's modeling of them.

Before any of these activities can be carried out, however, specific and particular norms must be put into place in the classroom (Yackel & Cobb, 1996). Teachers must work with students to establish the social and sociomathematical norms that allow for appropriate discourse to take place (Cobb et al., 1993; Yackel & Cobb, 1996). Social norms are those that apply across subjects and content; they are norms that are not unique to mathematics (Yackel & Cobb, 1996). An example would be the practice of listening attentively while a classmate or the teacher is talking. In contrast, sociomathematical norms are specific to mathematical discourse and include, for instance, rules about what counts as a mathematically different solution (Yackel & Cobb, 1996). In a study of how conceptual thinking is promoted in reform classrooms with ethnically diverse urban students, Kazemi and Stipek (2001) identified four such sociomathematical norms:

- Explanations are focused on processes rather than just procedures. Thus, students describe their thinking and provide mathematical justification for their explanations.

- Using multiple strategies to solve problems and describing those strategies to peers and teacher is required. Students are supported to understand the relationship between strategies.

- Errors are a natural part of the learning process, and they provide opportunities to extend learning and understanding.

- Collaboration among peers to find solutions is necessary. Additionally, groups must reach consensus about their solution through reasoning and argumentation.

These norms do not necessarily come naturally to students; they must be made clear (Walshaw & Anthony, 2008; Yackel & Cobb, 1996) and negotiated in the classroom through conversations explicitly focused on the mathematics itself (talking about mathematics), as well as on how to communicate mathematically (talking about talking about mathematics; Cobb et al., 1993). The teacher therefore plays a vital role in establishing classroom norms and guiding the class discussion (Cobb et al., 1993; Kazemi & Stipek, 2001; Lubienski, 2000a, 2000b; Walshaw & Anthony, 2008; Yackel & Cobb, 1996). While all students must learn the appropriate ways of participating in mathematical discourse in the classroom, this learning may be particularly difficult for students of color and students who live in poverty (Forman, 2003; Gee, 2008; Lubienski, 2000a, 2000b, 2002; Walshaw & Anthony, 2008; Zevenbergen, 2000) because their learned ways of communicating may conflict with what communicating about mathematics requires (Boaler, 2002; Zevenbergen, 2000). The following section explores in depth select research on reformed mathematics teaching and the difficulties students of color and those who live in poverty may face in reform-oriented classrooms.

Standards-based Mathematics Teaching and Equity

An important question is whether standards-based curricula and pedagogy support a more equitable education for students (Boaler, 2002). Skill-based approaches consistent with traditional mathematics pedagogy may be viewed as more explicit about how students should behave and communicate and thus are believed to reduce the inequities faced by culturally and linguistically diverse students. This perspective may be a contributing factor that drives teachers of these students to teach to the test, lower their expectations for struggling students, simplify content, and emphasize procedures and skills rather than concepts (see Davis & Martin, 2008; NCTM, 1999; Watson, 2002; Webb & Romberg, 1994; Weiss, 1994). Direct instruction and an emphasis on procedures are also popular instructional techniques with students who have mathematics learning disabilities (e.g., Jitendra et al., 2007; Montague, 2007). Taken together, these instructional practices form what Haberman (1991) called the “pedagogy of poverty”.

In a meta-analysis of research on mathematics instruction interventions for students with learning disabilities, Gersten et al. (2009) examined the effect of explicit instruction. They defined explicit instruction as: “(a) The teacher demonstrated a step-by-step plan (strategy) for solving the problem; (b) the plan was problem specific and not a generic heuristic for solving the problems; and (c) students were actively encouraged to use the same procedure/steps demonstrated by the teacher” (p. 1228). Explicitness as defined here is common in mathematics classrooms that adopt a direct instruction approach. Gersten et al. (2009) concluded that explicit instruction is an important instructional strategy for students with mathematics learning disabilities. Such a finding has direct implications for students of color and those living in poverty, as they are disproportionately placed into special education programs (Rothstein, 2002), but explicit instruction does not take into account students' cultures. Other researchers disagree with the argument for explicit or direct instruction. For instance, in an inquiry into teaching practices that promote equity, Boaler (2002) found that traditional instruction did not support learners who live in poverty, and that a standards-based approach was more beneficial for this population.

In an attempt to identify the pedagogical practices of teachers who narrow the achievement gap, Boaler (2002) sought to reexamine two series of studies that identified successful reform-oriented mathematics curricula. The first series (Boaler, 1997, 1998, 2000) she reexamined explored the relationship between students' mathematics achievement and their social class over a three-year period (from ages 13-16). Boaler followed two groups of students at different schools from their ninth-grade to eleventh-grade years. The first school, Amber Hill (*N*=200), followed a traditional, procedural curriculum, tracked mathematics students according to their perceived ability levels, emphasized teaching through direct instruction, and relied heavily on the textbook. The second school, Phoenix Park (*N*=110), adopted an open-ended, project-based mathematics curriculum (Boaler, 1997), used no textbook, and students were often encouraged to think mathematically, pose and extend problems, use their own mathematics, and invent their own strategies (Boaler, 1998). Phoenix Park classes were heterogeneously grouped rather than tracked, and students, who were considered responsible for their own learning, were able to work though problems at their own pace. Both groups of students had the same (individual, booklet-based) mathematics instruction during seventh and eighth grades; the change in instruction occurred in the ninth grade when the study began. Both schools also had similar populations of students: the majority were white, working class, and low achieving (Boaler, 1997).

Using a mixed-methods design, approximately 100 lessons were observed and students were surveyed, interviewed, and took a wide range of assessments. Standardized test data were also collected for all participants. Interviews and field notes were coded using grounded theory and data were triangulated (Boaler, 1997). When the two groups of students were compared, those at Amber Hill reported feeling inadequate, complained about a lack of relevant problems, and viewed school mathematics as boring, tedious, and disconnected from their daily lives. Furthermore, these students displayed a “rule following behavior,” believing mathematics to be only about rules, formulae, and equations. They were not encouraged to discuss the mathematics in which they engaged and were unable to determine whether different contextual situations were in fact mathematically similar. They also searched for cues when solving problems, focusing on irrelevant aspects of problems and “basing their mathematical thinking on what they thought was expected of them rather than on the mathematics in question” (Boaler, 1998, p. 47). This supports Schoenfeld’s (1988) assertion of the dangers of traditional mathematics instruction: Amber Hill students often stopped working if a problem seemed challenging, too easy, or if it required mathematical procedures other than those which they had most recently learned (Boaler, 1998).

In contrast, at Phoenix Park, where instruction was standards-based, students were viewed as independent workers and thinkers. They engaged in projects that lasted two or three weeks at a time, and were able to work at their own pace and in unsupervised settings. This resulted in not all students being on task at the same time, but every student eventually completed their assigned tasks. Due to the format of the lessons, Phoenix Park students were required to regularly monitor and control their own behaviors, and were able to discuss mathematics in a meaningful way. They also performed significantly better than their Amber Hill peers on application/transfer problems; scored equally well on traditional examinations including the General Certificate of Secondary Education (GCSE), Britain's version of an exit exam; and maintained higher grades. In fact, the project-based instruction equalized students' achievement in terms of both gender and social class, resulting in smaller gaps in student achievement (Boaler, 1998).

The second series of studies Boaler (2002) reexamined were a part of the Qualitative Understanding: Amplifying Student Achievement and Reasoning (QUASAR) project (see Brown, Stein, & Forman, 1996; Silver et al., 1995). Teachers at six urban middle schools developed a curriculum over the course of five years that incorporated problem solving and the encouragement of discourse, including justification, into their mathematics instruction. The QUASAR project resulted in significant gains in achievement for culturally and linguistically diverse students. While Boaler (2002) did not describe her data analysis methods, her reexamination of these studies highlighted three instructional approaches consistent with reform pedagogy that appeared to be associated with these results. First, in contrast to traditional classrooms where students are often expected to interpret text-based problems on their own, the participating teachers helped students understand problems through discussions before asking students to solve them. Second, students were required to explain and justify their solutions. Teachers were very explicit about the form these explanations and justifications should take, essentially talking about mathematics and talking about talking about mathematics in the manner described by Cobb et al. (1993). Finally, real-world problems were used to provide a context for mathematics. Boaler (2002) cautioned, however, about the nature of real-world problems used. Good problems require familiarity with the context described, and some student's backgrounds and experiences don't necessarily provide them with the same level of familiarity as their peers (see also Zevenbergen, 2000). Additionally, when working on realistic problems, students will often bring unexpected information into their interpretation of the problem. For instance, consider the open-ended task QUASAR teachers administered to their students (Silver et al., 1995, p. 41):

> Yvonne is trying to decide whether she should buy a weekly bus pass. On Monday, Wednesday, and Friday, she rides the bus to and from work. On Tuesday and Thursday, she rides the bus to work, but gets a ride home with her friends. Should Yvonne buy a weekly bus pass? Explain your answer.
>
> *Busy Bus Company Fares*
>
> | | |
> |---|---|
> | One-Way | $1.00 |
> | Weekly Pass | $9.00 |

The teachers were surprised when their students chose the weekly pass as the more economical answer. In the ensuing class discussions, students explained the pass could be used on evenings and weekends as well as shared with other family members (Silver et al., 1995). In being provided with a realistic problem, students gave real world solutions that "[situated] their reasoning in the context of their lives" (Boaler, 2002, p. 251). Teachers must be ready to accept these as valid answers (Silver et al., 1995) and allow students to explain their reasoning, providing further support for the importance of discourse. Boaler (2002) concluded that these instructional practices carried out by the teacher, and not necessarily the standards-based curriculum itself, are what ultimately promoted equity and improved student achievement.

Lubienski (2000a, 2000b, 2002) also conducted a study that examined the interplay between reform-based teaching and equitable instruction; this research took place in a seventh grade classroom where students learned mathematics via problem solving (Schroeder & Lester, 1989). The 18 participants in the class were primarily white (one Mexican-American female and one black male) but came from socioeconomically diverse backgrounds. Lubienski, acting as the teacher, used the Connected Mathematics Project (CMP) curriculum, which has a focus on open-ended, contextualized problems. Daily lessons followed the Launch, Explore, Summarize model: Lubienski "launched" the problem with the class, students broke out into groups to explore the problem and solve it, and finally, in whole class discussions, the group explorations were summarized. During these whole-class discussions, students were prompted to share their solutions and discuss the mathematical ideas. Over the course of one school year, several students were interviewed up to three times, student surveys were administered to the entire class, and Lubienski audio recorded her teaching and kept a daily journal (Lubienski, 2000a, 2000b). These data were transcribed, and themes across SES and gender were identified (Lubienski, 2000b).

One question the researcher sought to explore was related to students' perceptions of the CMP curriculum, specifically, how they experienced the open, contextualized nature of the problems (Lubienski, 2000b). The higher SES students clearly preferred the CMP curriculum to traditional mathematics textbooks. They found problem solving more interesting and easier than computation, were intrinsically motivated to work on the problems, and persisted when they faced challenging problems. The lower SES students, on the other hand, were overwhelmed and frustrated by the open-ended questions and gave up easily. They struggled with interpreting questions and deciding on a strategy, found it difficult to read the problems (in terms of the vocabulary and sentence structure), and reported feeling confused by the problems. They were very concerned with using the correct algorithm and finding the correct answer, unlike the higher SES students, who felt comfortable following their instincts when solving a problem. Furthermore, girls were found to put forth more effort on homework and completed many more problems than boys. This effort was correlated with quiz and test scores for higher SES students, but not for the lower SES students; they completed their assignments but were not able to demonstrate knowledge of the mathematics on tests (Lubienski, 2000b). Finally, while higher SES students were able to extract and generalize the mathematics embedded in the contextual problems, and complained of being “bored” after solving many problems with the same underlying mathematical principles, the lower SES students often failed to identify the underlying mathematics, instead taking into account many real world variables to solve problems. For example, in a “best buy” problem about purchasing popcorn at the movies, which had a mathematical goal of comparing volume and unit price, some lower SES students calculated the volume and then responded that the prices increase in order by size, so one should choose which size to buy based on how much popcorn one intended to eat (Lubienski, 2002). These results suggest that while NCTM (2000) calls for realistic, open-ended problems, some students may struggle to decontextualize the problems in a way that would allow them to learn the underlying mathematics (Lubienski, 2000b).

Another question Lubienski (2000a) explored related to how students of different socioeconomic statuses responded to standards-based pedagogy, particularly the discourse, and how their cultures may affect their openness to standards-based instruction. For this analysis, Lubienski examined the experiences of six girls of varying socioeconomic and achievement levels. By intentionally focusing on girls only, the researcher sought to hold gender constant. The degree of confidence students held in their mathematical abilities influenced willingness to participate in discussions and some students did not find discussions helpful to their understanding. Higher SES girls reported that they liked participating in class discussions and felt confident that their thinking was correct and some even reported that they enjoyed “arguing” with others about the problems. The lower SES girls, however, struggled with whole-class discussions and were afraid of sharing a wrong idea. They found it difficult to distinguish between correct and incorrect answers during the discussions, even when Lubienski provided them with hints, and they didn’t know how to handle it when a classmate disagreed with them. They reported feeling confused and stated that they preferred a traditional instructional style with more explicit teacher direction. Higher SES girls were more likely to discuss methods and ideas and to generalize contexts, whereas lower SES girls typically answered straightforward questions they were sure they would get correct (Lubienski, 2000a). Finally, the higher SES students articulated that they understood that by allowing students to reason out the mathematics on their own, the teacher was supporting deeper learning. On the other hand, lower SES students assumed the reason Lubienski didn’t clearly state who was right and who was wrong during discussions was to avoid embarrassing or hurting the feelings of the student with an incorrect answer (Lubienski, 2002). The author suggested that by giving authority to the class, certain students took on the authoritative role and other students were disempowered. She concluded that the classroom culture of standards-based pedagogy was better aligned with the preferred ways of communicating, knowing, and learning of the middle class students than the lower SES students (Lubienski, 2000a).

These results bring up some troubling questions regarding standards-based mathematics teaching and how it affects students of different cultures. There are some studies that suggest that standards-based instruction is beneficial for culturally, ethnically, and socioeconomically diverse populations (e.g., Boaler, 1997, 1998, 2000, 2002; Post et al., 2008), so why is it that Lubienski's results didn't agree? What was it about Lubienski's classroom, setting, or instruction that made the difference? Furthermore, if Lubienski, an educational researcher and presumed expert in mathematics instruction, struggled to implement reform in a way that benefitted her lower SES students, what does this imply for classroom teachers? To understand and help explain why students of different socioeconomic groups – which can be viewed as distinct cultures – had such different experiences with the discourse and open, contextualized nature of the problems, Lubienski (2002) adopted a sociocultural lens. She reviewed literature from anthropology and sociology, and suggested that the knowledge, skills, and beliefs students enter the classroom with, which are a product of their cultural heritage, influence their experiences with standards-based instruction. Lubienski (2000a) concluded that the practices of sharing, grappling with ideas, and comparing and critiquing others' explanations – in other words, the defining characteristics of her classroom – conflicted with the values, beliefs, and social norms of white students who live in poverty. This supports Gee's (2008) argument that if students' vernacular cultures do not match the school culture, they may struggle to succeed.

Furthermore, Lubienski (2002) argued that NCTM (2000) makes strong assumptions about how students will experience reform, suggesting that through problem solving, students will abstract powerful mathematical ideas and processes, and that open discourse will make all students feel their ways of thinking and communicating are valued. NCTM (2000) additionally suggests that listening to others will increase students' understanding of mathematics, and that students will enjoy and feel confident about their abilities when solving challenging problems. As Lubienski (2000a, 2000b, 2002) has demonstrated, these assumptions do not hold true for all students all of the time (see also Zevenbergen, 2000). In reality, problem solving and discussion as a means of learning mathematics will come more naturally to some students than others (Lubienski, 2002). If the goal of mathematics reform is to support students to become empowered mathematically, then the cultural assumptions of discourse need to be examined in order to better address the difficulties some students will face. As Lubienski (2002) argued,

> When we understand ways in which a particular discourse differs from students' more familiar discourses, we must be prepared to grapple with dilemmas about whether the discourse we are promoting is inherently valuable as an end in itself or is simply an arbitrary, value-laden means (perhaps a relatively White, middle-class means) to an end. In mathematics education, for example, this could mean that we must consider whether whole-class discussion of students' conflicting mathematical conjectures is simply one possible means to understanding mathematics or if it is an important mathematical process in its own right. If it is an important end in itself, efforts should be made both to help students understand the norms and roles assumed by such an approach and to adapt the approach to students' needs and strengths. (p. 120)

It may be that a lack of explicitness about the expectations for discourse in Lubienski's classroom, which may not have aligned with students' learned ways of communicating, contributed to the struggles the lower SES students had with the class discussions. Similarly, it is unclear in the description of her teaching whether Lubienski took time during instruction to make explicit the underlying mathematics being discussed as required by standards-based teaching. Teachers thus play an important role in reform classrooms not only in helping students learn the mathematics intended (Lubienski, 2000a, 2000b, 2002), but also in establishing classroom norms for discourse, making those norms explicit, and helping to bridge the gaps between students' vernacular language and culture and the school language and culture (Gee, 2008).

While Lubienski's work was conducted with mostly white children, we know that communication patterns and preferences of racially and ethnically diverse students also differ from those of the mainstream school culture (Brantlinger, 2003; Heath, 1983, 1989; Mohatt & Erickson, 1981). For example, black children are expected by the adults in their community to use their knowledge rather than explain it (Heath, 1983), which may create tensions for them in discussion-rich school environments requiring explanation and justification. Hence, it is possible students of color will struggle in similar ways with standards-based instruction unless they receive appropriate supports from their teachers. To clarify, the implication is not that some students are incapable of engaging in rich mathematical discussions and problem solving, but instead that they must be supported to learn to do so. Teachers must help to make explicit the mathematics being taught and discussed as well as the norms and expectations for engaging in mathematical discourse. This would serve to support students who enter the classroom with different cultural understandings of what is expected of them in terms of communication than what their teacher and classroom culture dictates. It therefore becomes important to understand not only how standards-based mathematics teaching is implemented and how that affects students of color and students who live in poverty, but also to understand the teaching practices that are responsive to students' differing cultures and how those may support their mathematical learning. We turn, then, to an examination of CRT, a practice thought by some to be responsible for the academic success of students of color who live in poverty and that may help to address the cultural dilemma described by Lubienski (2002).

Culture, Mathematics, and Teaching

The previous section explored the literature on the reform movement in mathematics education, and the potential of – and problems with – implementing this type of teaching with students who fall outside of the American mainstream. In this next section, the argument will be made that CRT can serve as a way to support students of color and students who live in poverty who are struggling in mathematics.

Many scholars contend that attending to the cultural needs of black students may help to narrow the achievement gap (e.g., Delpit, 2006; Hondo et al., 2008; Ladson-Billings, 1994, 1995a, 1995b; Nelson-Barber & Estrin, 1995; Tate, 1995) and that connecting the curriculum to students' cultures and building on their informal knowledge is necessary for academic success (Banks et al., 2005; Bishop, 1992; D'Ambrosio, 2001; Gay, 2000, 2002; Gutstein et al., 1997; Hinchey, 2004; Ladson-Billings, 1994, 1995a, 1995b; Tate, 1995; Zaslavsky, 1996). Teaching that is informed by students' cultures may provide a way to not only integrate cultures and experiences into classroom practices in order to empower, or enable, students in a system that typically disadvantages them (Ladson-Billings, 1994, 1995b; Peterek, 2009), but may also enhance reform efforts (Gutstein et al., 1997) and teachers' abilities to promote equity for all their students (Boaler, 2002). The next sections serve to define this instructional approach, referred to as both culturally relevant pedagogy and culturally responsive teaching, by beginning with a historical account of the works of Gloria Ladson-Billings and Geneva Gay.

Culturally Relevant Pedagogy

In an era where students of color who live in poverty often struggle to succeed in school, Ladson-Billings (1994, 1995b) sought to identify effective teachers of this population of children and describe the beliefs, practices, and instructional methods that set them apart from other teachers and that seem to be at the root of their students' success. Eight teachers were identified, and through ethnography, teacher interviews, and member checking, she discovered these teachers practiced a unique pedagogy, which she calls *culturally relevant*, that

> empowers students intellectually, socially, emotionally, and politically by using cultural referents to impart knowledge, skills, and attitudes. These cultural referents are not merely vehicles for bridging or explaining the dominant culture; they are aspects of the curriculum in their own right. (Ladson-Billings, 1994, pp. 17-18)

The teachers in the study all held the same three goals: (a) to ensure the academic success of all their students; (b) to build students' cultural competence, or acceptance and affirmation of their culture; and (c) to develop students' abilities to understand, analyze, and critique the existing social order. This last element, referred to as critical consciousness, includes empowering students to take action to change inequities they observe or experience (Ladson-Billings, 1995b). The pedagogy of culturally relevant teachers includes scaffolding students to build on what they know and what they need to learn, an unwavering focus on instruction and learning, and working to extend students' thinking and abilities (Ladson-Billings, 1994). Additionally, they hold high expectations for students and do not tolerate failure, pushing students and providing appropriate supports until they succeed (Ladson-Billings, 1994, 1995a, 1995b). In other words, being culturally relevant means teachers get to know their students and their cultures deeply, and by using that knowledge to build relationships, they help students in learning mathematics (or other subjects) and to feel proud of their cultural heritage. They also support students to feel empowered to understand and make changes in the world around them. This pedagogy is not about accommodation or assimilation of students of color into the mainstream culture, but rather about creating a synergistic relationship between home and school life (Ladson-Billings, 1995b). Unlike many teachers who often (and unknowingly) hold prejudices against students of color (Burdell, 2007), teachers who adopt a culturally relevant approach to teaching view all their students as capable and worthy without qualifiers. Through the relationships they build by showing students they know about and value their personalities, families, and cultures, teachers let their students know they care for them (Ladson-Billings, 1995), which is especially important considering that feeling cared for is a key factor for students' academic success (Garza, 2009; Tutwiler, 2007; Wald & Losen, 2007).

Building on this notion of cultural relevance, Gay (2000, 2002) posed a theoretical framework for teaching, which she calls culturally responsive.

Culturally Responsive Teaching

Similar to culturally relevant pedagogy, CRT uses "the cultural knowledge, prior experiences, frames of reference, and performance styles of ethnically diverse students to make learning encounters more relevant and effective for them" (Gay, 2000, p. 29), thereby enabling students to learn more easily and deeply. Like culturally relevant pedagogy, CRT comes from a critical theory perspective, and thus includes the notion of critical consciousness. Students are encouraged to question the status quo, including the portrayal of people of color in mass media, textbooks, trade books, and popular culture, and teachers work to build positive examples of diverse cultures into the curriculum. CRT thus places a great emphasis on multicultural education, including multicultural mathematics, in the curriculum (Gay, 2000, 2002). Responsive teaching, however, sometimes seems to lack the notion of *praxis*, an iterative cycle of reflection and action (Hinchey, 2004) that is a key component of cultural relevance (Gay, 2002; Ladson-Billings, 1994, 1995b). While questioning and thinking critically about the world are important aspects of both pedagogies, the literature on CRT is inconsistent in its emphasis on the action aspect of praxis (e.g., Banks et al., 2005; Gay, 2002; Scheurich & Skria, 2003). For the purposes of this paper, I adopt the broader definition, which does include praxis as part of CRT.

A note about terminology is warranted at this point. The pedagogy described here, which is informed by and congruent with the cultures of students of color and which contrasts with Haberman's (1991) pedagogy of poverty (Ladson-Billings, 1997), has been called by many names, including *culturally relevant, sensitive, congruent, specific,* and *informed* (Gay, 2000; Leonard, 2008). All these terms describe similar ideas (Gay, 2000), and the ways Ladson-Billings (1994) and Gay (2000) define this pedagogical approach support each other. To align with more current literature (e.g., Banks et al., 2005; Bonner, 2011; Hondo et al., 2008; Peterek, 2009; Tutwiler, 2007), culturally responsive teaching (CRT) will therefore be used to refer to such an instructional approach as described by either Ladson-Billings (1994, 1995a, 1995b, 1997) or Gay (2000, 2002) unless directly quoting a scholar.

In the current research on effective teaching of students of color across content areas and grade levels (Bonner, 2011; Delpit, 2006; Garza, 2009; Gay, 2000, 2002; Gutstein et al., 1997; Ladson-Billings, 1994, 1995a, 1995b, 1997; Long, 2008; Nelson-Barber & Estrin, 1995; Peterek, 2009; Sheets, 1995; Tate, 1995; Wlodkowski & Ginsberg, 1995), there are eight themes that emerge to characterize culturally responsive teachers' practices and beliefs. The research and theory related to each will be discussed in the following sections:

- Teachers' goals for students;
- Teachers' expectations for students;
- Teacher-student relationships;
- Students' knowledge and experiences;
- Supporting students to develop a critical disposition;
- Classroom environment;
- Culturally responsive classroom management; and
- Instruction.

Culturally responsive teaching is more a way of being and believing than it is about specific actions a teacher takes. The discussion of cultural responsiveness that follows is thus not intended to reduce CRT to a list of practices for teachers of students of color to engage in. The organization of themes into separate sections should not imply that each theme is discrete. In fact, many of these topics overlap, but they are presented in sections to facilitate the reader's understanding of this complex, dynamic approach to effectively teaching students of color.

Teachers' goals for students

The foremost goal culturally responsive teachers hold is that they want all their students to achieve academically. Academic success – which includes technological, social, and political skills; literacy; and numeracy, (Ladson-Billings, 1995a) – is non-negotiable (Gay, 2000; Ross, Bondy, Gallingane, & Hambacher, 2008). Teachers believe it is their primary responsibility, not the students', to ensure academic success (Gay, 2000, 2002; Ladson-Billings, 1995b; Sheets, 1995). Instruction and academic challenges are the main focus in the classroom (Gutstein et al., 1997; Ladson-Billings, 1997), and learning and mastery of content, rather than grades, is emphasized (Gay, 2000; Sheets, 1995). Similarly, standardized tests are not the focus of instruction, but rather a necessary annoyance, and teachers work to help students perform well on them without focusing on them at length (Ladson-Billings, 1995b). These teachers view disciplinary knowledge as necessary for helping students to understand sociopolitical issues (Gutstein, 2003; Ladson-Billings, 1994). Furthermore, culturally responsive teachers believe academic achievement must be a goal for students as well as for themselves (Gay, 2000; Ladson-Billings, 1995a).

In addition to academic success, culturally responsive teachers want their students to become empowered socially, individually, and politically. Students are supported to become empowered academically and personally by teachers who nurture their confidence, courage, and will to act (Bonner, 2011; Gay, 2000). They are also supported to develop self-efficacy for learning tasks (Gay, 2000). Additionally, teachers support students to become leaders both within and outside the classroom (Gutstein et al., 1997) and seek to support students in developing their sense of personal and social agency (Gay, 2000; Gutstein et al., 1997).

Another goal culturally responsive teachers hold is that they want all their students to develop cultural competence, a positive sense of ethnic identity and self-esteem. In a review of literature, Ladson-Billings (1995b) concluded that academic success of students of color tended to come at the expense of their ethnic identities, with students often "acting White" (Fordham & Ogbu, 1986, p. 176), having neither white friends nor friends who share their same cultural heritage. Culturally responsive teachers seek to avoid a negative self-identity and loss of ethnic pride for their students, instead supporting students to develop cultural competence, an acceptance and affirmation of their culture (Ladson-Billings, 1994, 1995b). Rather than learning according to European-American cultural norms, students of color are encouraged to maintain their cultural integrity while simultaneously pursuing academic excellence (Gay, 2000, 2002; Ladson-Billings, 1995a, 1995b). Teachers and students learn about, value, and praise each other's cultural heritages (Gay, 2000), and students are taught to challenge racist societal views of competence and worthiness of people of color (Delpit, 2006), with teachers affirming students' cultures, languages, and identities (Gutstein et al., 1997). Culturally responsive teachers build on the strengths of students' cultures to develop cultural excellence (Ladson-Billings, 1994). While this may look different from one classroom to the next, it may include lessons where students are allowed to write a rap song instead of a poem in English class or to learn about the mathematical algorithms developed by different cultures alongside traditional algorithms. In doing this, culturally responsive teachers support students to develop a positive ethnic identity, "a sense of self determined by racial and cultural variables and embedded in a social and historical context" (Sheets, 1995, p. 190).

Teachers' expectations for students

Culturally responsive teachers hold high expectations for *all* their students; they expect all students to succeed, rather than some succeeding and others not (Gay, 2000). No excuses for low achievement are tolerated (Gay, 2000, 2002; Ladson-Billings, 1994, 1995b; Ware, 2006; Wilson & Corbett, 2001). Culturally responsive teachers believe that holding high expectations for students will support the development of intrinsic motivation to work hard (Wlodkowski & Ginsberg, 1995) and students will in turn meet those high expectations (Gay, 2000; Ladson-Billings, 1997). Teachers will thus nag, pester, and bribe their students to work hard (Ladson-Billings, 1995b). They also treat students as capable (Gutstein et al., 1997; Ladson-Billings, 1997) and challenge them intellectually and beyond curricular expectations regardless of their home life (Delpit, 2006; Ladson-Billings, 1997; Sheets, 1995) in order to push their “thinking and abilities beyond what they already know” (Ladson-Billings, 1997, p. 704). Students’ academic strengths are identified, valued, and shared with other students (Delpit, 2006; Gay, 2000; Ladson-Billings, 1995b), as well as used for instructional purposes. In addition to academics, culturally responsive teachers hold high expectations related to the personal, social, and ethical aspects of students’ lives (Gay, 2000).

These teachers additionally view students from an asset- rather than deficit-based perspective. A deficit-based perspective objectifies students’ cultures and assumes that students need to be “rescued”, should not be challenged academically, and that families aren’t supportive (Gutstein et al., 1997). Rather than adopt this perspective, culturally responsive teachers value students’ different ways of knowing, believing, learning, and thinking (Ladson-Billings, 1995; Nelson-Barber & Estrin, 1995). They believe that learning styles, not intellectual abilities, are what affect how students learn (Gay, 2002) and that culture affects the ways in which students behave, interact with others, and learn, but this is viewed positively rather than negatively (Gay, 2000; Ladson-Billings, 1995). Thus, students' different cultural heritages are valued as well as used as a foundation for future learning (Gay, 2000; Gutstein et al., 1997; Ladson-Billings, 1994). Finally, these teachers never blame students or families for low achievement by a student but rather provide supports for students to overcome the challenges and barriers to their achievement (Bondy & Ross, 2008; Ross et al., 2008; Ware, 2006).

Teacher-student relationships

Teachers who instruct in a culturally responsive manner demonstrate care for and develop personal relationships with students. These teacher-student relationships are equitable and reciprocal (Ladson-Billings, 1995b). Teachers value students and work to build trusting relationships (Bonner, 2011; Garza, 2009; Nelson-Barber & Estrin, 1995; Peterek, 2009), getting to know their students well on both an academic and personal level (Bonner, 2011; Peterek, 2011), learning about their lives outside of school (Delpit, 2006), and treating students with respect (Garza, 2009; Gutstein et al., 1997; Nelson-Barber & Estrin, 1995). They may also adopt other-mothering behaviors, acting as students' extended families (Bonner, 2011; Ladson-Billings, 1994; Ware, 2006). Also, these teachers view students as human (Ladson-Billings, 1997), see themselves in their students, and act as role models for their students (Gutstein et al., 1997).

Culturally responsive teachers intentionally demonstrate care for their students (Gay, 2000; Garza, 2009; Ladson-Billings, 1995b). Students from different cultures may perceive care in different ways. Garza's (2009) study indicates, for example, that Latino students perceived providing instructional support as the key aspect of a caring teacher, whereas white students perceived a kind disposition as key. Thus, the way teachers demonstrate care toward students may vary from student to student, which Garza

(2009) calls *culturally responsive caring*. Furthermore, from a psychological perspective, students' perceptions of teacher affective support including care are important to attend to because these perceptions influence a student's sense of belonging, academic enjoyment, effort, and self-efficacy (Sakiz, Pape, & Hoy, 2012).

In addition to caring about students, culturally responsive teachers care about students' families and communities and encourage them to participate in school activities. Parents and families are valued, honored, respected (Delpit, 2006; Gutstein et al., 1997; Peterek, 2009; Wlodkowski & Ginsberg, 1995), and encouraged to be involved in their children's education (Sheets, 1995). These teachers work as allies to students and their families (Gutstein et al., 1997) and partner with parents to meet their classroom needs. Home visits to get to know families better are common (Sheets, 1995), and teachers are often a part of their students' communities, attending the same churches and community services (e.g. grocery stores and barber shops), as well as students' sporting events (Ladson-Billings, 1995a; Peterek, 2009). Connecting with students in personal ways is important for supporting achievement motivation (Patrick, Turner, Meyer, & Midgley, 2003).

Students' knowledge and experiences

Research on culturally responsive teachers indicates that students' prior knowledge of content is addressed and used in instruction. Culturally responsive teachers value non-school-based forms of knowing in addition to school-based knowledge (Nelson-Barber & Estrin, 1995), and they use students' knowledge and experiences (from both within and outside of school) as a foundation upon which they build learning experiences (Delpit, 2006; Gay, 2000; Gutstein et al., 1997; Ladson-Billings 1997; Wlodkowski & Ginsberg, 1995). Instructional scaffolding – for example, using familiar metaphors, analogies, and experiences from students' home lives and cultures – is used to connect what students know to what they are learning at school (Delpit, 2006; Gay, 2000; Ladson-Billings, 1997).

Another key element of CRT is that students' cultural knowledge is valued and integrated into instruction. Teachers in these studies were found to have respect for all cultures and believed them to be great resources for teaching, learning (Gay, 2000, 2002; Gutstein et al., 1997), and content worthy of being integrated into the curriculum (Gay, 2000). The intellectual potential of students is "[realized] without ignoring, demeaning, or neglecting their ethnic and cultural identities" (Gay, 2002, p. 110). Cultures vary according to communication styles; nuances; discourse features; use of logic, rhythm, and vocabulary; delivery; the role of speakers and listeners; intonation; body movements; music; ways of dressing; how children and adults interact; and whether they prioritize community and cooperation over individualism (Gay, 2002; Ladson-Billings, 1995a). Culturally responsive teachers invest time to learn deeply about the culture of their students and the community (Gay, 2000, 2002; Ladson-Billings, 1997; Tate, 1995), and use what they learn to bridge the gap between home and school cultures (Ladson-Billings, 1995b), meet the needs of diverse students (Gay, 2002), build relationships with students (Ladson-Billings, 1997), and otherwise "make curriculum and instruction more reflective of and responsive to ethnic diversity" (Gay, 2000, p. 32). One example may be integrating students' cultural ways of moving, speaking, dressing, and expressing themselves musically into their teaching and the curriculum (Gay, 2002; Ladson-Billings, 1995a; Long, 2008). The purpose of this effort to integrate culture into the curriculum is to maintain that culture and thwart negative effects of the dominant (i.e., white) culture (Ladson-Billings, 1994, 1995b).

In addition to cultural knowledge being integrated into the curriculum, culturally responsive teachers respect and often encourage students to speak in their native languages and dialects, incorporating them into the classroom dialogue (Gutstein et al., 1997; Long, 2008; Wlodkowski & Ginsberg, 1995). Bilingualism is valued (Hondo et al., 2008; Gutstein et al., 1997; Sheets, 1995), and students are supported to develop competence in both languages (Gutstein et al., 1997; Ladson-Billings, 1995a; Long, 2008). Dual languages may be spoken in class and students are supported to be able to translate between the two languages (Gutstein et al., 1997; Ladson-Billings, 1995a) so that they have the cultural capital that non-English speakers lack (Gutstein et al., 1997). For instance, Black English Vernacular (i.e., Ebonics) is treated as a separate language that students must master in addition to “standard” English (Ladson-Billings, 1995a). Furthermore, protocols of participation in discourse vary across cultures, and teachers address the different communication styles of their students (Gay, 2002).

In contrast to many traditional classrooms, in culturally responsive classrooms, the teacher is not the ultimate holder of knowledge. Instead, students and teachers share knowledge (Ladson-Billings, 1995a; Wlodkowski & Ginsberg, 1995), and the holder of power in the classroom is fluid between students and teacher (Bonner, 2011). Students sometimes act as the teacher (Ladson-Billings, 1995a, 1995b) and are expected to be arbitrators of knowledge, not simply accepting a teacher’s answer just because he or she is the teacher (Gutstein et al., 1997; Ladson-Billings, 1995b).

Supporting students to develop a critical disposition

Culturally responsive teachers encourage students to become critically conscious and social-justice oriented. Teachers support students to engage in cultural critique (i.e., develop critical consciousness), in which cultural norms, values, mores, and institutions that perpetuate or maintain social inequities are critiqued (Ladson-Billings, 1994, 1995a, 1995b) and students are taught to ask “Why?” when encountering social issues. Sociopolitical and controversial issues (e.g., poverty, racism, powerlessness, hegemony, historical atrocities) are addressed in class to help students recognize, understand, and critique inequities; reflect on their lived experiences to understand how they’ve come to believe and feel as they do; question assumptions regarded as “common sense”; articulate discriminatory practices; and explain causes of human differences, such as why some people are rich while others are poor (Gay, 2002; Haberman, 1991; Ladson-Billings, 1994, 1995b; Sheets, 1995; Wlodkowski & Ginsberg, 1995). They are also taught to critique mass media and popular culture portrayals of diverse cultural and ethnic groups (Gay, 2002; Ladson-Billings, 1995b). Issues important to students and their families (e.g. deforestation, racism, etc.) are addressed in class (Nelson-Barber & Estrin, 1995). Content knowledge, and particularly mathematics, is used as a tool to help students understand and change sociopolitical issues in their lives (Gutstein, 2003; Tate, 1995).

Culturally responsive teachers do not believe engaging students in cultural critique and questioning the status quo are sufficient and they strive to help students develop a sense of agency to address issues they see in society. Students are taught that with knowledge come consequences and responsibilities necessitating that they take social action to promote equity and justice (Gay, 2002). Therefore, teachers help students acquire the necessary tools to become active participants in society and develop into agents of social change and democratic citizenship (Gutstein et al., 1997; Ladson-Billings, 1994, 1995a, 1995b; Tate, 1995). This may involve supporting students in learning about local politics, write letters to government officials regarding an issue students are concerned about, or participate in a neighborhood clean up project. Teachers also help students to understand the difference between challenges to authority (such as that of their parents) and intellectual challenges (such as institutionalized racism; Gutstein et al., 1997; Ladson-Billings, 1995b).

Classroom environment

Students in culturally responsive classrooms take an active role in their own learning. Their teachers believe that students must be supported to become intrinsically motivated to succeed (Gay, 2000; Ladson-Billings, 1995b). Students are encouraged to take ownership of their own learning, and are “held accountable for knowing, thinking, questioning, analyzing, feeling, reflecting, sharing, and acting” (Gay, 2000, p. 32).

The culturally responsive classroom functions as a community of learners. Teachers indicate that a classroom focused on community and the development of a safe learning environment for students of color is crucial (Gay, 2002). The teacher thus creates an environment where the class functions as a cultural family, with teachers and students working as a team toward academic achievement (Delpit, 2006; Gutstein et al., 1997; Ladson-Billings, 1995; Sheets, 1995). Interdependence and group effort rather than independence and individual effort are valued (Gay, 2000; Sheets, 1995), so students work together as a community rather than as individuals, mentoring each other and working cooperatively and learning collaboratively (Gay, 2000; Ladson-Billings, 1995b; Sheets, 2000; Wlodkowski & Ginsberg, 1995). Students are responsible not only for their own success, but also for the success of their classmates (Gay, 2000, 2002; Ladson-Billings, 1995b), and the classroom environment is not competitive (Ladson-Billings, 1995b). Culturally responsive teachers insist that all students demonstrate respect. This culture of respect is both between teachers and students as well as among students, and it contributes to high academic achievement (Ross et al., 2008).

Culturally responsive classroom management

Discipline in a culturally responsive classroom is integrated within instructional practices. The teacher's disciplinary style is congruent with the culture-based disciplinary style of parents, and discipline and pedagogy are interconnected (Peterek, 2009). Teachers act as warm demanders when disciplining students (Bonner, 2011; Peterek, 2009; Ross et al., 2008). Warm demanding, a concept first introduced by Kleinfeld (1975) and a component of CRT, is "a teacher stance that communicates both warmth and a nonnegotiable demand for student effort and mutual respect" (Bondy & Ross, 2008, p. 54). Warm demanders are strict, authoritative, and adopt a "no nonsense" attitude, but they remain gentle, caring and respectful toward students and do not employ the use of threats, coercion, or the creation of power struggles (Ladson-Billings, 1997; Peterek, 2009; Ross et al., 2008). From an outsider's perspective, the warm demander may appear tough, harsh, or even mean (Bondy & Ross, 2008; Delpit, 1995; Ladson-Billings, 1997; Peterek, 2009; Ross et al., 2008; Ware, 2006). Students, however, do not interpret this as a lack of caring. In fact, the warm demander has been described as "demanding yet caring" (Ladson-Billings, 1997, p. 703) and some students claim they want a teacher that takes control, exerts authority, and who pushes, disciplines, and encourages them (Ware, 2006; Wilson & Corbett, 2001) because it makes them feel important (Wilson & Corbett, 2001). In other words, these teachers insist – though firmly and respectfully – that their students meet the high academic and behavioral expectations they hold for students (Bondy & Ross, 2008; Ross et al., 2008; Ware, 2006). They do this by making their expectations clear; repeating, reminding students about, and reinforcing those expectations; and responding in a calm and consistent way with consequences to continued misbehavior (Ross et al., 2008). The "primary purpose of teacher insistence is to create a supportive psychological environment that scaffolds student engagement and achievement" (Ross et al, 2008, p. 142). Thus, caring relationships as well as an insistence on a respectful learning environment and that students meet the high expectations set for them characterize a warm demander stance (Bondy & Ross, 2008; Dixson, 2003; Ware, 2006; Ross et al., 2008) that is part of CRT. High expectations, relationships, and the learning environment were described previously.

Instruction

Culturally responsive teachers are focused on teaching for understanding. They work to ensure all students learn the basic skills of the dominant society (Delpit, 2006). Basic skills serve only as a foundation, however, expectations for students additionally include critical thinking, problem solving, creativity, and higher level thinking skills (e.g., discussion, analyzing, identifying themes, examining concepts, and discourse) (Haberman, 1991; Ladson-Billings, 1997; Sheets, 1995). Furthermore, students are actively engaged in learning (Haberman, 1991; Sheets, 1995) and conceptual understanding is required (Tate, 1995), so students are supported to make connections between concepts rather than learning isolated facts (Haberman, 1991).

To help students learn conceptually and for understanding, culturally responsive teachers use multiple instructional strategies to engage students and attend to different needs. These multiple instructional strategies may include discussion, peer teaching, sharing, learning communities, and problem solving (Delpit, 2006; Wlodkowski & Ginsberg, 1995). Students are often given choices about what they'll learn (Haberman, 1991), and interdisciplinary units and teacher collaboration may occur (Gay, 2000). Students frequently work cooperatively in small, heterogeneous groups (Gay, 2002; Haberman, 1991; Ladson-Billings, 1995b; Sheets, 1995), technology is incorporated into instruction (Haberman, 1991), and students are provided opportunities to construct their own knowledge (Gutstein et al., 1997). In addition, students are taught more than just content; values, skills, and the cultural capital necessary for school success (e.g., test taking strategies, study skills, note taking, time management) and for participation in the society at large are explicitly taught as well (Gay, 2000). By multiculturalizing their instruction, teachers often adapt their instructional strategies to match to the learning styles of students of color (Gay, 2000, 2002).

The content in culturally responsive classrooms is connected to the real world. Relevant world issues that students care about and that reflect students' cultures are frequently reflected in problems (Haberman, 1991), and students are allowed to use their real-world knowledge to solve real-world problems (Tate, 1995). There is purpose to what students learn and its relationship to students' experiences (Wlodkowski & Ginsberg, 1995). Culturally responsive classrooms also emphasize multicultural content in the curriculum, and culturally diverse curricula are used (Gay, 2000, 2002).

Finally, culturally responsive teachers use varied, authentic, and formative assessment. In these classrooms, authentic knowledge is valued (Gay, 2000). Standardized tests are considered to be only one way to measure academic achievement and do not dominate the focus of instruction (Ladson-Billings, 1995). The many types of assessment used by the teacher include formal and informal, formative and summative, and authentic (Wlodkowski & Ginsberg, 1995). Students are given opportunities to revise and redo their work (Haberman, 1991) and are often encouraged to choose which content and assessment method they prefer, which may include tests, portfolios, peer feedback, observations, and self-assessments (Gay, 2000; Ladson-Billings, 1995b; Wlodkowski & Ginsberg, 1995). They are also allowed multiple options for practicing and demonstrating competence, knowledge, and skills (Gay, 2000; Wlodkowski & Ginsberg, 1995), including a “wide range of sensory stimuli (visual, tactile, auditory), individual and group, competitive and cooperative, active participatory and sedentary activities” (Gay, 2000, p. 30). In fact, culturally responsive teachers strive to learn about students’ learning styles and cultures in order to take them into consideration when assessing students (Delpit, 2006; Gay, 2000). Assessment processes are intended to connect to students’ world, frames of reference, and other types of knowledge, including values, attitudes, feelings, experiences, and ethics. (Gay, 2002; Nelson-Barber & Estrin, 1995; Wlodkowski & Ginsberg, 1995). Students also sometimes participate in critiquing biases in tests and testing formats (Wlodkowski & Ginsberg, 1995).

There few conceptions of CRT in this literature that focus directly on CRT in the context of specific gatekeeping subjects such as mathematics rather than effective practices in general (Peterek, 2009; Silver et al., 1995). For instance, while some of the participants in Ladson-Billings’ (1994, 1995a, 1995b) study are mathematics teachers, her research does not focus on mathematics teaching per se (Silver et al., 1995). One researcher has studied effective mathematics teachers of students of color in a quest to fill this gap in the literature and define culturally responsive mathematics teaching (CRMT) (Bonner, 2011; Peterek, 2009).

Culturally Responsive Mathematics Teaching

In an effort to understand CRT in the context of mathematics, Emily Peterek Bonner (Bonner, 2011; Peterek, 2009) chose to investigate how highly effective mathematics teachers in high poverty schools with large numbers of students of color structure the instructional practices and interactions in the classroom and establish learning environments that promote student academic success (Peterek, 2009). Similar to the study conducted by Ladson-Billings (1994, 1995a), Peterek used a community nomination process to identify an elementary teacher, Gloria Merriex, who was considered highly effective by both school personnel and the community. Ms. Merriex was raised in the same neighborhood as were her students, attended the same church, and shared the same cultural heritage. Over the course of several months, Peterek conducted semi-structured interviews with Ms. Merriex, as well as observed her class several times per week, collected student artifacts, and held informal conversations with students, parents, and other teachers. Using a grounded theory approach that included constant comparison and member checking, Peterek identified a model for culturally responsive mathematics teaching (see Figure 2-1) that describes four cornerstones of CRMT: knowledge, communication, relationships/trust, and constant reflection and revision. These cornerstones are dynamic and fluid; each cannot be considered in isolation of the others:

- **Knowledge.** This cornerstone includes knowledge of teaching (i.e., pedagogical knowledge and pedagogical content knowledge) and mathematics content (i.e., content knowledge). Knowledge of students is also essential, which was gained through communication with students and which allowed the teacher to connect with students to better use her knowledge of content and pedagogy.

- **Communication.** Perhaps because she shared the same ethnic and cultural heritage as her students, Ms. Merriex was able to communicate with them using discourse patterns with which they were familiar. This was evidenced in the frequent call-and-response and rhythmic patterns used during instruction, as well her use of specific vernacular in the conversations she held with students and her warm demander pedagogy.
- **Relationships/trust.** Ms. Merriex built strong relationships with school community members, families in the neighborhoods near the school, and her students. The students and community knew she cared for them and felt they could trust her.
- **Constant reflection and revision.** Reflection and revision often occurred "on the spot" during lessons, or immediately afterwards. For example, if students were confused, Ms. Merriex stopped the lesson and probe them to get at the sources of their confusion or misconceptions.

In addition to these cornerstones, Peterek (2009) describes a cycle of pedagogy and discipline in Ms. Merriex's classroom. Ms. Merriex wrote engaging and reflective lessons, and students were constantly moving from one concept to another, responding in unison, dancing, or engaging in call-and-response chanting, which provided little time for them to act out. Thus, edagogy and discipline occurred almost simultaneously and were sometimes indistinguishable, and the four cornerstones constantly influenced this cycle.

Finally, as in Figure 2-1, students are the focal point of CRMT. They are most affected by the pedagogy and discipline cycle, but should they fall out of that cycle (such as when difficulties at home cause a student to feel disengaged at school), the other cornerstones work to bring the student back to center (e.g., perhaps through her relationship with the student, Ms. Merriex was able to re-engage him/her). This model was intended to be a working theory that fit within the larger framework of CRT rather than a static depiction of CRMT or a separate aspect CRT (Peterek, 2009).

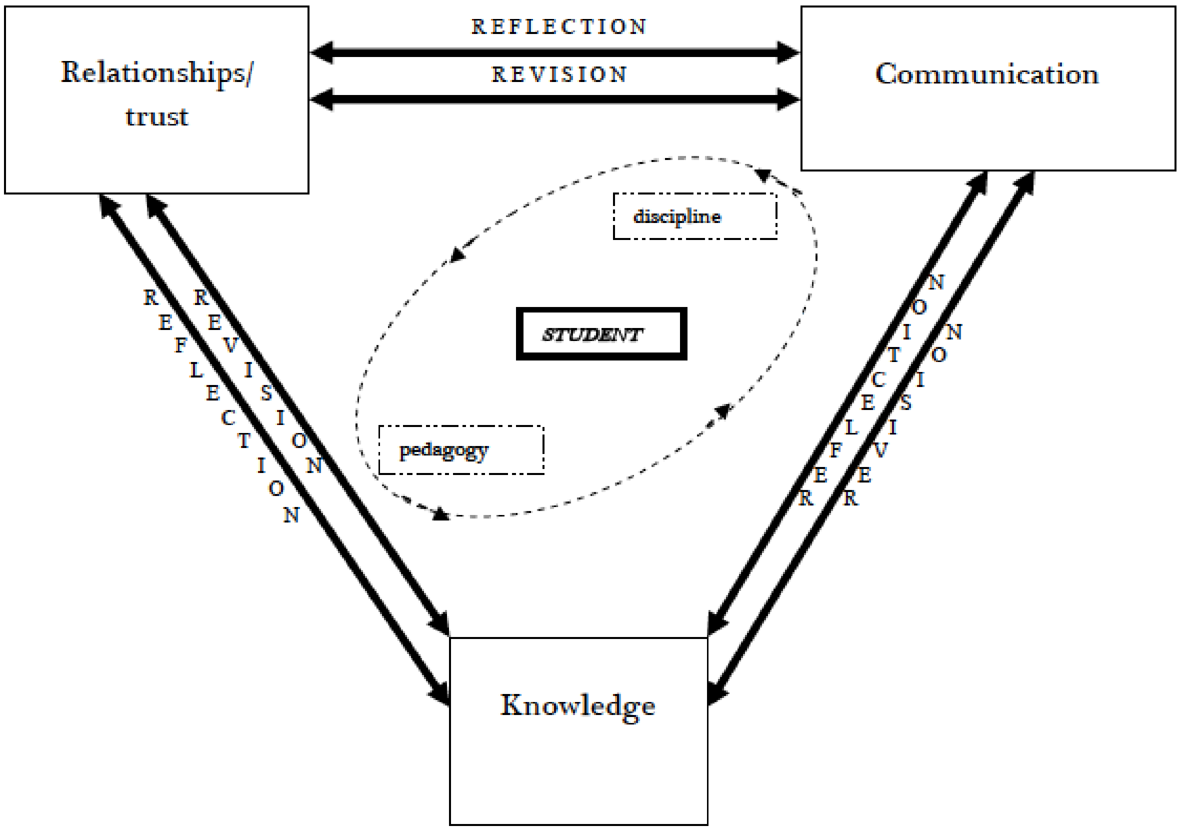

Figure 2-1. A model of culturally responsive mathematics teaching. From *Culturally responsive teaching in the context of mathematics: A grounded theory approach* (p. 120), by E. Peterek, 2009, ProQuest Digital Dissertations database (Publication No. ATT 3385979).

This line of research continued with another study that held the goals of refining the theory of CRMT described in Peterek (2009) as well as investigating the commonalities among culturally responsive mathematics teachers. Bonner (2011) identified two more such teachers, again using a nomination process. The first, Ms. H., worked at a white-majority middle school but her students were mostly of color (particularly Hispanic, some African American), and, unlike Ms. Merriex, she had a different ethnic background from her students. Her instructional focus in the classroom was on differentiation. The next teacher, Ms. A., worked at a largely Hispanic Title 1 school, and her students were reflective of the student population. She is a foreign national and focused on technology and innovation in the classroom. Using the same data collection and analysis methods as Peterek (2009), and by combining these data with the data from the previous study of Ms. Merriex, Bonner revised her model of CRMT (see Figure 2-2).

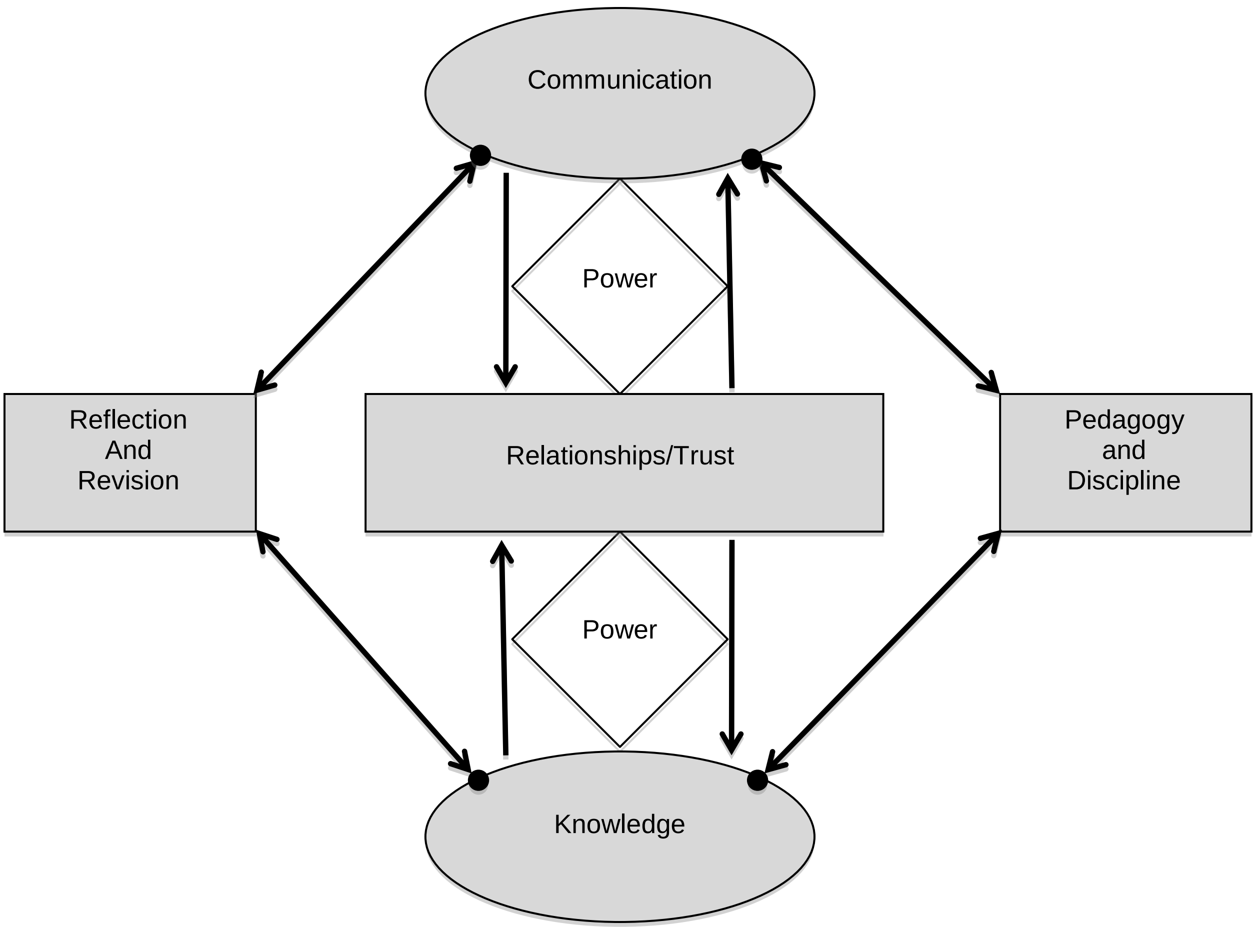

Figure 2-2. A revised model of culturally responsive mathematics teaching. Adapted from *Unearthing culturally responsive mathematics teaching: Using grounded theory to deconstruct successful practice* (p. 11), by E. P. Bonner, 2011, Fifteenth Annual Association of Mathematics Teacher Educators Conference, Irvine, CA.

While this model includes the same four cornerstones as those described by Peterek (2009), there are a few major differences. Relationships/Trust was moved to the center of the figure to emphasize that this cornerstone is a foundational aspect of

CRMT. Additionally, the element of power was added. Bonner (2011) described that the locus of power in the classroom was fluid (moving between teacher and student at any moment), and that the empowerment of students was a main goal of these three teachers. Power was at the forefront of instruction, and teachers purposefully provided opportunities to support students in developing their sense of empowerment.

Furthermore, Bonner (2011) identified several themes across her participants related to the ways in which they embodied CRMT:

- Cultural connectedness;
- A deep understanding of mathematics (content knowledge);
- Knowledge of self;
- Warm demanders (how this disciplinary approach manifests differed across classrooms);
- Mothering;
- Frequent movement;
- Fluidity/flexibility; and
- Constant responsiveness to students' needs without coddling.

Bonner emphasized that the way in which these elements of culturally responsive mathematics teaching played in individual classrooms differed and that these themes and the model were not intended to be static. She further suggested that there should not exist one single model for CRMT, since students' cultures and the way teachers respond to them will vary.

While these two models of CRMT provide us with an understanding of how teachers in a particular context (i.e., mathematics classrooms) might embody cultural responsiveness, there is nothing in either to suggest that how these teachers approached the education of students of color was unique to the mathematics classroom. Building relationships and trust; communicating; reflecting on and revising instruction; holding a deep knowledge of content, pedagogy, and students; and pedagogy and discipline are all important aspects of CRT that might manifest in any classroom. Indeed, Ms. Merriex described how the rhythmic teaching so characteristic of her mathematics instruction also played a large role in her teaching of vowels and vowel songs to younger students (Peterek, 2009). This model, therefore, is perhaps not characteristic of culturally responsive mathematics teaching but of culturally responsive teaching in general.

Furthermore, the nature of the mathematics instruction in these culturally responsive classrooms remains unclear. Bonner (2011) described each class as "mathematically rigorous" (p. 4) but failed to elaborate on what that meant. Was the instruction standards-based and focused on conceptual understanding? Or, did "rigorous" mean "difficult", so that students were engaged in challenging, yet still procedurally driven, mathematics (such as multi-step exercises)? When prompted to clarify what was meant by mathematically rigorous, Bonner was unable to give a clear description, suggesting instead that it differed from class to class. Additionally, when asked whether conceptual understanding of mathematics was a goal of these teachers, she suggested that it was but cited students' success on standardized tests and in high school mathematics as evidence (E. P. Bonner, personal communication, January 28, 2011). Achievement tests, however, are not a main focus of culturally responsive classrooms (Ladson-Billings, 1995b), and standardized tests and high grades may not necessarily be indicators of conceptual mathematical knowledge. This leaves one unsure of the nature of the mathematics teaching and level of students' conceptual understanding in these culturally responsive classrooms. It may be the case that culturally responsive mathematics teachers instruct in a more traditional manner, focusing on drill and memorization without emphasizing understanding, or it may be that they use standards-based instruction with an emphasis on teaching mathematics for understanding (or perhaps there are teachers who serve as examples of both). Consider also that Ms. Merriex was able to use discourse patterns with which her students were familiar (Peterek, 2009), but it is unclear whether she also supported them to learn the standardized mathematical language and discourse described by Walshaw and Anthony (2008) as necessary for students' future mathematical success.

Many scholars argue that a consideration of students' cultures and life experiences is a necessary part of mathematics education (Banks et al., 2005; Forman, 2003; Gay, 2002; Gutstein, 2003; Gutstein et al., 1997; Ladson-Billings, 1994, 1995a, 1995b, 1997; Peterek, 2009; Tate, 1995; Zevenbergen, 2000), particularly within the context of standards-based instruction (Gee, 2008; Lester, 1994; Lubienski, 2002; Mohatt & Erickson, 1981; Zevenbergen, 2000). Studies to further refine the model of CRMT and that also describe the nature of the instructional practices particular to mathematics teaching that occur in concert with CRMT are needed. Additionally needed are studies that examine whether CRT or CRMT supports students to overcome the obstacles of mathematics reform described by Lubienski (2000a, 2000b, 2002). This brings up the question, however, of whether it is even possible to integrate CRT with standards-based instruction in a mathematics setting. In the following section, the work of Gutstein and colleagues, which provides a depiction of CRT within reformed mathematics classrooms, will be examined.

Culturally Responsive, Standards-based Mathematics Teaching

Earlier sections of this chapter described two approaches to teaching that both hold potential for helping all students to engage with mathematics content and support them to succeed academically. Standards-based teaching provides teachers with guidelines related to mathematics instruction, but does not address broader instructional issues addressed by CRT such as teacher-student relationships, beliefs about students, developing a critical disposition, and classroom management. On the other hand, the literature on CRT and CRMT lacks a clear description of the mathematics instruction of culturally responsive teachers and the mathematical practices that occur within their classrooms. Thus, these two approaches are described separately in the literature and seem disconnected, but they may be complimentary. Some of the practices advocated by literature on CRT are theoretically consistent with standards-based teaching, for instance, connecting instruction to students' real world knowledge; establishing a classroom environment in which students are held accountable for their own learning and are expected to question, reflect, and share their thinking; and using multiple instructional strategies. Few studies exist, however, that specifically examine both culturally responsive and standards-based mathematics teaching. In this section, we explore the work of Gutstein and his colleagues, who provide a rare glimpse into this area.

In an examination of the nature of culturally responsive mathematics teaching in the context of reform, Gutstein and colleagues (1997) conducted a study in a Southwestern U. S. middle school where over 96% of the students were Mexican

American, 99% were considered to be from low-income families, and nearly half (46%) qualified for English as a Second Language services. At the time of the study, Gutstein worked closely with the middle school teachers in a professional development program on the reform-based *Mathematics in Context* (*MiC*) curriculum and helped them to foster practices congruent with CRT. The researchers (Gutstein et al., 1997) explored how teachers built on students' informal mathematical knowledge through their connections with students and knowledge of their cultures and sought to describe the nature of CRT in a Mexican American context.

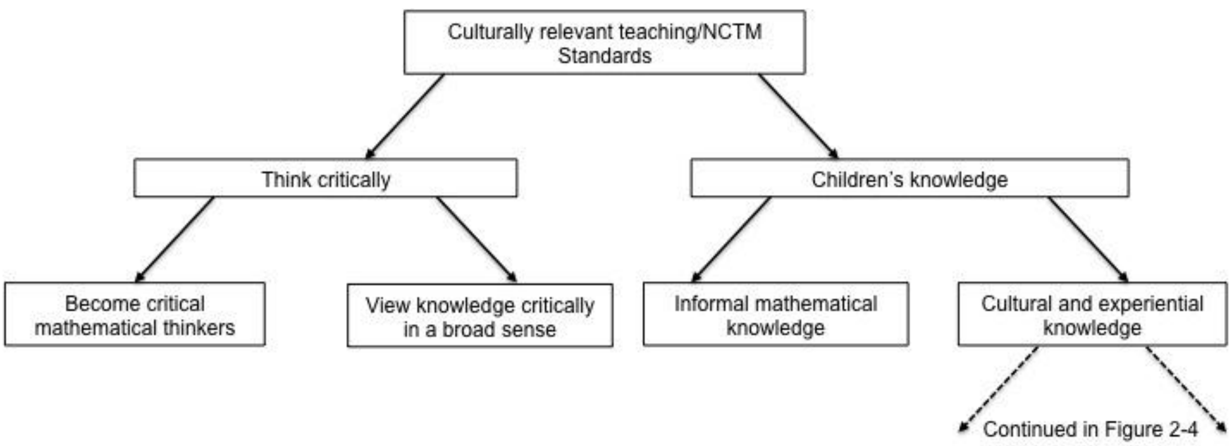

Figure 2-3. CRMT and Standards-based instruction (Part 1). Adapted from *Culturally relevant mathematics teaching in a Mexican American context* (p. 719), by E. Gutstein, P. Lipman, P. Hernandez, & R. de los Reyes, 1997, *Journal for Research in Mathematics Education, 28*.

Data collection methods included the use of field notes from classroom observations, open-ended interviews, artifacts, group conversations, and teacher journals. These data were transcribed and analyzed using a grounded theory approach. What resulted was a three-part model of instruction that connects CRT with the NCTM (1989, 1991, 1995) *Standards* documents (see Figures 2-3 and 2-4). The first component of the model contrasts critical mathematical thinking with thinking critically.

Critical mathematical thinking (e.g., explaining and justifying, theorizing, and developing arguments) falls under the NCTM (2000) Communication and Reasoning and Proof standards. Thinking critically is a notion in the literature on critical pedagogy and relates to critical consciousness. Teachers who adopted this stance challenged students to question the standard curriculum, consider multiple perspectives, construct their own knowledge, participate in democratic practices, develop a sense of agency, and, as one teacher stated, “stand up for what they think is right” (Gutstein et al., 1997, p. 270). This critical stance applied not only to mathematics instruction but also to the broader world, and particularly to situations where students were marginalized or disempowered. The authors identified several teachers who encouraged both forms of thinking in their students.

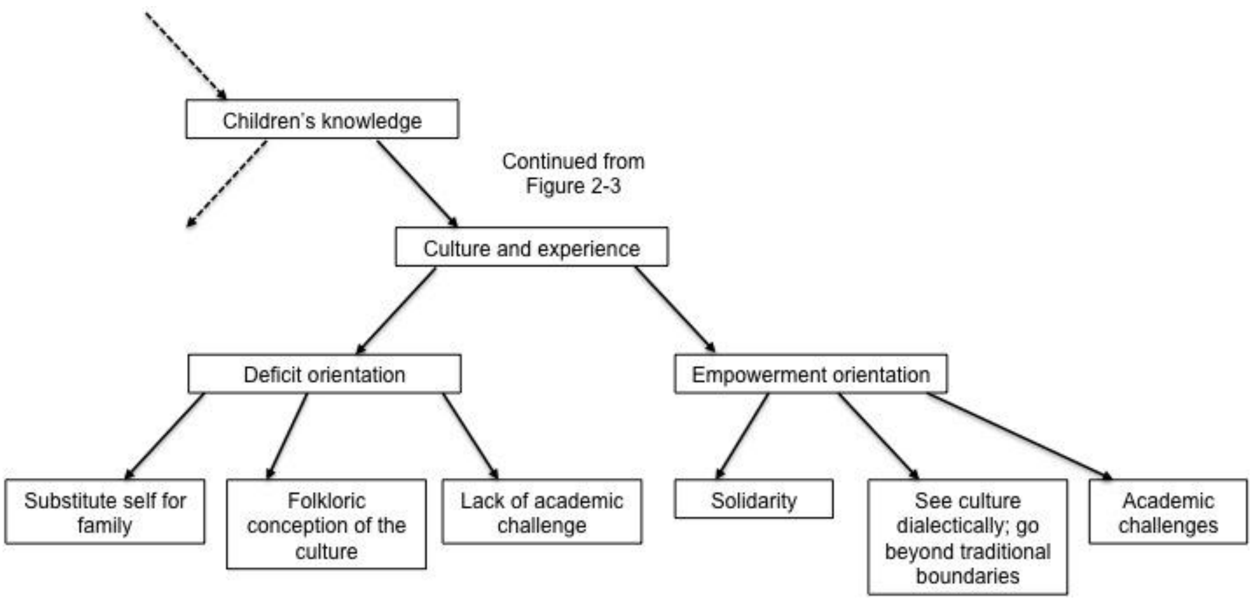

Figure 2-4. CRMT and Standards-based instruction (Part 2). Adapted from Culturally relevant mathematics teaching in a Mexican American context (p. 727), by E. Gutstein, P. Lipman, P. Hernandez, & R. de los Reyes, 1997, *Journal for Research in Mathematics Education, 28*.

The second component of Gutstein and colleagues’ model relates to the way teachers used students’ knowledge to inform their instruction. Some of the teachers built on students' informal mathematical knowledge as a starting point for lessons in line with a constructivist view of teaching and learning as well as with standards-based instruction (NCTM 1989, 1991, 1995). Other teachers added to this, also using the cultural knowledge and experiences of students to enrich the curriculum. This is a key element of CRT (Gay, 2000, 2002; Ladson-Billings, 1994, 1995b). Teachers thus used cultural knowledge to develop a "curriculum of empowerment" (Gutstein et al., 1997, p. 724). Students' cultures also formed the foundation for relationship building for some teachers, and others worked to develop students' competencies in both Spanish and English, fostering a sense of cultural and linguistic power and pride (i.e., cultural competence).

The third component of the model, cultural and experiential knowledge, contrasts a deficit orientation to students' cultures and experiences with an empowerment orientation. Those teachers found to hold a deficit orientation may have become familiar with students' backgrounds, but romanticized the Mexican culture and treated it as stagnant and folkloric. Additionally, they viewed families as providing insufficient support and thus substituted themselves for the students' families, a perspective referred to as the "messiah complex" (p. 728). Finally, a deficit orientation was characterized by a failure to challenge students academically, perhaps believing that by simplifying instruction, they were helping students who struggle. On the other hand, teachers who adopted an empowerment orientation taught their students more than just mathematics. Teachers who held high expectations, believed every child could learn, and challenged them academically characterized such an orientation. They also understood the fluid, evolving nature of culture that is shaped by people's experiences and that by facing adversity, oppressed people can develop strengths. They worked in solidarity, acting as allies to students and their families rather than saviors of students. Finally, these teachers did not enable students but rather supported them to become empowered (Gutstein et al., 1997). The empowerment orientation aligns with the Equity Principle proposed by NCTM (2000) and is consistent with a culturally responsive approach (Gay, 2000; Ladson-Billings, 1994, 1995b).

The authors concluded that while aspects of standards-based and culturally responsive teaching were related, one did not imply the other (Gutstein et al., 1997). For instance, teachers may help students to develop critical mathematical thinking without encouraging a critical disposition for effecting social change. Also, these perspectives build upon student knowledge, but the type of knowledge valued by each perspective differs. Thus, the connections between reform and CRT do not manifest unless teachers actualize those connections themselves. Additionally, Gutstein and colleagues' (1997) model doesn't explicitly explore the specific mathematical instructional practices teachers engaged in (e.g., were problem solving and multiple representations a common part of instruction?), nor how the approaches to teaching that they investigated supported students to gain access to mathematical knowledge. While this model suggests that CRMT and reform-based teaching can be integrated, the effects on students' mathematical success and understanding are unclear.

In a later study, Gutstein (2003) taught mathematics for social justice by supplementing a standards-based curriculum with problems focused on social justice issues and offered some insight into the question of achievement. The researcher explored the use of a standards-based curriculum coupled with projects based on social justice issues. He also examined the effects practice had on students' sociopolitical consciousness and specific mathematics-related objectives. Teaching for social justice involves supporting students to develop sociopolitical consciousness or conscientization, a sense of agency, and positive social/cultural identities. Teaching for social justice, then, is congruent with CRT but does not necessarily focus on using students' cultural backgrounds and knowledge to drive instructional decisions. The mathematical objectives for students in this study included reading the world with mathematics (i.e., using mathematics to develop conscientization), developing mathematical power (a notion similar to the strands of mathematical proficiency), and changing their dispositions toward mathematics. The goals for the project were twofold: to explore (a) the nature of teaching and learning mathematics for social justice, and (b) the relationship of that process to a Standards-based curriculum. The focus of Gutstein's study was on students' conscientization and the curriculum used, not his pedagogy.

Gutstein, acting as both teacher and researcher during this study, taught honors mathematics to 28 Latino, immigrant students whose families were working-class during their seventh and eighth grade years. He conducted a teacher-inquiry using semi-ethnographic research methods (e.g., participant observation, surveys, textual document analysis, informal student interviews) and engaged in systematic, critical self-inquiry. Textual data were analyzed using open coding, and codes were then combined into themes. Gutstein taught using *MiC*, the same Standards-based curriculum with real-world problems used in Gutstein et al. (1997). He was concerned the problems were not relevant to students, and thus supplemented the curriculum with projects focused on social-justice issues such as racism, gentrification, and poverty. The projects were problem-based, and it was their context, rather than the mathematics, that made them social justice oriented[2]. Students were encouraged to solve problems in ways that made sense to them (i.e., use invented strategies), often wrote explicitly about the mathematics they used in completing the projects, and examined and discussed others' solutions (Gutstein, 2003).

Gutstein (2003) found that the students shifted from not having a critical perspective at all to "connecting mathematical analyses to deeper critiques of previous assumptions" (p. 53). They developed a critical disposition, questioned what they had been taught and what they thought they knew, and used mathematics to make sense of these ideas. Students realized the value of mathematics for both understanding and critiquing the world, felt mathematically able to understand inequities, and changed their views of the nature of mathematics. Gutstein also suggested that 27 of 28 students showed increases in mathematical power: they were able to generalize, solve non-routine problems, explain and reason, and were more confident in their mathematical abilities. They additionally performed well on conventional measures of mathematics success: all passed the eighth-grade standardized test, and 15 went on to magnet high schools. Finally, most students developed more positive dispositions toward mathematics.

Considering the second goal of the study, Gutstein (2003) found that the standards-based curriculum potentially supported a social justice pedagogy, but there were some necessary conditions of the curriculum. *MiC* used problems with real-life

[2] Examples of such problems can be found in Gutstein & Peterson (2006).

contexts and encouraged multiple perspectives and invented strategies. Gutstein argued that a safe classroom culture where students could openly discuss social justice issues was important, and while *MiC* didn't explicitly address the classroom culture, the curriculum did encourage an inquiring habit of mind that played a supportive role in creating an environment where students were comfortable questioning assumptions and power dynamics. Finally, coherence between curricular aspects was necessary, and Gutstein worked to ensure the big ideas of projects and *MiC* aligned well overall.

This study is useful in understanding how to supplement a standards-based mathematics curriculum to incorporate social justice teaching, and the results are encouraging. Students showed deep understanding and continued to thrive after leaving Gutstein's class. The participants, however, were in the honors track, so they were already successful mathematics students before taking his class. Literature suggests social justice issues be addressed in classrooms with high numbers of students of color, but Gutstein's results may not be generalizable to traditionally low achieving students of color. It is unclear whether his high achieving students would have struggled with the reformed nature of the curriculum in the same way Lubienski's (2000a, 2000b) students did or whether they would have experienced such success mathematically. Furthermore, Gutstein (2003) only focused on the curriculum used and did not describe the pedagogical aspects of his teaching. This is a limitation of the study that does not allow one to understand what went on in his classroom over the two years (e.g., what was the nature of the discourse and classroom norms? Did students work individually or in groups on the projects?). In fact, as indicated previously, Boaler (2002) suggested that the pedagogy a teacher adopts is more important than the particular curriculum used. More studies that examine the pedagogy adopted by teachers to support struggling students – particularly those of color and those who live in poverty – to engage with mathematics are needed.

Conclusion

As described earlier, low-income students of color often struggle to succeed in school mathematics (Davis & Martin, 2008; Dewan, 2010; Post et al., 2008; Rothstein, 2002; Tutwiler, 2007) and their achievement levels are far below those of their white, middle class peers (Banks et al., 2005; Brantlinger, 2003; Gutstein et al., 1997). The reform movement in mathematics, which emphasizes standards-based instruction, is the predominant strategy suggested in mathematics literature to support these struggling students (see NCTM, 2000). Some research suggests that this teaching approach may help to address issues of equity and narrow the achievement gap (Boaler, 1997, 1998, 2000, 2002; Brown et al., 1996; Post et al., 2008; Silver et al., 1995). Students in Boaler's (1997, 1998) study also indicated that low-income students enjoyed the nontraditional mathematics instruction they received. Other research, however, points to problems with standards-based teaching. Low-income students sometimes not only seem to prefer traditional mathematics instruction (Lubienski, 2000b), but they also report feeling less confident and struggle to participate in classroom discourse in reformed mathematics classrooms (Lubienski, 2000a). There may be differences in how teachers implement standards-based instruction that account for these discrepancy in findings. For instance, the ways in which some students have learned to communicate and behave outside of school conflicts with how their teachers expect them to communicate and behave in school (Gee, 2008; Lubienski, 2002; Zevenbergen, 2000), and perhaps some teachers explicitly support their students in learning the school culture in a way that leads to a more successful mathematical learning experience. This attention to culture is not a characteristic of reform mathematics, but rather of CRT.

Culturally responsive teaching is a pedagogical approach that takes into account students' cultures, integrates those cultures into the curriculum, and seeks to support students to become empowered and successful academically, socially, personally, and politically (Gay, 2000; Ladson-Billings, 1994). Studies of effective teachers of low-income students of color indicate that these teachers adopt a culturally responsive approach (Bonner, 2011; Ladson-Billings, 1994, 1995a, 1995b; Gay, 2000, 2002; Peterek, 2009). This approach is further characterized by an insistence on academic achievement and appropriate behavior, as well as explicit teaching of the rules, roles, norms, and other types of capital necessary for school success (Gay, 2000; Ladson-Billings, 1994; Ross et al., 2008). Most studies on CRT, however, are not specifically focused on effective mathematics teaching (Silver et al., 1995; Peterek, 2009). One series of studies (Bonner, 2011; Peterek, 2009) sought to address this dilemma by examining the culturally responsive practices of mathematics teachers and describing culturally responsive mathematics teaching. In spite of this, this series of studies does little to specifically characterize the mathematics instruction in culturally responsive classrooms and it is unclear if standards-based or traditional teaching was occurring. Further, it would be helpful to understand what specific actions – if any – that culturally responsive teachers take to help students to overcome their difficulties with reform mathematics instruction.

Gutstein and colleagues (1997) suggested that standards-based instruction and CRT can occur simultaneously, but teachers must actualize the connections between these two teaching approaches themselves for this to occur. The teachers in that study received specialized training, and the literature does not indicate whether classroom teachers who do not receive such training are able to actualize those connections on their own. Furthermore, it brings up the question of whether actualizing the connection between standards-based and culturally responsive teaching is necessary for effective teaching of low-income students of color, or if one of these pedagogical techniques is sufficient for student achievement. Peterek (2009) and Bonner (2011) describe a model for culturally responsive mathematics teaching and Bonner (2011) suggests that this model be further researched and refined; perhaps Gutstein and colleagues' (1997) model also needs to be further developed. One way to do this includes examining the practices of teachers of students of color and determining whether their instruction contains elements of both reform and culturally responsive teaching. Another concern with Gutstein and colleagues' (1997) study is that they did not examine the effect of such a pedagogical approach on student achievement. A later study (Gutstein, 2003) suggested that a reformed curriculum coupled with some elements of CRT (specifically, teaching for social justice) may support the mathematics achievement of students of color and improve their dispositions, but the researcher – not the regular classroom teacher – was providing the instruction, and the students were in the honors track.

This dissertation study seeks to understand whether classroom teachers who are effective with low-income students of color adopt a reform-based approach, a culturally responsive approach, or an integration of these approaches. I also seek to fill in some of these gaps in the literature by examining effective teachers' practices and focusing specifically on the mathematical practices in classrooms with a high percentage of students of color. By analyzing their instructional practices and perspectives, the goal is to determine whether their instruction is characterized by elements of reform, cultural responsiveness, both, or neither. This will help the mathematics education community to better understand the instructional practices teachers adopt that contribute to the success of their traditionally underachieving students of color.

CHAPTER 3
METHODS

Overview

The purpose of this collective case study was to understand how teachers who are successful with low-achieving students of color and living in poverty supported their students in learning mathematics. The following questions guided this investigation:

- How do teachers identified as highly effective with students of color living in poverty help their students to engage with mathematical content?
    - What are these teachers' classroom practices?
    - What are these teachers' perspectives of the practices that are important for engaging their students with mathematical content?
- In what ways do these teachers' practices align or not align with standards-based instruction and culturally responsive teaching?

This study adopted a naturalistic approach and utilized participant observation methodology within the constructivist paradigm (Hatch, 2002). Two teachers were selected for participation based on nominations from the county's secondary mathematics curriculum specialist. Data were collected through classroom observations and interviews with teachers. These data were analyzed using qualitative methods to identify themes.

Methodology

This dissertation is a naturalistic qualitative study of teachers' instructional perspectives and practices that used a participant observation methodology undertaken within the assumptions of the constructivist paradigm (see Hatch, 2002). Constructivism assumes that individuals build knowledge through interactions with the world and that their experiences and particular perspectives are subjective (Crotty, 1998). This paradigm necessitates the use of naturalistic qualitative research methods (Lincoln &

Guba, 1985). This perspective holds the goal of capturing naturally occurring activities in their natural settings because these methods allow the researcher to “spend extended periods of time interviewing participants and observing them in their natural settings in an effort to reconstruct the constructions participants use to make sense of their worlds” (Hatch, 2002, p. 15). Thus, participant observation was selected as the methodology for this study, which allows data to be collected within social settings and enables the researcher to concentrate on a particular area of interest – in this case, instructional practices. Data collection strategies for participant observation fieldwork, including interviews and direct observation with field notes, were used for this study. The interviews provide a means for the researcher to engage with participants in the coconstruction of a subjective reality to better understand their perspectives. Direct observation enables the researcher to capture the cultural knowledge of participants but also serves as a source of evidence in support of or contrary to the participant’s perspective from interviews (Hatch, 2002).

Procedure

Participants

Identification of participants

Participating teachers were purposefully selected from a pool of middle or high school mathematics teachers identified as highly successful in order to represent critical case samples, which, according to Patton (as cited in Hatch, 2002), include individuals who “represent dramatic examples of or are of critical importance to the phenomenon of interest” (p. 98). For this study, the criteria for a critical case included (a) teaching predominantly low-income students of color and (b) identified as highly successful with traditionally underperforming students. The county’s secondary mathematics curriculum specialist nominated participants for this study based upon student demographic information and achievement test scores. She described each of the nominees as highly successful with the student population in question.

For the purpose of identifying the participants, the phrase “highly effective” was broadly defined. First, highly effective teachers are those that have demonstrated ability to habitually secure higher-than-average performance from traditionally underperforming students on measures of mathematics achievement. Florida’s Comprehensive Assessment Test (FCAT), the state’s annual standardized test, and the standardized end of course (EOC) examinations administered by the State were used as measures of mathematics achievement. The goal was to identify teachers of students who previously demonstrated low achievement in mathematics on the FCAT or EOC but who, with the help of the teacher, made higher than the average gains in the county on the exam. While there are certainly other ways to measure teacher effectiveness (e.g., students’ problem-solving abilities, motivation, attitudes toward mathematics, engagement), successful performance on the FCAT and the EOC is necessary for students to graduate from high school and thus it is crucial that teachers make strides in preparing students for these standardized tests.

The teachers nominated by the secondary mathematics curriculum specialist were invited to participate in the study. From the volunteers, two were selected as participants for the proposed study. They were provided with an informed consent form (Appendix A) that provided participants with a description of the research and required their signatures.

Description of participants

Several teachers were nominated and two subsequently volunteered for participation in this study, Ms. J and Ms. W (all names of people and places are pseudonyms). Ms. J was a 25-year-old Hispanic female in her third year of teaching middle school mathematics. She was born in Minnesota but moved frequently as a child and has lived in several states within the U.S. as well as other countries including Algeria, Indonesia, and Brazil. Ms. J's bachelor's degree is in hospitality and tourism management with a minor in business from State University, a large public institution in the same town in which this study took place. Upon graduation, Ms. J became a substitute teacher; she was later hired as a long-term substitute as a high school English teacher in the ESOL program at one of the schools at which she substituted. The following year she worked as a long-term substitute mathematics teacher at Southside Middle School, where she was subsequently hired as a full-time mathematics teacher. During the course of this study, Ms. J held a temporary teaching certificate and was taking courses to become alternatively certified as a middle school mathematics teacher. One hundred percent of Ms. J's students met Adequate Yearly Progress (AYP) on the FCAT her first year teaching, and she was nominated for the Teacher of the Year award at her school while this study took place.

During the course of this study, Ms. J taught seventh grade mathematics and eighth grade advanced mathematics, and she co-taught eighth grade mathematics. Her first period seventh grade mathematics class served as the context for this study. Fourteen of the seventeen students in this class were of color. Data were not available on the socioeconomic statuses of these students, though Ms. J indicated that "many" of them were on free or reduced lunch.

Ms. W was a 31-year old Caucasian female in her ninth year as a mathematics teacher and described herself as a country girl who grew up in a small town that had little cultural diversity. She attended the same large State University as Ms. J, and pursued a five-year bachelor's/master's degree program in which she majored in mathematics with a minor in education as an undergraduate student and received a master's degree in mathematics education. Ms. W was the County Teacher of the Year in 2010.

Ms. W has taught Algebra IA, Algebra I (regular and honors), and Geometry (regular and honors), and during the course of this study she taught both Algebra I and Algebra I Honors. Her third period block Algebra I/Intensive Math course served as the context for this study. Twenty of the twenty-one students in the class were black. Data were not available on the socioeconomic statuses of these students.

Setting

The district in which this study took place was located in an ethnically and socioeconomically diverse county in Florida. The student population was just above 27,000 students and was 49% White, 36% Black, 6% Hispanic, 5% Multiracial, 4% Asian/Pacific Islander, and less than 1% American Indian/Alaskan Native. The graduation rate was approximately 65%. Forty-four percent of students qualified for free or reduced lunch.

This study focused on two teachers at two schools within the district. One school, Southside Middle School, enrolled approximately 1,020 students. The student population was 51% White, 32% Black, 9% Hispanic, 5% Multiracial, 3% Asian/Pacific Islander, and less than 1% American Indian/Alaskan Native. Forty-one percent of students qualified for free or reduced lunch. Southside housed the Cambridge

International Program, but this program was not identified as one of the district's magnet programs. The second school, Maya Angelou High School, enrolled approximately 1,500 students. The student population was 26% White, 60% Black, 3% Hispanic, 3% Multiracial, 9% Asian/Pacific Islander, and less than 1% American Indian/Alaskan Native. The graduation rate was below the district average at approximately 48%. Forty-three percent of students qualified for free or reduced lunch. Maya Angelou High was home to two district magnet programs: the International Baccalaureate Program and a culinary arts program.

Data Sources

Primary data sources for this study included direct observation with field notes as well as informal and formal interviews. Classroom artifacts provided by the teachers served as a secondary data source.

Data Collection

The majority of data collection for the present study took place from October to December 2011, with additional interviews in February 2012.

Classroom observations

Observation was used as one method of data collection. This study focuses in part on the perspectives of teachers, and Hatch (2002) states that observation allows the researcher the opportunity to understand the context being studied from the perspective of the participant. Observation additionally allows the researcher to gain a deeper understanding of the context and learn about that which was not mentioned during interviews (Hatch, 2002). Two observations occurred each day, so that one class period taught by each participating teacher was observed over the course of five and one-half weeks. The goal was to reach saturation, or redundancy. Lincoln and Guba (1985) described redundancy as the practice of simultaneously collecting and analyzing data over an extended period of time until findings become repetitive – and then collecting observational data once more for good measure. The total number of classroom observations was 33; Ms. J's class was observed 15 times, and Ms. W's class was observed 18 times.

I took field notes during classroom observations. Adhering to Hatch's (2002) guidelines, these "raw" field notes included descriptions, in as much detail as possible, of the classroom context as well as of the actions and conversations that occurred during the class. Particular care was taken during instruction and conversations to record exactly rather than summarize or paraphrase what was said. My initial impressions, interpretations, and feelings were also recorded, but were bracketed so that they were clearly distinguishable from the raw field notes. The goal when taking field notes is to create accurate descriptions of what was observed, but these descriptions are usually incomplete. Thus, the raw field notes were "filled in" once the observation for the day was completed. This process involved rewriting the raw field notes into an organized format (i.e., research protocol) while simultaneously expanding on the details to create as accurate a record as possible of everything that was observed. Because I was working from memory as well as from the raw field notes, the research protocols were filled in as soon as possible after an observation occurred, and always occurred before the next observation in that classroom. Similar to the note-taking process during observations, any impressions, interpretations, and feelings that occurred to me during this filling in process were bracketed in the protocol to separate them from the descriptive data (Hatch, 2002).

Analysis of the research protocols from observations began as the data were collected. These observations informed later interviews with the participants. For instance, I asked the teacher to explain specific classroom interactions or instructional decisions she made during the observations. Furthermore, artifacts (e.g., teacher handouts) were collected during classroom observations and served as a secondary data source; they were not explicitly analyzed but instead were used to support my understanding of the instructional practices being observed.

Interviews

Interviews with participating teachers focused on their perspectives about practice and teaching philosophy. There were three formal interviews per teacher using a semistructured interview protocol (Hatch, 2002). These formal interviews lasted approximately forty-five minutes to one hour and focused on (a) background and general teaching practices and perspectives; (b) knowledge of mathematics teaching and how the teacher used this knowledge in the classroom; and (c) knowledge of culture and CRT and how the teacher used this in the classroom (see Appendices B, C, and D for interview protocols). Some interview questions have been adapted from Adkins (2006) and Peterek (2009). These formal interviews were scheduled at a time convenient for the teacher, and were audio recorded and transcribed verbatim.

Additionally, there were multiple informal interviews that occurred throughout the course of the study as needed, typically immediately before or after an observation. The informal interviews allowed me to probe the teacher about something I observed during the class period. As an example, I asked a teacher to explain her thinking behind a particular activity, why she responded in a certain way to a student’s question, and to explain classroom procedures that were unclear. Thus, the questions for the informal interviews varied depending on what aspects of the observation I felt need to be clarified or further investigated (see Appendix E). Field notes were taken during these informal interviews. After each informal interview, these field notes were reviewed and expanded in the same manner described in the section on classroom observations.

Summary of data collection

Over the course of this study, 15 observations were conducted in Ms. J's classroom and 18 observations were conducted in Ms. W's classroom for a total of 33 observations. Additionally, three formal interviews and multiple informal interviews were conducted with each teacher. Artifacts, including handouts distributed to students, were also collected throughout the study.

Data Analysis

As suggested by Hatch (2002) and Lincoln and Guba (1985), I kept a daily research journal throughout the analysis process. This journal provided documentation of the affective experience of conducting the study, as well as served as a running record of what has been done each day during the study. It further provided a place for me to record relationships and patterns emerging from the data that I wanted to further explore during analysis (Hatch, 2002).

An abundance of data were collected for this collective case study. To make meaning of these data, both within-case and cross-cases analyses were conducted. For the within-case analysis, I followed a series of steps to identify emerging themes in a single case. These steps combined several analysis methods described by Hatch (2002). First, I began by reading through the data (i.e., interview transcripts, expanded field notes, and artifacts) multiple times to get a sense of the context of the data as a whole. As data collection continued and new data were added to the data set, all the data were reread repeatedly. Next, I identified frames of analysis. These conceptual frames of analysis are segments of text that contained one idea, piece of information, or occurrence (Hatch, 2002; Tesch, 1990) and which broke up the large data set into smaller, analyzable units. For this study, the frames of analysis of observation data typically began when the teacher posed a question for students and ended when the problem was solved. Thus, each observed lesson included several frames of analysis.

Next, I read through bracketed comments and impressions I made during the course of data collection and which were recorded in the research journal. These interpretations and impressions were recorded in separate memos, which “are written notes to yourself about the thoughts you have about the data and your understanding of them” (Graue & Walsh, 1998, p. 166). I read through the frames of analysis several times and recorded new impressions in additional memos.

The next step in data analysis involved rereading the memos and examining them for emerging themes. As suggested by Hatch (2002), some memos were combined while others were kept in their original form. For instance, there were several memos about observations in which I noted Ms. J was guiding students through the procedures for solving a mathematics problem. There were additional memos about interview data where I noted Ms. J’s assertions that students needed her guidance before they were able to solve problems on their own. These memos were combined into a theme that describes the ways in which she broke down mathematics into easily followed procedures.

After identifying themes from the memos, I reread the data and identified instances in the data that supported my interpretations. This step also involved a search for counterevidence in the data, and my interpretations were modified as necessary. Finally, I read the data once again in search of excerpts to support my findings. In this final step, I conducted a final check to ensure the data were adequately represented in the findings. A detailed summary of my interpretations was written from the memos and included the excerpts I had identified.

For the cross-case analysis, I drew on a CRT and standards-based instruction framework to compare the observed teaching practices of the participating teachers. Specifically, I examined the cases for similarities and differences in the ways each teacher's practices and perspectives aligned or did not align with CRT and standards-based instruction. I again recorded memos and examined those memos for themes, conducted a search for counterevidence, and wrote a summary of my interpretations.

Establishing Trustworthiness

In any study, it is important to ensure the study is rigorous. Lincoln and Guba (1985) suggested that researchers conducting naturalistic studies attend to credibility, transferability, dependability and confirmability to establish the trustworthiness. The following sections describe how each of these was attended to in the present study.

Credibility

Credibility refers to the degree to which findings accurately represent the realities of participants. There are five techniques one can use to establish credibility: engaging in activities that increase the probability that credible findings will be produced (e.g., prolonged engagement, persistent observation, and triangulation); peer debriefing, negative case analysis, referential adequacy, and member checks (Lincoln & Guba, 1985). For the present study, data collection occurred over an extended period of time (five and one-half weeks) and observations occurred on a nearly daily basis.

Additionally, multiple sources were used to triangulate the data, such as formal and informal interviews, observations, and classroom artifacts. Furthermore, the interviews were audiotaped. Interpretations of the data were shared with participants at interviews, and they were provided with the opportunity to confirm these interpretations or provide further clarifying information. Finally, data analysis included the search for counterexamples.

Transferability

Unlike establishing external validity in quantitative studies, establishing the transferability of results of naturalistic studies to other people and settings is not the responsibility of the researcher. Instead, the researcher must provide a thick description of the setting, participants, context, and time of the study so that the reader is able to determine whether results are transferable (Lincoln & Guba, 1985). The thick description of participants, setting, and data required for establishing transferability is included in the present chapter and expanded upon in the case studies (Chapters 4 and 5).

Dependability and Confirmability

Establishing whether results of a study are dependable and whether they could be confirmed by an outside source requires the researcher to provide an "audit trail" of all activities engaged in during the design of the study as well as collecting and analyzing the data that an outsider could later review (Lincoln & Guba, 1985). This includes keeping records of raw data (e.g., recorded data, field notes), data reduction and synthesis products (e.g., description of findings and their connections to relevant literature), process notes, and materials related to intentions and dispositions (e.g., research proposal, research journal; Halpern, as cited by Lincoln & Guba, 1985). To ensure the dependability and confirmability of this dissertation study, a detailed explanation of each step of the research process has been provided. Furthermore, the method chosen for data analysis required the production and retention of many of the records suggested by Halpern.

Subjectivity Statement

Before presenting the results of this study, my personal perceptions, incoming experiences, and expectations related to the education of youth in America must be bracketed. I am a 28-year old, married mother who has much in common with both the participating teachers in this study as well as the students they teach.

First, I am a Ph.D. candidate majoring in Curriculum and Instruction with a concentration in Mathematics Education. As such, I certainly have my own opinion about what form mathematics instruction should take that is informed by the research I read about and conduct. In particular, I believe mathematics teaching should engage students in problem solving and mathematical discourse, and should provide students with an opportunity to learn about mathematics conceptually before they learn about procedures. Furthermore, my studies are funded by an organization that provides professional development to teachers in low-performing schools with high numbers of low-income students of color, and my doctoral experience involves educating and supporting mathematics teachers to improve their instruction. I am also a former high school mathematics teacher. While I don't claim to have been "highly effective" in the way the participating teachers are, I did teach mathematics to struggling, low-income students of color just as they do. My parents are educators who have worked both in public schools and after school programs for youth living in poverty. I spent much of my childhood in these settings and listening to my parents discuss the difficulties teachers face in a poorly funded, conservative, standards-driven school system. These experiences have privileged me with an insider's knowledge from early on about what it takes to be a teacher, and I understand on some level many of the struggles (and successes) these teachers face on a daily basis.

Second, I am a U. S. citizen born abroad to an American father and Brazilian mother. I also claim citizenship of Brazil. I am bilingual and consider myself bicultural. I have seen my mother, who is dark-skinned and bears a heavy accent, struggle at times with language issues and prejudice. I have thus struggled in the past – as many students of color do – with maintaining the Brazilian in me while attending school in a system designed for white, middle class Americans. Due to my father's background and the fact that both my parents are teachers, however, I am fortunate to have grown up with the knowledge and cultural capital necessary for successfully "playing the game" that I believe is part of schooling in America. This has required me to often set aside my "Brazilianness" and act the part of the studious "white" girl. Furthermore, when my parents moved to the U. S. with their four young children, they struggled financially for several years. These past experiences with poverty and the struggle I still have to maintain my cultural identity, I am in a sense (or at least was in my younger years) similar in background and feel a connection to some of the participating teachers' students.

My identity and these experiences certainly colored the way I perceived the instruction I observed and the conversations I had with the teachers in this study, as one can never completely disconnect oneself from the participants and data or be truly objective. As a researcher, however, I strove to put aside my assumptions and preconceptions as much as possible in an effort to be receptive to the practices and perspectives I was trying to understand.

Structure of the Cases

Each case (Chapters 4 and 5) begins with a description of the teacher, her students, the classroom setting, and why she believes she was selected for the study. Next, the goals the teacher held for her students are described, followed by an examination of the psychological environment in the classroom that helped the teacher reach those goals. A description of how the teacher approached mathematics teaching in particular follows, and includes a narrative of a “typical” day in her classroom. Finally, each case concludes with a discussion of the influences on instruction identified by the teacher.

Excerpts from interviews and field notes will be included as evidence to support my interpretations of data. These excerpts were coded using a system to identify the participant, the data source (e.g., interview or observation protocol) and the date. For example, [PJ_103111] refers to an observation protocol of Ms. J’s instruction that occurred on October 31, 2011. Similarly, [W_Int3_120111] refers to the third interview with Ms. W, which occurred on December 1, 2011. In observation excerpts, students’ names (pseudonyms) were used when possible. Otherwise, “S” was used to indicate a student, and “Ss” was used to indicate several students.

CHAPTER 4
CASE ONE: MS. J

An Introduction to Ms. J and her Classroom

Ms. J is an alternatively certified mathematics teacher. She is an Hispanic woman who was 25-years old and in her third year of teaching middle school mathematics at the time of this study. Her background differed from those of her black students who lived in poverty. She was born in Minnesota but moved frequently as a child and has lived in several states within the U.S. as well as other countries including Algeria, Indonesia, and Brazil. As a child she dreamed of becoming a teacher and often played school with her sisters but was convinced by her parents to study something other than education when she began college. Thus, Ms. J's Bachelors degree is in Hospitality and Tourism Management with a minor in Business. Following an internship during her final year of studies, however, Ms. J realized she wanted to pursue teaching after all. She applied for the Masters in Education program at her university and took up substitute teaching while she waited for the next semester to begin.

Ms. J was then hired as a long-term substitute as a high school English teacher in the ESOL program at one of the schools where she worked and decided not to pursue her Master's degree. Ms. J admitted, "I haven't taken a class that tells you how to teach; I've never done an internship" [J_Int1_110711] and indicated that this made her initially apprehensive about participating in the study. She additionally had no formal training in advanced mathematics, and when questioned about the differences between mathematicians and mathematics teachers, she stated, "I'm no mathematician. Let's leave it at that" [J_Int2_013012]. In fact, Ms. J's hardest subject in school was mathematics. She explained, "I struggled a lot in math.... I had to go home and practice, so I feel like I sometimes can relate to some of these students who get frustrated with math" [J_Int2_013012].

Ms. J became a mathematics teacher almost by chance. She worked as a long-term substitute mathematics teacher at Southside Middle before being hired full-time. She enjoyed the other subjects she taught as a substitute and in particular English for ESOL students and stated, "I felt like I could get to know them a little bit better because I got to read their writing whereas in math I don't get that opportunity. So perhaps if I had to pick a different subject it wouldn't be math" [J_Int2_013012]. Even so, Ms. J believed that math was "important and fun" [J_Int2_013012].

Aware of her lack of formal education in both content and pedagogy, Ms. J stated that she sought out every possible opportunity to attend workshops. She indicated that most of the teaching strategies she used were learned in workshops – particularly in a Kagan[3] workshop she attended over the summer – or came naturally to her, a gift that she says was given to her by God. Everything else, she's "learning as [she goes]" [J_Int1_110711].

Perhaps it was her lack of formal training in education and mathematics that made Ms. J very modest about her teaching abilities. Though her colleagues knew her as a successful teacher who cared deeply for her students, Ms. J indicated surprise at being identified as highly effective and being nominated for participation in this study, stating, "I really don't know [why I was nominated], honest. I mean, I'm assuming maybe ... my principal, the first year I taught, or after the first year I taught he's like, 'Well, Ms. J, your FCAT scores are unbelievable, like 100% [made AYP]" [J_Int3_020612]. Ms. J was

[3] See Kagan and Kagan (2009).

described by her principal as an "outstanding choice" as a participant, even though she repeatedly expressed disappointment in the fact that many of her students were making F's in her class. She explained, however, that "whenever the standardized tests come out [my students] do really well, so he can't really fault me. 'Okay, well whatever you're doing you're doing something right!'" [J_Int1_110711]. Even though her students demonstrated growth on the FCAT, Ms. J claimed to have never actually looked at sample FCAT test questions, though she did utilize resources designed for the benchmark assessment administered by the district.

When asked to describe what she thought about when it came to teaching, Ms. J responded, "Instructing.... Having a classroom full of kids, explaining to them how to do something where they walked in not knowing how to do it and hopefully by the time they leave they've learned something new" [J_Int3_020612]. Thus, the role of the teacher was to show or explain to students how to solve problems.

The following section describes the goals Ms. J held that influenced the way she taught and interacted with students.

Goals for Students

Ms. J held three overarching goals for her students. First, she indicated students needed to learn mathematics and be able to apply it in the real world. Second, she stated that she wanted students to become well mannered. Third, Ms. J indicated it was important for her students to care about school.

Learn and Apply Mathematics

Ms. J's main goal for her students was academic success. She "[wanted] them to master the benchmark, you know, learn the lesson" [J_Int3_020612]. Ms. J also indicated that being able to use mathematics outside of the school setting and apply the knowledge that they've learned was an important goal for her students:

> Hopefully they're gaining skills that they can apply, not just in math class but outside of you know the classroom.... I try to make a bunch of applicational [*sic*] problems ... and so trying to bring it back to real world and not just you know figures in their textbook. So yeah, my goal for them is to acquire the math skills that they need in life. [J_Int3_020612]

This statement is supported by the classroom observations during which most of the problems assigned were word problems, or what Ms. J called the "applicational" problems. She explained that the reason she assigned word problems was because they better prepare students for their futures than learning to solve bare numerical problems would:

> [Word problems are] what they need to know. This is what's going to be tested.... That's what life is about. They're not going to go to a job and it says, "Ok, do two plus two, please." No, it's going to be a word problem. [J_Int1_110711]

Finally, Ms. J indicated that in addition to learning mathematics, it was important to her that students enjoyed it and said, "Ideally I'd like for all my students ... to just like math" [J_Int3_020612].

Become Well-mannered

Ms. J was committed to the growth and success of her students in life, not just in mathematics. To her, this meant equipping students with social skills, and she sought to support students in learning manners and morals. She indicated, "I feel like I need to [teach them manners] on a regular basis" [J_Int2_013012]. She used any opportunity to teach these skills to students. For example, during games or when students were assigned new seats (and new partners), she asked students to practice shaking hands and introducing themselves to someone. She spent a great deal of time at the beginning of the year teaching social skills because she believed them to be “super important” [J_Int1_110711]. Ms. J found it challenging, however, when teaching students of varied cultural backgrounds:

> I have a student who’s like looking this way [*she gestures to her side. Then, gesturing toward her face:*] “I’m right here talking to you.” You know, eye contact.… So I learned that at her house if you look at your parents in the eyes, that’s a sign of defiance, like you’re not supposed to do that in that house. I was like, “What?!” I had no idea. Here I am telling my kids, “eye contact,” you know, but she can’t do that at home. [J_Int3_020612]

Ms. J stated that she believed these ideas were so important that she wanted to teach a class on morality, manners, and social and life skills. She even asked for permission from the principal to offer such a course as an elective, but in the meantime did her best to incorporate these skills into her mathematics class.

Care About School

Ms. J believed many of her students did not care about school, so one of her goals was to “to get kids who aren’t passing to care about school” [J_Int3_020612] and to realize what a privilege it was that they are able to attend school at all:

> [I want them to] enjoy coming to school and realize it really is a privilege to be here. In America they come to school for free, you know? A lot of kids don’t have that opportunity and the kids don’t realize it. [J_Int3_020612]

Ms. J indicated that a lack of care was more of a problem with her students of color than their white counterparts, stating that perhaps “the student of color is more frustrated when they don’t understand something because they lack the skills or whatever it is, or maybe they just don’t care.... Mostly they don’t care” [J_Int3_020612]. Ms. J believed this lack of care was a result of the difficult lives many students of color who live in poverty faced and that it was her responsibility to get them to care about school:

> I think for those students who don’t necessarily pass I think my main concern with them is getting them to care [about school.] A lot of times they

> have other things outside of school that intervene with them being able to focus in the classroom. Some of them I think it's a miracle that they even come to school because of some of the situations at home. So you know you work with the students individually. I do what I can. [J_Int3_020612]

In summary, Ms. J sought to support students to become learners of mathematics who mastered content standards and were able to apply the mathematics knowledge they learned in real-world settings outside the classroom. She suggested that it was important for students to learn manners, morals, and social skills. Finally, Ms. J stated that her students needed to learn to care about and appreciate school. These goals impacted the way Ms. J approached the teaching of mathematics and the psychological environment in her classroom. This psychological environment is the topic of the next section.

Psychological Environment

The field notes garnered during the observation of Ms. J's teaching yielded several themes that characterized the psychological environment in her classroom. The data related to each will be discussed in the following sections:

- Cares deeply for students;
- Classroom is a community of respect;
- Adopts an attitude of high expectations; and
- Engages in explicit and consistent classroom management.

Cares Deeply for Students

Ms. J cared deeply for her students. When asked about her students of color, she stated, "they're fun. They're fun. They're great. I don't know, I love them," [J_Int3_020612]. When her first year FCAT results became available and she found out 100% of her students made AYP, Ms. J's principal asked her to talk about her teaching at a faculty meeting. Afterwards, one of the teachers stood up and said "he's never seen anybody love their kids like I do and that's what he thinks makes me successful.... I do love my kids" [J_Int3_020612]. She frequently used the phrase "love" when talking about her students, and it was her students that Ms. J liked most about teaching. She asserted, "I'm happiest about seeing them, coming to school and seeing them, you know, like 'Jesus bring each one back to school, please. Let nothing happen to them.' Yeah, I'm excited about my students, that makes me the happiest" [J_Int3_020612].

Ms. J believed that letting her students know she cared was crucial to her success as a teacher:

> When the kids know you care about them they're more motivated and more willing to try. And so you know there's one student I've had such a hard time with who was here in first period and she told me, she goes, "I had a great time with you [on the field trip], Ms. J. I did my homework." You know, just… "Oh great!" ... I think it's very important. [J_Int3_020612]

Ms. J stated she wished she had more time in her day to talk with students individually and get to know them on a deeper level, because "some of them are probably going through really, really hard times" [J_Int1_110711]. Because she believed, however, that demonstrating care was a necessary part of her teaching, she communicated her care in many ways. She greeted students excitedly as they entered her class every morning, frequently asked them about their lives outside of school, and expressed concern for students when they were out sick. Ms. J noticed when students got their hair cut, made sure to congratulate them when they won an award, and shared personal stories about herself with her students.

Moreover, Ms. J's demonstration of her warm feelings toward her students extended beyond the school walls. She regularly visited the homes of students who were struggling with personal matters. When a student's mother passed away:

> I'd go visit, see how they were doing, still encourage him.... One time the guidance counselor told me that she went to go visit him and as soon as she went to visit him he pulled out a card that I had written. It was just very

> encouraging and he was so excited about that card and I didn't think he remembered. [J_Int1_110711]

Ms. J also took a personal interest in some students who were having a particularly hard time:

> My first year teaching [one student] was just really a troubled child, getting into a lot of trouble, poor home life situation, and I just kind of took her under my wing.... Now that she's not a student I'll pick her up, I'll bring her to church, I take her shopping when it's her birthday because nobody… she doesn't have somebody to do that. [J_Int1_110711]

In fact, Ms J stated that many of her students did not have positive role models in their lives and part of her job was to serve as that role model for them. She suggested this was especially important since she believed a lack of parental support was a contributing factor to the lack of success in mathematics of students of color:

> I guess what contributes [to the struggles of students of color] is you know, the lack of parent support sometimes. I remember one time I called a parent ... and she yelled at me. She's like, "You don't care about my daughter, dah, dah, dah…" and I'm like, "Look, ma'am, the reason I'm calling is because I care about your daughter." ... Parents used to be more involved and used to ... [do] something about their schoolwork, [do] something about… But a lot of my kids, they don't live with their parents. They live with a step dad or foster parent, or cousin, you know, grandma. So I guess the lack of parental support in the homes probably contributes. [J_Int1_110711]

This was in contrast to Ms. J's white, middle class students, who she believed the majority of did have parental support:

> [Parents] do supply them with materials and extra help and they have a place where they sit down and do their homework and they have to get it done before [being allowed to participate in extra curricular activities]. [J_Int3_020612]

She indicated that this wasn't always the case, that "some parents [of color] think academics is important but don't know how to help their child," [J_Int3_020612] but she believed this was more the exception than the rule. By serving as a positive role model for students of color, Ms. J provided support to students that she believed they did not receive at home and thus demonstrated care.

Ms. J's students knew she cared about them and they cared about her as well. Once, when Ms. J was telling the class that she would be out the next day for a wedding, many of the students started to complain. They made comments that the wedding should have been planned for a different day because they didn't want a substitute; they wanted Ms. J there. They told her, "Ms. J, you're a nice teacher" [PJ_112911] and made her a "Get Well" card when she was out sick for several days. Ms. J explained,

> Every now and then I'll get an essay in my mailbox from a teacher and they'll say, "This student decided to write their essay about you." ... And I'm like, "Oh, that's so nice…" and I would just read it. I'm so mean to this kid and they're saying I influenced them or whatever.… That, I guess, makes it worthwhile. [J_Int1_110711]

Perhaps the following story best exemplifies Ms. J's feelings for her students, their mutual feelings for her, and her willingness to go above and beyond what most teachers do in order to support her students:

> This one [student] that I teach, she struggles with English and with obviously the math content. She's very low with math. She hasn't passed the FCAT and she also struggles with health-related issues. So she's suffering physically, emotionally, but for whatever reason she loves being in this class. I don't know why. The guidance counselor said, "we can move you to a – " "No, no, no, I want Ms. J, Ms. J." So I was like … it kind of made me feel happy but at the same time okay, now I have to work extra hard with this student because she's going to be staying in my class. So I've gone to her home, I sit with her during lunch, after school one-on-one. [J_Int3_020612]

Ms. J loved her students, and they cared for her in return. She used a variety of methods to communicate her feelings toward her students, including taking an interest in their personal lives, acting as a role model, and making home visits.

Classroom is a Community of Respect

Ms. J insisted on a classroom environment in which students were respectful. She modeled use of manners on a regular basis and complimented students who worked well together. Additionally, she did not tolerate negative comments or interruptions. The next example illustrates that while students sometimes misbehaved, they knew what Ms. J expected of them:

Chantilly: [*To another student*:] Shut up! [*Ms. J calls her name*.] Oh, I'm sorry. I'm sorry, Aaron, and I'm sorry, Ms J. [PJ_120111]

When students were exceptionally talkative, Ms. J did not treat it as misbehavior but rather as a sign of disrespect:

Ms. J: Guys! You're staying after the bell. I love you and want you to have fun, but you have to be respectful to each other.... [*At the end of the period, Ms. J dismissed students individually. The loudest students were left at their desks.]* Guys, please, tomorrow, be respectful. Do your homework. [*The students were dismissed.]* [PJ_112811]

This statement also exemplifies how Ms. J drew on her relationship with students, and particularly her expressions of care for them, to encourage them to behave more respectfully.

Ms. J explained that she spent a great deal of time teaching students about respect and morality in order to support students to become well-mannered:

> The first week of school ... we just focus on social skills and team building and manners, respect, responsibility, classroom roles and ... I model it, we practice it, you know, respecting one another.... I try to incorporate things like that ... while I'm teaching and while the kids are interacting and engaging on the material. [J_Int2_013012]

In Ms. J's classroom, respect also meant mutual care. At the end of one class period, I noted:

> Then Ms. J tells the class that today is the last day for one of their "much loved" students, Tanisha. The class made and signed a card for her. Ms. J gives Tanisha the card and says they'll miss her and wishes her luck at her new school. Also, someone says that it is Nova's birthday tomorrow. Since Ms. J will be out tomorrow, they sing "Happy Birthday" to Nova as well. [PJ_110911]

This example illustrates how Ms. J took time to build a sense of community among the students. Ms. J insisted that students treat each other and herself with respect in her classroom. She modeled use of manners for students and took time away from teaching mathematics to educate students about etiquette and social skills.

Adopts an Attitude of High Expectations

Although Ms. J stated that her students faced many challenges to school success, often without the support of their families, Ms. J believed she adopted a "no excuses" attitude with her students, held high expectations for them, and suggested that students held the responsibility for their learning. She warned her students at the beginning of the year that she was not like other teachers who passed students even if they haven't learned the material, "I tell the kids, 'it's a wakeup call when you come into this classroom and I'm going to hold you accountable and you're going to learn'" [J_Int3_020612]. Ms. J also stated that she challenged her students, expecting them to solve the hardest math problems:

> I really like to challenge my students. I don't go and pick the easy problems out of the textbook. I'll pick the difficult ones, I'll pick the ones that challenge them, I'll pick the applicational [*sic*] ones, I'll pick the word problems. [J_Int2_013012]

Ms. J provided multiple opportunities for students to meet her expectations. For instance, she allowed students to make corrections on graded quizzes for partial credit:

> If they get [all the corrections] right they get up to an 80%. So it helps a lot of students and not only does it help their grade but then they're actually going back and doing the problems that they didn't know how to do and

> hopefully by them mastering it then they'll do better on the test. [J_Int3_020612]

Additionally, Ms. J allowed students to submit late work during the first semester and she provided frequent reminders. She stopped this practice as the year progressed, however, expecting students to be responsible and complete their work on time:

> Starting second semester I don't accept the homework so it's, "Okay, when I ask you to get it done, get it done." ... So, hopefully get them a little bit more responsible and accountable for their stuff. [J_Int3_020612]

Ms. J used a variety of strategies to motivate students to work toward the high expectations she held for them, drawing on both intrinsic and extrinsic factors. She frequently communicated to them a belief in their abilities and regularly told the students that she held high expectations for them:

Ms. J: [*Ms. J was about to give out grade reports.*] I'm a little disappointed with some of your grades. All of you are capable of getting an A. If you don't have an A you should be upset, because you can do better. [PJ_120111]

This excerpt also illustrates another common strategy Ms. J used in an attempt to motivate students: using her relationship with them to stress their ability by communicating her disappointment. For example, when Ms. J was helping students with a difficult problem, she told the class, "You guys quit without even trying. It's so frustrating" [PJ_120611]. In another example, Ms. J told a student who did not have his homework, "You're letting yourself down and you're letting your whole class down" [PJ_120711]. She also frequently praised students, pointed out positive behaviors, or made statements of encouragement. Examples include: "I love how you both leaned over and helped him" [PJ_113011], "You guys did a fabulous job. ... It makes me so happy!" [PJ_111511], "You guys are so smart!" [PJ_110111], "You know how to do this!"

[PJ_120711], and “Jim, I want to see your work. Try it. Try it, that’s all I’m asking you to do” [PJ_120611].

As additional reinforcement Ms. J gave students rewards, sometimes returning assignments to high-scoring students with a piece of candy attached to it. She also held competitions between class periods, such as the “Homework Challenge”. The class with the highest homework completion rate for the grading period was rewarded with a pizza party.

Even though Ms. J accepted late work, allowed students to make test corrections, and used multiple strategies to motivate students, they did not always take advantage of these opportunities and many students did not complete assignments. For Ms. J, holding high expectations and accepting no excuses for not completing work meant that her students often received poor grades when they were unsuccessful at meeting her expectations. She indicated that her high failure rate was, in part, due to her refusal to accept anything but the best from them:

> My kids are learning in my classroom and ... perhaps I am a little harder grading because they tend to do better on the FCAT and standardized tests as opposed to other classrooms.... Maybe I should be a little more lenient on the way I grade but I don’t know. I think [I] have high expectations for my students and if I don’t who does? [J_Int3_020612]

She was unhappy about the high failure rate, but remained firm in her conviction that students needed to work for their grades: “[I don’t want them to fail] but I want them to earn it, I want them to work hard, I want a work ethic” [J_Int3_110711]. She expressed this to students by constantly reminding them in class to turn in their homework and study hard, telling them,

> I need you guys to learn this. Because a lot of you guys are failing. I’m not up here juggling. I’m up here teaching you. You have a quiz when? ...

> Friday. If I take the quiz, I'll ace it. It's not for me. It is up to you to learn it. [PJ_112911]

This statement also reflects Ms. J's conviction that students are responsible for their learning. She told them it was their responsibility, stating, "it is up to you whether you're going to sit up and learn it" [J_Int3_020612].

Ms. J sometimes felt as if she pushed her students too hard by insisting that they learn, but she did not believe she had another option, nor did she seek out barriers to students' success. Instead, she saw school as a place for students to focus themselves and get away from the negative distractions in their lives:

> I really push them.... I really do. And again, not to diminish the situations that they may be going through at home, but if nobody at home has high expectations for them I'm not going to do the same.... You've still got to learn to get out of that hole by ... focusing your energy on your schoolwork. I don't say, "Oh, well." [I] comfort them but I'm not like, "Well you don't have to do anything." No, it's like, "let's redirect your anxieties and your whatever into your school work" ... as opposed to drugs or whatever a lot of these kids get involved in.... I set the bar high. [J_Int1_110711]

Overall, Ms. J sought to support her students in learning mathematics by telling them she had high expectations for them, reminding them to turn in missing assignments, and not accepting a difficult home situation as an excuse for not turning in work. She motivated students to work toward her expectations by using her relationship with them to stress their ability and communicate her disappointment. She was also encouraging and supportive and rewarded students with candy and pizza.

Engages in Explicit and Consistent Classroom Management

Classroom management was built on top of the climate of care and respect in Ms. J's classroom. As described earlier, excessive talking was not treated as misbehavior but as a sign of disrespect. Further, when students misbehaved, Ms. J communicated her disappointment to them clearly:

Ms. J: Guys, you were terrible this morning. Terrible. Talking. There's an activity we have to do today and no one was listening.... It really bothers me you were talking during announcements. [PJ_111611]

Ms. J was very explicit and consistent about her expectations for behavior. For instance, she frequently pointed out positive student behaviors and explicitly stated her expectations of them:

Ms. J: By the way, you guys did an incredible job yesterday staying quiet during the morning announcements. I expect the same thing today. [PJ_110111]

Ms. J also used a variety of strategies for managing that behavior. For instance, she had a very predictable daily routine and indicated, "having procedures helps, you know, so they know exactly what we do in class" [J_Int3_020612]. She also dealt with behavioral problems in private, perhaps to preserve her relationship with students. She knelt down next to a student to remind him to turn in his homework or assigned a problem to the class and spoke with a student in the hallway about her behavior.

Ms. J was also selective in which matters she chose to address and which to ignore. Some issues, such as tardiness, she chose not to take up even though school policy dictated that excessive tardies warranted a referral. She preferred for students to come to class late and be present to learn than for them to not come to class at all:

> There are other more important reasons why they should be going into [in-school detention] all day. [The Dean] said, "Well why don't you write them up?" and I'm like, "Because they get ISD and then they're not in my classroom and then they miss instruction." You know? So I just kindly remind them, "please be on time." [J_Int3_020612]

Similarly, Ms. J did not always scold a talkative student for his or her inattentiveness. Often, she called on a student to answer a question if she believed that student wasn't paying attention. If the behavior continued, however, she did address it by moving the students' seat, communicating her disappointment in their behavior (as described above), playing a game that allowed students to get out of their seats, or bribing them. These bribes included candy and promises of pizza parties. She also handed out "Whirl-One" tickets to students who were exhibiting positive behavior. On the ticket, it said, "Thanks for being prepared, respectful, responsible, and positive". This was a school-wide practice, and tickets could later be redeemed for rewards.

Ms. J asserted that classroom management was less of an issue in classes where the majority of students were white:

> [With white, middle class students,] I still do the hands up, I still tell them don't be tardy. If there's a disruption I send them out. Generally there isn't though. Most times kids are in their seats doing what they're supposed to. Like I'll tell them once and they'll do it whereas with the [students of color] it's a lot of repetition. But I don't think they don't respond because they don't care or are trying to be defiant, it's just they forget. [J_Int3_020612]

She did not see these differences in the behavior between the two groups of students as necessarily negative. She described some of her students of color as very loud and "sometimes that can be a challenge but at the same time, you know, you can use it for good. 'OK, you know, now is your opportunity when we have games and activities'. They seem to enjoy that a lot more [than white, middle class students do]" [J_Int3_020612].

Overall, Ms. J situated classroom management in the community of care and respect. She used a variety of strategies to address classroom management issues. She did not blame students of color for misbehavior. Instead, she was explicit in her expectations and took advantage of students' differences during games and activities.

Summary of Psychological Features

Ms. J felt a deep sense of care for her students. She communicated this care frequently and believed that the relationships she built with her students were paramount to her success as a teacher. Her classroom was a community of respect, where good manners were encouraged and social skills were taught explicitly. She felt that she challenged her students, held high expectations for them, and adopted an explicit and consistent approach to classroom management.

Teaching Mathematics

In this section, the ways in which Ms. J addressed her goal of supporting students in learning mathematics and apply it in the real world will be explained. First, a "typical" day will be described to provide context for the discussion of Ms. J's mathematics teaching. Ms. J stated that her assistant principal encouraged her to set up her lessons in the "I do, We do, You do" format, a terminology she was unfamiliar with. After consulting with a fellow teacher about what this meant, she realized this was already how she structured her lessons. After learning about this method of sequencing a lesson, she often titled the slides used during instruction as "I do", "We do" and "You do" so that it was explicitly clear to observers in which phase of the lesson she was engaging [J_Int2_013012]. The typical day example will highlight these portions of the lesson. This section will conclude with a discussion of the themes that emerged in Ms. J's mathematics instruction.

A Typical Day in Ms. J's Seventh Grade Mathematics Class

First period at Southside Middle School always began with televised announcements. Ms. J had a student helper whose job it was to turn on the television every day when the tardy bell rang. A warm-up assignment, or what Ms. J called "Today's Special", was projected on the Smart Board and consisted of review from previous lessons. Most often, as in the following excerpt, the problem was practice of the procedures for solving the type of problem taught the previous day. Other times it was a review of older ideas needed for the day's lesson. Students began working on the warm-up during announcements, after which Ms. J always explained the solution to the class:

[*Today's Special was on the Smart Board:*]

> Your dinner at a restaurant costs $13.65 after you use a coupon for a 25% discount. You leave a tip of $3.00.
>
> a) How much was your dinner before the discount?
>
> b) What percent tip did you leave if your tip is based on the price before the discount? Round answer to the nearest tenth.

[*Ms. J wrote on the board:* "*Please have your HW out. If I don't see it, It's a zero!" Ms. J circulated, stopping to check each student's homework for completion. The announcements concluded, and Ms. J greeted the class*.]

Ms. J: Thank you for being quiet, I really do appreciate it. Let's do Today's Special. If you still don't know how to do this, where should your eyes be? [*Ms. J pointed at the board*.] Who can read it for me? [*A student read the introduction to the problem and question a*.] What are you solving for?

S 1: The original price.

Ms. J: Yes, you're solving for the original part. What do you write? [*Ms. J wrote on the board:* $\frac{\text{you pay}}{\text{original}}$.] If you had a 25% discount, how much do you pay? [*Several students called out 75%. Then Ms. J asked how much was paid, and students responded with $13.65. Ms. J wrote* $\frac{75}{100}=\frac{13.65}{x}$ *on the board.*] Over x. I want to solve for that original amount. [*Ms. J asked the students to solve the equation on their own and then check their answers with their shoulder partner. As they worked, Ms. J walked around, looking at students' solutions. She gave one student a high-five for having the answer correct. Ms. J went to the board*.] Cross-multiply, guys.

S 2: You get 1365 equals $75x$ [*Ms. J wrote this equation on the board*. *She finished the problem by writing* $x=\$18.20$.] [PJ_111511]

In the excerpt above, Ms. J approached solving the problem in a procedural way by setting up the proportion rather than writing a mathematical sentence. Additionally, she told students how to solve the proportion when she said, “cross multiply”, directing students toward the procedural strategy she expected them to use to solve the problem. Finally, she encouraged students to check the correctness of their answer with a partner. Next, Ms. J continued to go over the solution to the Special:

Ms. J: “What percent tip did you leave if your tip is based on the price before the discount? Round answer to the nearest tenth.” What are you looking for?

Ss: The percent.

Ms. J: Okay, listen up. If this is my whole amount [*Ms. J pointed to $18.20*], I pay $3 based on the whole amount, so I’m actually going to use the percent equation. [*J proceeded by writing the percent equation on the board,* $P = \frac{\%}{100} \times W$.] What is the whole?

Ss: Eighteen-twenty.

Ms. J: And what is the part?

Ss: Three.

Ms. J: [*Ms. J wrote on the board*: $3 = \frac{x}{100} \times 18.20$. *She asked what the next step was, and students called out, telling her to divide the 18.20 and then multiply by 100.*] Go ahead and do that on your papers. [*She paused as students worked.]* Okay what’d you guys get? What’s the percent? [*Students called out several different answers, including 5.5% and 6.25%*.] What?? So we divided three by eighteen-point-two, then multiply by 100 [*Ms. J wrote the steps as she talked*] and I asked you to round to the nearest what?

Ss: Tenth.

Ms. J: So we get 16.5%. [PJ_111511]

Ms. J began the problem by identifying what to solve for and thus what formula they needed. Here, Ms. J asked students, “What do you write?” referencing the formula with which they were to begin every solution. She frequently emphasized choosing the correct formula in this manner. Then Ms. J proceeded by asking questions about the values for each parameter in the formula and setting up the solution path she had taught students to take in order to solve the problem.

Following the warm-up exercise, Ms. J went over the homework by calling out the answers and then asking students if they had questions. On quiz days or when questions arose, Ms. J sometimes asked a student to write the correct solution on the board. Other times, she went over the problem herself in the same manner she did on the warm-up: she began by asking students what formula to use, wrote down that formula, and then asked step-by-step questions to students while guiding them through her intended solution strategy.

Several times during the course of the observations, Ms. J played a game with students at this point in the lesson. These games were non-mathematical and required students to get out of their chairs and move around, similar to a game of tag. Ms. J used these games to engage students as well as to teach them the social skills she believed were important for them to learn.

Next, Ms. J shifted the focus to new material. She began by asking the students, "'What are we learning today? Why do you think I'm teaching this?' so that they really understand why this [topic] is important for them ... why this is applicable to their lives" [J_Int1_110711]. They answered her question by reading the agenda that was posted on the board. Lessons on new material in Ms. J's class almost always followed the "I do, You do, We do" format, which required teacher demonstration, guided practice, and drill or individual practice. Rules, procedures, formulae and correct answers were explicitly taught and reinforced. Consider, for example, the following excerpt. The focus of this lesson was on finding the percent of change. Ms. J began with vocabulary by writing the definition of *percent of change* on the board. She then illustrated this idea by asking for a real-world example:

Ms. J: You go to [the grocery store] to buy…?

S 1: A bag of apples.

Ms. J: How much does that bag of apples cost?

S 2: $1.25.

Ms. J: Then you go back the next week and now the cost is…?

S 3: $2.35.

Ms. J: Can we find out how much it changed? [*Students told her to subtract the two amounts, resulting in $1.11*.] Is that the percent it changed? No! [PJ_110311]

In this episode, notice also that Ms. J engaged students by asking them to suggest values for her example. Next came the "I do" portion of the lesson, which Ms. J began by displaying a PowerPoint slide on the Smart Board that listed the steps for finding the percent of change. Students were provided with an identical handout to glue into their notebooks (see Figure 4-1) so they did not have to copy the procedures themselves. Ms. J told students to write "100" in the first blank on the handout and "right" in the second blank. She proceeded by putting a word problem on the board and asked:

- Did the amount increase or decrease?
- What is the new amount?
- What is the old amount?
- What is the value when we subtract those amounts?

As she asked these questions, students called out answers and she wrote them on the board. Ms. J then "did" the problem herself ("I do") by completing steps 3 and 4 in the procedure outlined in Figure 4-1, writing on the board as students copied what she wrote in their notebooks. In other words, Ms. J asked step-by-step questions that guided students through the procedure she presented them with. This was similar to the way she reviewed the solution method in the warm-up exercise as described above.

Steps: FIND THE PERCENT OF CHANGE $\frac{N-O}{O}\times 100$

1. Determine if change is an increase or decrease.

2. Find the amount of change: **New** amount – **Original** amount (subtract new minus original)

3. Divide amount of change (**your answer in step 2**) by the **original** amount.

4. Convert to percent:

-Multiply by _____

OR

-Move decimal 2 places to the _____

Figure 4-1. Handout: How to find the percent of change. [PJ_110311]

Following the initial introduction of a formula and procedures, Ms. J engaged in the “We do” portion of the lesson. She posed several mathematically similar problems on the board and explicitly guided students through the procedures again by asking step-by-step questions:

[*The following problem was posted on the Smart Board:*]

> In 2000 the price to for [*sic*] a full day pass to Disney world was $50 for an adult. In 2011 the price to for [*sic*] a full day pass to Disney world is $65 for an adult.
> ???What is the percent of change???

[*Ms. J asked students what to write for each step:*]

Ms. J: Did the amount increase or decrease?

S: Increase.

Ms. J: What is the new amount?

Ss: 65.

Ms. J: What is the old amount?

Ss: 50.

Ms. J: What is 65 minus 50?

[*Ms. J continued to ask questions guiding students through the steps for finding percent of change. As she asked the questions, she wrote students' responses on the board:*]

1. Increase
2. $N-O$ $65-50=15$
3. $\frac{15}{50}=0.30$
4. 30% increase

Ms. J: You always need to write if it is an increase or decrease. [PJ_110311]

After this guided practice the students were given problems to solve on their own (the "You do" portion of the lesson). She circulated as they worked, checked students' answers, provided assistance to struggling students one-on-one, and offered encouragement to those whose answers were correct. For example,

> Okay a lot of you guys are doing this incorrectly because you're not dividing by the original amount! [*Inaudible.*] Why are you dividing by the 20? Is that the original amount? [*Inaudible.*] Thank you, finally one student got it right. …Thank you, Jarvis! You got it! [PJ_110311].

This example also illustrates two other common practices. First, Ms. J emphasized correct answers over the process that students used to find the correct answer. Second, Ms. J frequently pointed out common student errors.

Once students practiced a solution on their own, Ms. J reviewed the answer by asking step-by-step questions to guide students through the procedures and wrote students' responses on the board:

[*The following problem was displayed on the Smart Board*:]

???What is the percent of Change???

In 1980 there were 460 students at Southside Middle School. In 2010 there were 990 students at Southside Middle School [*There are 2 pictures of students at Southside*].

Ms. J: [*The students solved this problem at their desks individually. Ms. J walked around and checked students' answers.… Ms. J wrote the percent of change equation on the board.*] All right let's check this out. What's the new amount?

Ss: 990.

Ms. J: Minus?

Ss: 460.

Ms. J: Divided by 460 times 100! You have to do ALL THESE STEPS!! [*Ms. J wrote* $\frac{990-460}{460}\times 100$*. She asked for the difference, wrote it down, and then she calculated the answer. Ms. J wrote the final answer on the board:* "115% I".] [PJ_110311]

Ms. J almost always began a solution by either stating the formula or procedure needed or by asking students to state the formula or procedure. At times she then put the solution on the board as in the excerpt above. Sometimes she asked a student to write his or her solution on the board rather than writing it herself, but she explicitly guided the student through the procedure she intended in a similar manner as described above. She did not ask students to express their mathematical thinking or provide reasons for why they answered the way that they did.

After the introduction of new material in which Ms. J showed the class how to solve a given type of problem, she engaged students in drill and practice by assigning problems very similar in structure to the problems practiced on the board with teacher guidance. She indicated that allowing them an opportunity to practice was important to their success, “although I wish I had more of that time” [J_Int1_110711]. Following this practice, Ms. J asked students to call out the answers, sometimes reviewed the solution on the board, or walked around checking answers before assigning homework. When time permitted, students were instructed to begin their homework in class before being dismissed.

Variations from the Typical Day

There were several variations in the way the mathematics instruction proceeded in Ms. J’s class. These opportunities for divergence occurred when students were to take a quiz, during review of previously taught material, and on days during which Ms. J supported students to generalize a rule.

On a day when Ms. J’s students took a quiz, instruction varied from the typical format. Prior to the quiz Ms. J went over every homework problem in detail rather than just reading out the answers, assigned students review problems to solve in pairs, and then went over these problems. She called out each question, students responded with the answer, and Ms. J wrote the answer on the board before assigning the quiz. Changes in instruction were mostly superficial, however, as many of the elements of the instruction described above were still present. The problems on the review that was assigned for homework and on the in-class review just before the quiz were similar in structure to problems Ms. J used as examples during instruction and on homework the days leading up to the quiz. Thus, the review was additional practice of the formulae and procedures emphasized during instruction. Additionally, students were allowed to use their notes on the quiz. Ms. J also provided feedback as to the correctness of students' solutions on the quiz and gave them the opportunity to correct their mistakes before submitting their quizzes, again demonstrating Ms. J's emphasis on correct answers.

Another variation in instruction occurred when reviewing previously taught material. Whether this review occurred before the introduction of new material or was the focus of the lesson the day before the quiz didn't affect the way the review occurred. When reviewing, Ms. J did not begin by showing students how to solve a given type of problem. Instead, after posing a question, either she or the students stated the formula or procedure that could be used to solve it, and then she assigned one or several problems for students to practice individually. Finally, Ms. J went over the answers at the board, asking students step-by-step questions to lead students through the procedure they were to follow. Thus, she substituted values into the given formula and carried out calculations with student input. These reviews mirrored Ms. J's instruction of new material, with the exception that students solved more problems individually before she went over the solution.

The final variation in instruction occurred over the course of the tenth and eleventh observations. Instruction followed the same pattern on both days. Ms. J's goal for those lessons was to support students to generalize a rule about the relationship between the dimensions of similar geometric figure and their perimeters and areas. Thus, she did not begin with the rule or procedure. Instead, she first guided students with her questions through a few carefully chosen examples that focused on calculating perimeter and area and then writing ratios comparing those to the sides of the figure. Next, she asked students to solve several similar problems and asked them to notice a pattern among the solutions to their answers. Students were thus supported to compare the ratios of the perimeters (or areas) of similar figures to the ratios of the sides and generalize a rule about the relationship between those ratios. In essence, these lessons had the same components as lessons on other days – namely, students were shown how to solve a particular type of problem and then solved several similar problems on their own – with the main difference in instruction being that Ms. J did not begin with the rule to be learned but rather concluded with it. In the next section, common patterns in Ms. J's instruction will be discussed.

Themes in Mathematics Teaching

The typical day example highlighted several themes in how Ms. J taught mathematics. These themes are the topic of this section.

Breaks down mathematics into easily followed procedures

Most of Ms. J's instruction was spent teaching students formulae, guiding them through procedures, and practicing those procedures. There were multiple posters around the classroom displaying the formulae being taught, and when solving word problems, students were encouraged to always begin with a formula. In one example, Ms. J commented on the solution one student wrote on the board, exclaiming, "I like how she wrote her equation first! How many of you have memorized the equation?" [PJ_110311]. Similarly, Ms. J prompted students to begin with a formula in the following scenario:

Ms. J: What key word tells you what you're going to do?

Ss: Percent of change.

Ms. J: [*She underlined the phrase "percent of change" in the problem.*] So *immediately* what does that tell you to do?

Ss: Write the equation!

[*Ms. J wrote the percent change equation on the board.*] [PJ_110711]

In the typical day example, Ms. J asked the students, "What do you write?" referencing the formula with which they were to begin every solution. This formula was usually chosen based on a key word in the problem. She explained during an interview that writing the formula was the first step in solving a problem:

> [I tell the student,] read the directions, read the problem. ... What does it ask you to find? What do you know? What's the first step? "Write out the formula." Okay, well why haven't you written down the formula? What shape is it? "It's a cylinder." So ... find the formula of a cylinder, write it down. [J_Int3_020612]

After writing down the appropriate formula, Ms. J asked questions to guide students through the procedures for substituting values in for the parameters and then for solving the expression or equation. By guiding students through the procedures, Ms. J was setting up the solution path she wanted students to take in order to solve the problem. In fact, Ms. J insisted that students solve problems using the procedures and formulae she taught them, and other strategies were considered incorrect. In the following vignette, students were asked to find a simple interest rate:

[*Ms. J posed a problem on the Smart Board:*]

> Another example: Find the annual simple interest rate.
>
> I = \$18 P = \$200, t = 18 months

Ms. J: [*She asked students to set up the problem on their own, then reviewed it on the board, writing students' responses as they called them out.*] What did you put for *I*?

Ss: 18.

Ms. J: What did you put for *P*?

Ss: 200.

Ms. J: What did you put for *r*?

S: *r* over 100.

Ms. J: What did you put for time?

S: 18 over 12.

[*Ms. J has written the following equation on the board:*

$$18 = 200 \times \frac{r}{100} \times \frac{18}{12}$$

She told students to finish solving it on their own and then walked around checking answers. After a few moments, she addressed the class.]

Ms. J: All right guys, what did we get?

Ss: 6 percent.

Ms. J: 6 percent. The fastest way I found to do this, guys, is multiply 200 by 1.5. What do we get?

Ss: 300.

[*Ms. J wrote* $18 = 300 \times \frac{r}{100}$.]

Ms. J: This is where I do the inverse operation. A lot of you guys are doing 300 divided by 100. That's wrong. I gotta do inverse operations. [*She told students to first divide both sides of the equation by 300, then multiply both sides of the equation by 100.*] [PJ_111511]

This vignette demonstrates Ms. J's practice of guiding students through a procedure by asking step-by-step questions about what values to substitute into the formula. Furthermore, Ms. J told students that their strategy of simplifying the equation by dividing 300 by 100 was incorrect. This strategy was not mathematically incorrect, but it did not follow the inverse operations procedure Ms. J had shown the class several times earlier in the lesson and thus was not an acceptable strategy.

Ms. J indicated that her role as a teacher was to break down the mathematics into easily followed procedures and take “baby steps with these kids” [J_Int3_020612]. She suggested that by guiding students through the procedures for unfamiliar problems until they were able to solve that type of problem individually, she was supporting them to learn. She stated, “when they’re not getting it then I know, okay, this … the majority of the class isn’t getting this part so I’ll break it down” [J_Int1_110711]. Breaking down the mathematics manifested as Ms. J showing how to solve a type of problem, practicing a few of these problems with students, and then allowing them an opportunity to practice more of the same type of problem on their own:

> If a kid’s never seen a problem before, you know, well okay, *show them how to do it*. ... Sometimes I’ll say, “Put your pencil down, *watch what I do* ... and then they see it first, the first time, “okay, now let’s try one together” until they can do it by themselves. [J_Int2_013012]

Additionally, Ms. J regularly told students that a problem was tricky or hard and she demonstrated how to solve the problem for them. In fact, she made certain to never “give them something they haven’t seen before” [J_Int3_020612] and showed students how to solve a problem when she believed they were struggling. She said to students, “So how do we solve this, guys? So what I’m going to do is, hold on, so I’m going to show you guys because some of you are a little stuck” [PJ_120611].

Finally, as Ms. J explicitly taught formulae and procedures, she did not emphasize conceptual understanding or focus on meaning. She sometimes asked students “Why?” questions, but they were rarely answered in a way that conveyed students’ underlying understanding of the mathematical concept. For example,

Ms. J: Why do we multiply by 100?

S: Because we're looking for percent. [PJ_110711]

In this example, the student clearly knew that the concept of percent and the number 100 were somehow related, but Ms. J did not push him beyond this simple answer to clarify his underlying reasoning. In another example, when asked about the difference between area and perimeter, Quentin responded that the difference was "Add." Ms. J told him, "Very good, area, you don't add up the sides, you multiply length times width" [PJ_113011]. Based on this one-word response, Ms. J assumed the rest of Quentin's response and emphasized the procedure for calculating area or perimeter of a rectangular shape rather than emphasizing the fundamental mathematical differences between these two mathematical concepts.

By encouraging students to begin every problem with a formula and by breaking down mathematics into procedures, Ms. J believed she was helping her students learn. She required students to follow the strategies she outlined for solving problems and did not explore the conceptual meaning underlying the mathematics.

Emphasizes correct answers

Ms. J's instruction was characterized by an emphasis on correct answers. She suggested to students that if they knew the formula, they would be able to solve the problems she assigned correctly:

Ms. J: Who's got the right answer? [*Ms. J. circulated, stopping at students who had their hands up.*] I'm telling you, all you've got to do is plug into the formula.... Anytime you see 'percent change', you should be looking for what formula? [PJ_110711_54]

Ms. J often asked the class for a show of hands of who got the correct answer, told them not to make careless mistakes, and said, “Don’t give me the wrong answer!” [PJ_113011; PJ_120111].

Furthermore, Ms. J taught procedures in a way that led to correct answers. She asked students questions to guide them through the procedures and students called out responses to these questions. If someone called out an incorrect answer Ms. J’s response was usually to correct the student or ignore his or her answer, then state the correct response or call on another student. This frequently followed the Initiate-Respond-Evaluate, or IRE, format. In the following example, Ms. J asked a student about the Today’s Special, in which students were required to calculate perimeter and area. The student, Chantilly, began by explaining how she found the original perimeter:

Chantilly: I did three times two.

Ms. J: [*She drew the figure on the board*] How do we find perimeter?

Chantilly: [*Realizing her mistake:*] Three and four is seven… Oh wait!! [*The other students called out that the perimeter of the original figure should be 14, so the new perimeter should be 28. Ms. J asked for the area*.] Three over four? [*Ms. J ignored this incorrect response and called on another student who responded that they should do three times four. Chantilly looked confused. She sat, thinking, for a few moments.*] Oh! I was finding the ratio! [PJ_120611]

Chantilly is a bright, engaged student and she was able to figure out on her own where her mistakes were. In the days leading up to this observation, however, the emphasis of the lessons was on calculating ratios of the sides of figures and it is possible that other students in the class made the same mistake. Ms. J did not take up the incorrect answer for discussion. She ignored Chantilly’s comments and allowed other students to call out the correct answer. In this excerpt, Ms. J pushes Chantilly to explain how to find perimeter, illustrating her tendency to question students about their responses when they were incorrect. In contrast, when an answer was correct, Ms. J usually accepted the answer without questioning it, possibly suggesting to students that if they were questioned about a response they gave, they must be incorrect. Other times, Ms. J clearly became frustrated and reprimanded students when they were incorrect:

Ms. J: [*Ms. J was circulating, checking students' answers. She said to one student:*] Nope, you're not paying attention. [*To the class:*] If you have 4 over 5 as your answer for a, you haven't listened all period! [PJ_113011]

Here, Ms. J stated that incorrect answers were because students had not paid attention. As will be discussed further in the section on struggle, once Ms. J explained how to solve a problem, she expected students to remember the procedures or figure them out without her help.

Addresses common errors

Ms. J pointed out common procedural errors on a daily basis. At times, she noticed a particular common error as she circulated and then took time to address the entire class about it, such as in the typical day example. Other times, she anticipated a common error and pointed it out to students before they had the chance to make the error. The following excerpt highlights both these practices:

Ms. J: This is what I saw a lot of students do. [*Ms. J. wrote* $\frac{6}{3}=\frac{2}{4}$.] Don't write this down, this is wrong. Jaquanda, tell me why this is wrong. A lot of students forget that just because a figure is rotated… you have to be careful. Is the 6 the longer side or the shorter side?

Ss: Longer side.

Ms. J: So what's the longer side on the rectangle?

Ss: Four.

Ms. J: So the 6 and the 4 are corresponding sides. [*Ms. J set up two proportions on the board, told students that both will work. Then* *she gave another example:* $\frac{6}{2}=\frac{4}{3}$.] Why is this wrong? Isn't the 6 corresponding to the 4 and the two corresponding to the 3?

Ss: Yes.

Ms. J: So why is this wrong? [*Response is inaudible. Students did not give an articulate answer to Ms. J's inquiry.*] You have to put both values from [Figure] A on one fraction and both values from [Figure] B on the other fraction. You have to take your time setting up the proportion. [PJ_112811]

Ms. J was adept at anticipating common procedural errors and frequently presented them as non-examples to the class during instruction. In doing this she noted the error and taught or re-taught the correct procedure with a focus on identifying the correct numbers to use in the formula or the correct order of steps to solve the problem.

Students compare answers with partners

Students in Ms. J's class sat in groups and were regularly asked to check their answers with a partner. Occasionally Ms. J encouraged them to check their answers with everyone in their group and then perform a "team cheer" if they all had the same answer. Ms. J also sometimes asked one student to explain how to solve a problem to their teammates when they were struggling, because "I'm pretty confident that the person next to them knows what it is" [J_Int1_110711].

Ms. J suggested that by working cooperatively, students took on the responsibility of teaching their peers, resulting in deeper understanding:

> When they're able to teach something they learn it better.... I could teach the whole period but if a peer is sitting down next to another peer sometimes that interaction is a lot more helpful to understand than having a teacher in front of the classroom.... They have to really reflect on, "OK, how did I do this again?" or "Let me make sure I'm explaining it correctly." [J_Int2_013012]

Observations, however, did not entirely support this statement,. Students did not usually take the time to share their thinking with each other. Sometimes students explained their solution method, but most often they compared answers and waited for Ms. J to show them how to solve the problem if there was disagreement. Thus, cooperative work typically took the form of comparing answers rather than discussion of solution strategies.

Allows students to struggle

Ms. J believed that once she had taught procedures it was important for students to work independently to solve problems during practice:

> I really do try to break it down for them and just repeat myself and reinforce the important things and have them repeat it to me and have them pick up the pencil and struggle to figure it out on their own. [J_Int3_020612]

She always showed students procedures for solving a problem, but subsequent questions on the topic were often left to students to figure out on their own:

> A lot of times when kids ask questions I don't answer it. "How do I do…?" I'll be like, "Well I don't know. How do you? What are you looking for?" You know, "you tell me," and … they have to figure it out.... I think that's a good thing because they need struggle [because] that's how they'll learn it. I think that's how they'll remember it because they actually did it on their own. [J_Int2_013012]

Ms. J believed that by allowing students to struggle, she was challenging them and teaching them to persist through difficult problems:

> Realistically it's probably good I don't have the time to sit down and break it down to them.... I want them to struggle. I want them to figure it out, I want to challenge them. A lot of them seek that approval real fast and sure every now and then you give it to them or whatever, but other times no, work at it, and sometimes they'll get frustrated, sometimes they'll quit. And I'm like "That's a choice you're making," but I really push them. [J_Int1_110711]

From Ms. J's perspective, struggling meant that a student persisted with the problem long enough to figure it out without teacher help. Examples of her comments that support this notion include: “Maybe if you look at it long enough you’ll figure it out!” [PJ_120111], “look at the board, figure it out” [PJ_112911], and, after going over two examples on the board and putting up a practice problem, “I’m not going to help you any more than that. You have to figure it out on your own” [PJ_120711]. Ms. J seemed to make these statements when students were particularly talkative and inattentive:

Ms. J: [*Ms. J was stating a rule at the board. She told the class to make sure to write it down in their notes. Jaquanda wasn’t paying attention.*] If you don’t get this, Jaquanda, it’s not my fault.... I’m disappointed. [*Jaquanda indicated that she didn’t understand the lesson.*] I want you to stare at your paper until you know how to do it, because I’m not going to go over there and give you a lesson all by yourself. [PJ_120111]

As illustrated in these examples, Ms. J often asked students to stare at their paper or the board. This suggests that by encouraging students to focus and be attentive, Ms. J thought it would allow them to understand the mathematics and overcome their struggles.

Teaches about key words and provides hints

Ms. J used the key word strategy and provided hints as a way of simplifying problems for her struggling students. She told students to look for key words, from which they would know which formula or strategy to employ:

Ms. J: Why did you subtract?

S: Because it says ‘left’?

Ms. J: No, because the key word says deleted. Delete means subtract.... You’re looking for key words. This word ‘delete’ told you to add or subtract your answer?

S: Subtract. [PJ_110711]

Consider also the following example, from a day during which Ms. J taught about simple interest. She assigned a problem in which students were asked to calculate the interest earned after "putting" a given amount of money into a savings account. Ms. J had already talked about the word "put" several times and suggested that "putting" money into an account meant that person deposited money:

Ms. J: 'You *put*', what does the word *put* mean? [*J underlined the word 'put' in the problem.*] Deposit, yeah. And then I see the word 'simple interest' and I see the word 'years', so what formula am I going to write down?

Ss: I equals p-r-t.

Ms. J: So you see how I use the key words? I see simple interest, I see years, I see savings account, so I'm going to use the interest formula. [PJ_111511]

Ms. J also hinted to students about how to solve a problem:

Ms. J: [*Ms. J called on Jaquanda, who wouldn't give an answer. Ms. J pushed her for an answer.]* If you *double* the side length, the perimeter also…? [PJ_113011]

In this episode, Ms. J drew out the word "double", indicating to Jaquanda that the answer to the question is also "double." Sometimes her prompts were in fact hints to guide students toward the answer. Other times her hints provided the answer:

Ms. J: How do I find perimeter?

S: Add up the sides.

Ms. J: You add up the sides? So what's 1 plus 1 plus 1 plus 1? P equals 4. [*Ms. J wrote* $l \times w$ *on the board.*] How do we find area? I just gave you guys a hint.

Ss: Length times width. [PJ_120111]

In the same way that Ms. J emphasized procedures as a way to 'break down the mathematics', she explained that by hinting and teaching the key word strategy, she was 'breaking things down'. This approach stemmed from a belief that her students did not have the prerequisite skills necessary for success in middle school mathematics:

> I feel like sometimes I have to really… I don't want to say the word "dumb it down" but try to like get them built on those foundations to then be able to also – without going past the time that I'm supposed to be teaching certain things – getting them to learn that. I want to say that's the majority of my students [who] walk in my classroom and don't know how to do two plus two. Two plus three is… I was just shocked when I started teaching math. I couldn't believe it. [J_Int1_110711]

Because of her students' lack of prerequisite skills, Ms. J stated she needed to simplify the mathematics as much as possible for them. She did this through hinting and teaching the key word strategy.

Plays games to increase engagement

Ms. J frequently engaged students in nonmathematical games. She indicated that since she was out sick for several days during the study, the class fell behind on the pacing calendar and "I don't think we played enough games when you [the researcher] were here" [J_Int3_020612]. These games were physical, requiring students to get out of their seats and sometimes run around the classroom. They also usually required students to shake hands or make eye contact with other players, thus practicing the etiquette Ms. J was so insistent on them learning.

When asked about the games, Ms. J indicated they were one strategy she learned at a Kagan workshop that she used for dealing with inattentiveness: "Those kids who were inattentive all of a sudden now they're getting oxygen, their heart's pumping or whatever, so whenever we sit back down they're a little bit more you know like curious or awake for the lesson" [J_Int3_020612]. She suggested that her mathematics lessons were not interesting and stated that "sometimes like we need to get this content out, you need to know these steps, you need to know how to solve this problem, so unfortunately sometimes that's not the most engaging" [J_Int3_020612]. The games were thus her way of addressing the lack of engagement with the mathematics instruction.

Makes problems relatable

Ms. J often asked students to suggest values for examples she presented at the board as a way of engaging them. She also rewrote word problems to make them more relatable to students and provide relevance for them. She stated, "I remember one time I'd just changed the name to one of my student's and he was like, 'I can do this problem. It's got my name in it!'" [J_Int2_013012]. In another instance, Ms. J displayed a problem on the Smart Board that had a teacher's name it in. She explained, "Oh no! I didn't change it… Hold on, hold on!" She rushed to her computer, replaced the teacher's name with her own, and then told the students to continue working on the problem [PW_110211]. Ms. J also attempted to make problems relatable by activating students' knowledge about the contextual elements in a problem. For example, "When I talked about pyramids I'm like, 'When you think of the word pyramid, what do you think of?' and they'll say, 'Oh, Egypt.'" [J_Int2_013012]

Students seemed to enjoy seeing references to their names, school, and the local university's mascot in the word problems they were assigned. These practices helped to increase students' in interest and engagement in the problem. Ms. J's emphasis was not on building on mathematical background knowledge. Instead, she focused on contextual elements and the use of students' names in order to increase relevance and engagement.

Supports struggling students

Ms. J cited several strategies for supporting struggling students. She indicated that one of her main strategies was working with them one-on-one and was observed many times doing just that:

> All kids learn better one-on-one. In my opinion, like when I sit down with one student like after school or whatever they pick it up, you know, because whether they're distracted, whether they're in the classroom and ... probably half the kids aren't really [understanding] it. [J_Int1_110711]

Other strategies Ms. J cited as important for supporting struggling students included hands-on and structured cooperative learning activities (although these were not observed during the course of the study), Rally Coach (another Kagan strategy in which student A solves a problem with only one correct answer and student B either confirms A's answer or coaches A toward the correct answer), calling home, ensuring students had adequate materials such as calculators and pencils, playing non-mathematical games, and working with a partner (the latter two having been described above). Additionally, Ms. J often called on students she knew were struggling:

> You might think, "Well, why are they going to explain the problem if none of them knew how to do it?" Well we're going to help them as a class, like they're the ones that need to get it if they didn't get it. Me just going over it sometimes, the ones that didn't get it they're not going to sometimes pay attention when I'm going over it so I'll have them come up and show us how to do the problem. Hopefully they'll get it. [J_Int3_020612]

Having a struggling student "explain" how to solve the problem at the board frequently involved Ms. J explicitly guiding the student through the procedures required to solve the problem, as is illustrated in the following scenario:

[*Ms. J asked a student, Kendra, to solve the problem on the whiteboard. Kendra said she didn't know how to do it.]*

Ms. J: Do you know how to set up a proportion?

Kendra: No.

Ms. J: Yes, you do... What are the corresponding sides? The six corresponds to what?

Kendra: I don't know.

Ms. J: Pick up your marker. Write “6”. The six matches what side? A proportion is a fraction. Something over something equals something over something. [PJ_120611]

In this example, Ms. J explicitly instructed Kendra on what to write. By doing this, Ms. J led Kendra (and the other students) to the correct answer.

Another strategy Ms. J used often was moving a struggling student to a single desk that she had placed at the front of the room, directly in front of the board:

> This is the hot seat. I make my students like want to sit here because they want to be up front to learn. Like, “Can I sit in the front this time, for today?” And they’ll fight for the front seat sometimes.... I’ll be like, “I really want you to understand this today,” you know if they don’t want to come. But usually they want to sit up front. [J_Int1_110711]

During observations it was noted that it was always the same two students being moved to the “hot seat”, Jaquanda and Jarvus. At times Ms. J moved their seat to help them understand, but she also put them in the hot seat and called on them frequently when they were off-task.

Additionally, Ms. J cited the Smart Board and individual student white boards as important tools for supporting students who were struggling in mathematics. In particular, when she assigned practice problems, she frequently asked students to write their answers on the white boards and hold them up so she could assess the entire class at once (what she refers to as “Showdown”). Finally, she encouraged students to stay after school to attend the tutoring sessions she held several times a week, stating, “I really push them hard to come” [J_Int1_110711], although many of her students rode the bus to school and could not attend activities after school. She encouraged these students to come to her classroom at lunch for extra help.

Summary of a Typical Day

A day in Ms. J's seventh grade mathematics course began with practice of previously learned content followed by a review of homework. Ms. J introduced a new topic and showed students the procedures for how to solve problems related to that topic, then provided time for them to practice the procedures they learned. Indeed, Ms. J agreed with this characterization of her instruction when she described a typical day in her class:

> You know, Today's Special.... We go over the homework, we go over the warm-up, we start a new lesson or we'll review from the lesson before so then, "OK, what are we learning today? Pull out the spiral notebook. Let's go." [J_Int3_020612]

Overall, Ms. J's mathematics instruction was characterized by explicit teaching of formulae and procedures and an emphasis on practice, correct answers, and teacher demonstration. Ms. J strove to make problems contextually relevant, address common errors, and break down problems for struggling students.

Influences on Teaching

The ways in which Ms. J taught were driven by several factors. First, there was the issue of the pacing calendar assigned by the district. Ms. J felt pressure to stay on track with the pacing calendar, which did not, in her opinion, allow students enough time to practice the skills she was teaching and had a negative effect on what they learned:

> I look at the pacing calendar and I really think it's extremely fast paced the way it is. They don't incorporate enough time for students to practice, so I've actually decided come January I'm just going to teach to the kids, make sure that they actually get this because at the point of rushing through something, the kids don't obtain anything… well minimal, you know, facts or material. [J_Int2_013012]

Ms. J also struggled with time management because she wanted to spend as much time as necessary with each student but found it logistically impossible. She explained that when a more senior teacher observed her, “he said, ‘you spend way too much time with one student’ you know, so I have to like just give them one thing and keep going” [J_Int1_110711]. She also explained that she had other goals for her future, including teaching overseas, but “for now I am here and I love it. It is a lot of work and I feel like sometimes I spend too much of my time into this” [J_Int1_110711].

Finally, Ms. J asserted that teaching mathematics to students of color living in poverty was not very different than teaching white, middle class students. She indicated that the two populations of students acted differently, but her instructional approach did not change. She taught procedures in the same way with both populations but, when compared to students of color, did not have to conduct as much review or break down the mathematics as explicitly while teaching white, middle class students. For instance, Ms. J stated that black students viewed mathematics differently or did not have the same skills as her white students. They “[asked] questions [and it was] like, ‘Oh, I didn’t think of it that way’ or maybe a more basic question, ‘Oh, I thought you knew this’ so I’ll slow down or break it down” [J_Int3_020612]. Moreover, she explained that black students struggled and her white, middle class students learned quicker:

> [With the white, middle class students,] I don’t have to really nail it. I don’t have to drag desks to the front. Like, they pick it up which is kind of nice, you know. You do tell them, “Okay, step one, step two, step three,” ... and they learn it faster so we don't spend so much time on the actual lesson and we can do more activities and other things. ... My method of teaching is still the same, it just seems to go by much faster. [J_Int3_020612]

Thus, Ms. J maintained that her overall approach to teaching mathematics remained unchanged regardless of which population with which she is working. She added a caveat, however, “you have to do different strategies sometimes. If I’m teaching the same lesson some things might not work with certain students, so differentiated instruction [may be necessary]" [J_Int2_013012]. Additionally, "you have to find ways to … differentiate the instruction and teach them the same thing, like, 'what are other ways for these kids to see it?'" [J_Int3_020612]. During the course of this study, however, Ms. J did not differentiate instruction. In fact, students were always assigned the same problems and expected to solve them the same way. Furthermore, when a student didn't understand something, she frequently restated the procedure they were to use rather than explaining it differently.

Summary of Case One

Ms. J held several goals for her students. She indicated she wanted students to learn mathematics and be able to solve real-world problems, become well mannered, and care about school. Ms. J cared deeply for her students and believed that her relationships with them were crucial to her success as a teacher. The students clearly felt cared for and returned the feelings toward Ms. J. She also built a community in her classroom that demanded respect and insisted that students be well mannered. She also believed that she held high expectations for her students. Ms. J pushed her students, did not accept excuses for poor achievement, and challenged them with word problems. She drew on her relationships to motivate students in addition to offering them external rewards. Finally, Ms. J built classroom management on top of the climate of care and respect in the classroom and took time to explicitly inform students about her expectations for behavior. She was selective about which issues to address, but was consistent in how she addressed those issues.

Ms. J's mathematics instruction was characterized by an emphasis on formulae and explicitly guiding students through procedures for solving problems in an effort to break down mathematics into something manageable for struggling learners. She engaged students regularly in drill and practice related to these formulae and procedures. Furthermore, Ms. J emphasized correct answers and encouraged students to check with partners to ensure the correctness of their solutions. She engaged students by playing nonmathematical games with them and making problems contextually relevant. Finally, Ms. J addressed common errors, provided hints, emphasized the key word strategy, and used a variety of methods to support struggling students.

CHAPTER 5
CASE TWO: MS. W

An Introduction to Ms. W and her Classroom

Ms. W was a traditionally certified mathematics teacher and her background differed from those of her black students who lived in poverty. She described herself as a 31-year old Caucasian country girl who grew up in a small town with little cultural diversity. She came to Maya Angelou High School as an intern and was hired directly following this initial experience. Ms. W shared that she always wanted to be a teacher:

> When I was five I knew I wanted to be a teacher.... I liked the idea of you know having this place where kids can come in and feel safe or be comfortable and be able to teach them so I know they're leaving with something more than they came in with. [W_Int2_111711]

Ms. W regularly hosted visitors and interns, and data for the present study were collected when an intern was placed in her classroom. While the intern taught two lessons during the observations, the focus remained on Ms. W's instructional practices during these instances. There were also two student aides, Matthew and Asia, present in the class. Ms. W explained that at times "[the student aide will] be an IB student, but they typically try to put a student in here that has gone through the major program successfully, who...can relate to [the students], tell them, 'Hey, I've been where you are. This is what helped me'" [PW_103111]. The aides provided assistance to students as they worked on a computer program, described below.

One class of Ms. W's Algebra I students served as the context for this study. In order for students to obtain credit for the course, the State required they pass an end-of-course (EOC) exam. Ms. W explained how the EOC worked to her students:

> [If you have an A but don't pass the EOC], your A disappears and you have to do the class again. It's like you did not spend an entire year working on that class. What if you have an F but *do* pass? The EOC gives you

> permission to keep your grade. Your grade is spank but you still have it in your record that you took the exam. [PW_110311]

Ms. W taught on a block schedule that followed the A day/B day pattern, and class periods lasted 80 minutes. Although students had algebra every other day, the mathematics department decided students should receive mathematics instruction daily, so Ms. W taught these students both Algebra I and Intensive Math, which counted as an elective credit. They received separate grades for the courses, however, she treated each period as Algebra I. The instruction and content did not differ when she taught Intensive Math.

Ms. W's students worked individually in the computer lab on a self-paced computer program, Carnegie Learning, for the first 40 minutes of the period. The program provided individually tailored instruction and focused primarily on word problems. Ms. W explained, "Everything is right there in the story and they're taking it and translating it into the algebraic expressions or building their equations. It's just...great practice for test-taking, [and] for life in general" [W_Int1_110311]. If students demonstrated mastery of the first semester content in Carnegie, they were exempt from their semester exam. The second 40 minutes of the class period involved introduction of new material, practice, tests, and quizzes. Sometimes during this second half of the period, the intern taught a lesson. More details about the teaching that occurred in these two components will be described in a later section.

Ms. W spent a couple of hours planning each week. She mostly used the textbook only as a resource for test items, or additional support:

> The way that it's structured is not necessarily an organic way of how you would learn it. So that's why I try to say you know if you get stuck "go back, look at how they do it, whatever," but really yeah, [the textbook is] more of a resource than a driving force. [W_Int2_111711]

On most days Ms. W taught with the aid of a Smart Board using resources adapted from the New Jersey Center of Teaching and Learning. She learned about the resources at a conference and described them as lessons developed by multiple teachers as part of a lesson study [W_Int2_111711]. Finally, on the topic of resources, Ms. W stated that she did not “use any [lesson plans] from the year before. I’m always kind of starting fresh and so I use a lot of the same strategies but...I kind of tweak it as we go” [W_Int3_120111].

The curriculum specialist for secondary mathematics and several educators at State College nominated Ms. W for this study. When asked why she believed she was nominated, she cited her open-door policy to visitors and the constant culture of learning in her classroom as likely factors. Ms. W also explained that she was known for her efforts to build strong relationships with her students.

Ms. W was well known in the community for being a successful teacher who had strong relationships with her students. The following section describes the goals Ms. W held that influenced the way she taught and interacted with students.

Goals for Students

Ms. W stated during interviews that she held three overarching goals for her students. First, she indicated she wanted students to build their mathematical knowledge. Second, she said she wanted students to become problem solvers. Third, Ms. W indicated the importance of enabling each student to feel comfortable and cared for.

Build Mathematical Knowledge

Ms. W indicated in interviews that the most immediate goal she held for her students was for them to learn the mathematics being taught and earn credit for the course, which required successful completion of the EOC exam. More than gaining credit, however, was Ms. W's goal that students stayed engaged and showed improvement in their mathematical knowledge: "If I feel like my kids are engaged and that there's improvement in a student from test to test to test then I feel that's probably my main goal" [W_Int2_111711].

Ms. W's definition of "improvement" was flexible. She explained that the amount of improvement or progress students made in a year varied by student:

> I think everybody's goal is progression, that wherever they are that they walk out somewhere higher…. For some that's a year's worth of growth, for some that's two years worth of growth, for some that's like you learned something new this year, you know, and it's just where that kid's coming from. [W_Int2_111711]

This flexibility in her definition of improvement, however, did not mean that students were not expected to achieve their potential. In fact, Ms. W held high expectations for all her students, which will be described in further detail in a later section.

Become Problem Solvers

In addition to wanting students to build mathematical knowledge, Ms. W held a goal for students to become problem solvers. To her, that required her to provide a context in which students had the opportunity to learn practical mathematics that could be applied in real life. She suggested that her students should be able to "go into a store and [look] at price points on items … look at ounces on the package or whatever – you know, trying to do taxes and discounts" [W_Int2_111711]. Ms. W indicated that in the long term, this ability to use mathematics in daily life and to reason through problems was something students should learn in addition to the day-to-day topics covered in school. She described that it was important to "[develop] the logical side of your brain and reason and order … even if you don't retain the content, that you understand problem solving and ‘do your answers make sense?’” [W_Int2_111711]. Thus, for Ms. W, knowing how to find solutions when they weren’t immediately evident was something she indicated her students needed to be able to do:

> Maybe they don’t remember like, “Oh, what do I do when I see this? How do I factor this quadratic?” or whatever, but that they know, like “Oh yeah that looks familiar and if I needed to go back and look it up I could find how to do it.” [W_Int2_111711]

In fact, to Ms. W, the “ideal” mathematics student was not necessarily one who knew all the answers, but who was an expert problem solver [W_Int2_111711]. She strove to support her students to become learners who “[dealt] with problems as they [arose]” [W_Int1_110311], which Ms. W admitted was “a lofty goal” [W_Int1_110311] but was one she was committed to nonetheless.

Feel Cared For

Ms. W’s third goal was that students felt comfortable and cared for. She stated that she wanted students to know they had “somebody at the school who cares, you know, and building those relationships is first priority” [W_Int1_110311]. She further explained that students should feel that the classroom was a safe environment. She clarified that by “safe” she meant that "they’re comfortable, that they feel like they can talk and they’re not, you know, they’re not like prim and proper and whatever” [W_Int1_110311]. She strove “to promote, you know, not just the knowledge [but] the community and to be supportive” [W_Int3_120111]. Finally, Ms. W stated that she wanted her students to view the classroom as a place where they felt free to be themselves.

Ms. W cited three reasons why feeling cared for and comfortable was an important goal for students. First, she maintained that when students felt cared for, they were more willing to do the work assigned to them, “I think kids will do anything for you if they know you care about them" [W_Int2_111711]. Thus, Ms. W suggested that if students felt cared for, they made an effort in her class that they may not have made for another teacher.

The second reason related to students' home lives. She believed they didn't always receive the support outside of school that was necessary for their success and stated, "some of them don't come from places where they have somebody's who's – I don't want to say unsupportive because they get support, but – supportive in a constructive way" [W_Int1_110311].

Finally, Ms. W argued that feeling supported and cared for would enable her students to defy stereotypes about poor achievement of black students and to become active and contributing citizens:

> Beyond the credit it's to create a sense of like community here so that there's a break in like the reputation of you know the stereotypes or whatever to get them to a point where they're functioning citizens in society, where they're contributors, where they're not a drain on family or whatever. [W_Int2_111711]

In summary, each of Ms. W's goals for her students influenced the way in which she taught. The first two goals, build mathematical knowledge and become problems solvers, influenced the way Ms. W approached the teaching of mathematics. The final goal, to feel cared for and supported, impacted the kind of psychological environment she created in her classroom. This psychological environment is the topic of the next section.

Psychological Environment

Analysis of Ms. W's teaching yielded two themes that characterized the psychological environment in her classroom. The data related to each will be discussed in sections that communicate that demonstrating care and building relationships with students was a priority and classroom management was grounded in her relationships and the community of care.

Demonstrates Care for and Builds Relationships with Students

Ms. W's goal for students to feel cared for led her to focus on building caring, supportive relationships with her students. These caring relationships were the essence of Ms. W's teaching, and she demonstrated care in a variety of ways, including building a community of respect and honesty, identifying and addressing barriers to meet high expectations, using humor and sarcasm, and interacting with students on a personal level.

Builds a community of respect and honesty

One way Ms. W demonstrated care and built relationships with students was by treating students with the utmost respect. She stated that she tried to treat them as adults and frequently referred to students as "professionals" [W_Int3_110311]. This communicated respect and a belief in their abilities. In one instance, Ms. W was talking to Elwood about his grade, which he had brought up from a D to an A. She stated, "I'm impressed and amazed.... Look at where it was, look at where it is. I told ya." [PW_120711]. This example highlights how Ms. W expressed care. Additionally, it demonstrates Ms. W's use of manners. She regularly modeled etiquette as a method of building respect. Also, Ms. W praised students when they were respectful and polite. Once, a student told Ms. W that his mother taught him to say, "Yes, ma'am," and she responded, "You tell your momma she raised a good son" [PW_111011]. Ms. W commended this student for his manners in this example, reinforcing respect. She also spoke positively about his family, further strengthening the relationship with her student.

In addition to encouraging manners as a way of reinforcing respect, Ms. W maintained that it was important to be honest and straightforward with her students. She explained that being honest with students was an essential aspect of getting them to respect her and to maintaining positive relationships. She stated,

> [It's important to be real and] honest because these kids see through any face just as quick as you lay it out there. If I am fake in any way they will call me out on that and then that translates into a lack of respect, which then translates into "Why do I need to listen to that person? Because I don't respect them, because they're not honest with me." [W_Int1_110311]

Being honest and respectful, according to Ms. W, meant not holding back, even when what she had to say was not something her students wanted to hear. She told students, "This may sound mean, but I'm going to be really honest" [W_int1_110311]. Thus, sometimes the way Ms. W spoke to her students may have given the impression that she was harsh or rude, but her students did not seem to take it that way. Perhaps this approach worked for Ms. W because she balanced her honesty with commendation for their successes. She was explicit with students about her reasons for being honest:

> You're not going to like some of the things I tell you but I'm always going to tell you the truth and I need you to know that I'm coming from a place where I'm not going to lie to you. If you're in a bad boat I'm going to tell you, "Hey, you're about to fail and this is why." And … if they're good I'll tell them. Like today, "You guys did awesome today."… They need to know both sides of that. [W_Int1_110311]

Relationships with her students were important to Ms. W, and her honesty with them was not only about building respect but also connecting with students and supporting them to feel cared for. Also, Ms. W did not demand respect and expect students to give it to her for no reason. Instead, she treated them with respect first, which in turn helped to build a respectful relationship between students and teacher.

Identifies and overcomes barriers to meet high expectations

Another way Ms. W demonstrated care for and built relationships with students was by holding high expectations and insisting that students meet those expectations. She drew on her relationships with students to communicate her high expectations and scaffolded them to meet those expectations:

> I try to have like a safe place, to create a place where they know it's okay to mess up or whatever, but not a place where they feel like they can get away with half way work either.... Like still having a standard and an expectation and saying, "Look, you're reaching for this. I see you're reaching for this. You're not there yet. Let's do this."...They're not going to get away with less than what they're capable of. And then the bad thing about me is I'm like, ... "Oh, well you can do that. There's no reason to stay there. Let's now do more! ... Let's push until we get someplace great." [W_Int1_110311]

Ms. W did not accept excuses for failure. She maintained all her students were capable and explicitly taught students strategies for reaching her expectations. She also provided reminders when necessary:

> "This is something that you missed from a month ago. Why haven't you done it? ... You got a zero and you should have a score for it," [I try to be] really obvious about that...to get them to a point where they're self-sufficient. But yeah, I know I will have to remind them until June that "Okay, if you missed a quiz come see me" because there's just not that natural inclination. [W_Int3_120111]

She further indicated that being explicit about expectations and the reasoning behind those expectations helped students to better accomplish the tasks set forth for them. This suggests that it was important to Ms. W to teach students what behaviors were expected of them rather than penalizing them if they did not know what was expected.

Ms. W also supported students to succeed by identifying and addressing barriers to their success. One such barrier was instability at home:

> Kids come with so much baggage.... [One student's] mom was ill and in and out of the hospital. Her older brother was not the best role model; her home situation was not great. She moved three times during the school year. She

> would lose her textbook every time she moved. There's [*sic*] so many little things that keep coming at these kids. [W_Int1_110311]

Another barrier was that students were not expected to achieve at high levels in their past, though she did not adopt a blaming attitude toward previous teachers or parents:

> I think a lot of times kids get into this position because somebody has caved somewhere along the way.... Sometimes it's easier to do something for a kid than to make them do it for themselves. [W_Int1_110311]

She also noted that a pattern of unsuccessful experiences in school mathematics sometimes undermined student's efforts and acted as a barrier. Specifically, Ms. W stated that at times, white, middle class students were more willing to work and they persisted in spite of the teacher, but students of color living in poverty did not persist:

> [The IB kids will] do whatever you ask them to do and I think that's the major difference here is with a lot of kids coming from maybe not-so-successful background in math are just used to kind of shutting down at the first sign of you know, being not successful, and I hope that … this kind of gets them over that and they keep trying. [W_Int3_120111]

> Ms. W adopted several strategies to support students to overcome these barriers:

> I try to find what works with that kid and if praise works with that kid then praise. If like revving them works, you know, like, "Where's your homework? You told me you were going to do your homework." … If that works with them, do that, and if joking around with them works then do that and whatever it is that really connects with that kid. [W_Int2_111711]

This excerpt also illustrates that when students reached the expectations Ms. W held, she was not satisfied. She pushed them to reach even higher expectations. Additionally, Ms. W encouraged students and reinforced effort by congratulating them for what might appear to be minor achievements, such as turning in an assignment on time or being present at school. For instance, she told one student, **"**Monicaaaaa… Thank you for doing your homework. I'm so proud of you" [PW_110211]. Through her encouragement, Ms. W supported her students to feel successful.

Ms. W challenged students to hold each other accountable as another way of supporting students to meet her high expectations. In the following exchange, a visiting student was talking to Tyrion as he tried to work. Ms. W said to the visitor:

Ms. W: You friends with Tyrion? [*The student nodded.*] Y'all hang out outside of school? [*The student indicated, 'yes'.*] Make sure he does his homework. [PW_111611]

In fact, some of the students began to take on this challenge of holding each other accountable and encouraged their peers without prompting from Ms. W:

S: I'm on unit 15.2.

Makai: Fifteen was already due. Sixteen is due Friday. I want you to be doing better. [PW_120711]

Thus, the community of care and respect was not just shared between the teacher and her students, but among students as well.

Finally, in order to convince students to make an effort so that they were able to overcome barriers to success and reach the expectations she set for them, Ms. W supported her students to attribute their achievement to the amount of effort they put in:

> They need to see that direct … and immediate positive consequence to their choices, "Okay, I did my homework. Oh look, my grade went up a point. Oh look, I knew how to do the problems on the quiz today because I did my [homework]." … And even the negative, "Oh, you didn't do your homework and your grade just dropped. Look at that direct relation. Do you see how that happened?" [W_Int1_110311]

Ms. W tried to support students to attribute their grades to effort by telling them:

> "I noticed you didn't take any notes yesterday and now here it's on your quiz and you didn't get the point on your quiz so …what are some strategies, some ways you can deal with that?" … Hopefully it's like that translation becomes apparent. [W_Int3_120111]

Ms. W's high expectations, however, related to more than mathematics. She expected her students to learn vocabulary and learn to speak Standard English and she scaffolded them to do so. In the excerpt below, Ms. W suggested that students solve a problem she assigned in the "most efficient" manner:

Ms. W: What does "more efficient" mean? [*The students were unsure. Ms. W described a trip to Orlando.*] You can get up, get gas, and drive down I-75 and take the Turnpike to Orlando. Or, you can wake up, go to Grandma's cause you forgot something there, then stop to get something to eat… These are scenarios we have discussed in the past. [*Ms. W explained that efficient means quicker, easier.*] It doesn't mean one way is better than another just that one is more efficient. [PW_110111]

In another example, the class discussed why they didn't write a negative in the denominator, and Ms. W responded, **"**It's improper. Like the conversation we were having [in the hall] where someone said, 'What it is?' You know what it means, but it's improper" [PW_110211]. Similarly, Ms. W joked with a student who stated, "We funna divide by negative three":

Ms. W: [*She winked.*] "Funna? In the country, we say 'fixin-ta'. [*Students made several comments, teasing Ms. W.*] I'm just telling you what we say in the country.… We are *about* to divide. [PW_103111]

By referring to her own background, Ms. W kept the situation light and did not imply that the student was wrong for not speaking Standard English. She personalized the correction to help students understand that there are different vernaculars that need to be learned. Ms. W addressed this topic often in class and also supported students in learning standard pronunciation of words. By correcting students' language use in a casual, nonthreatening manner, Ms. W preserved her caring relationship with students while also supporting them to learn the standard language and vocabulary that she viewed as important.

Ms. W adopted an attitude of high expectations and no excuses for failure to succeed with her students. She identified barriers to her students' success, which included difficult home lives, low expectations, a history of unsuccessful mathematics experiences, and a lack of effort. She then regularly encouraged students, reinforced their efforts, supported them to feel successful, and held them accountable so that they could overcome those barriers. She also supported them to learn to speak Standard English in addition to the vernacular they spoke. These practices communicated to students that she cared about their futures, thus strengthening her relationship with them.

Uses humor and sarcasm

Ms. W's personality had a sarcastic nature to it, and she used this to her advantage with students in order to build relationships with them. Laughter was common in Ms. W's classroom, and she frequently joked, as in the following scenario:

Ms. W: Are $\frac{2}{3}$ and $\frac{16}{24}$ equivalent ratios? ... Octavius is saying, "Yup, yup, yup." Did you ever see *The Land Before Time*? "Yup! Yup! Yup!" [PW_111411]

Ms. W also frequently teased students and used sarcasm with them:

Dominique: [*To Ms. W:*] Did you just hear [Matthew]? He told me to shush up or he's going to slap me in my face.

[*Ms. W stared at them for a moment, then rocked her arms as if rocking a baby. She walked over to them and they all started laughing.*] [PW_110311]

In another instance, she teased one student for being the only person off-task, stating, "Octavius, sometime today, please. Look at everyone else and look at you" [PW_111811].

Sarcasm can come across as hurtful if all involved do not recognize that it comes from a place of care, but because of the relationship she held with students, this was not an issue in Ms. W's classroom. Students laughed with her and responded to her teasing and jokes with smiles and jokes of their own. In this way, the sarcasm and humor helped to reinforce the connection Ms. W had with her students. If there were times when Ms. W's use of sarcasm did not convey the message she intended, she was aware of these situations and remedied them quickly. In the following scenario, Ms. W had just handed out a quiz:

Reagan: This whole thing the quiz?

Ms. W: No, just the first problem.... [*After class, Ms. W approached Reagan.*] I apologize for being sarcastic. I hope you know I didn't mean just the first problem. [PW_112811]

This excerpt again demonstrates that relationships were central to Ms. W's instruction. If she thought she might have damaged a relationship, she worked to repair it. Ms. W joked, teased, and was sarcastic with students as a way of letting them know she cared about them.

Gets personal

Ms. W made an effort to interact with students on a personal level in order to strengthen their relationship. She explained that by taking an interest in their lives and getting to know students on a personal level, she was letting them know she cared:

> If I know that the kids has [*sic*] a game one day and then I ask them the next day, "How did the game go?" or, "Oh, I saw you at the game, you made that throw," or whatever then they kind of are like, "Oh, oh, somebody did notice me." … It's an easy thing to do. [W_Int2_111711]

She also questioned students who had been absent or suspended about why:

> I want to know what they're doing…. The school will send out discipline reports or we'll see who's been where and I'll ask them and they know that

> I'm going to ask them and they'll be honest with me about that because I think they kind of know ahead of time, "Oh she's going to get me for this." [W_Int2_111711]

Ms. W also often talked to students about who was dating whom, their pets, and other personal topics. She enjoyed getting to know her students, indicating:

> They're deciding who are they going to be, what are they going to do, where are they going from here, what sports are they involved in, who they're going to date…. They have all these choices and to be a part of that for a little while in their lives with me is pretty cool. [J_Int3_120111]

Ms. W's interest in and care for her students was not superficial. She genuinely cared about her students and made an effort to convey that to each of them, even after they were no longer in her class, by remembering them and continuing to build her relationship with them:

> As they get older and I see them in the hallway I try to remember them and ask how they're doing and speak to them.... I just try to make it a priority to keep in touch with the kids. [W_Int3_120111]

Finally, Ms. W interacted with her students personally by being physically affectionate toward them. She frequently put her arms around a student's shoulders, put her hands on a student's head and rubbed it, or gave them hugs, and they enjoyed her affection. Once, two visitors entered her class and one exclaimed, "I get my hug first this time!" [PW_112811].

By asking students about their personal lives, attending their extra-curricular events, and being physically affectionate toward them, Ms. W built caring, respectful relationships with her students. These efforts to build relationships with her students in order to create a classroom community in which students felt comfortable and cared for were successful. Students entered her classroom happily, joked with her, and clearly liked Ms. W. They also felt comfortable sharing about their personal lives with her. She recalled:

> It makes me happy when I know the kids and I feel like they want me to be a part of their lives. Did you hear Makai today? "I got my belly button pierced.... Aren't I the only boy you know that's gotten his belly button pierced?" … They want to share things with you. [W_Int3_120111]

It was also common for former students to come by Ms. W's classroom to visit with her on a daily basis. One of these visitors said, "Ms. W, you know what I wish I could do? I wish I could go back in time and be in your class" [PW_103111]. Ms. W's relationship with her students was so strong that at times she served as a mother figure to them. She described the first time she realized students viewed her in that role:

> It was maybe my third or fourth year here and a kid was raising their [*sic*] hand like for help and finally they're like, "Ma! I mean, Ms. W!"...If it gets to the point where they're accidentally calling me Mom that makes me feel like, "Okay, I'm doing something good" because you want to feel like there's that connection. [W_Int1_110311]

Ms. W stated that she valued the relationships she built with students because those were what made teaching meaningful.

Ms. W worked hard to create a classroom community in which students felt comfortable and cared for. To do this, she was respectful and honest with students, who were in turn respectful toward her. She identified barriers to students' success and supported them to overcome those barriers so they could reach the high expectations she held for them. Ms. W also used humor and sarcasm to strengthen her relationships with students, got to know them on a personal level, and was physically affectionate toward them. These efforts were worthwhile, as students clearly perceived the care Ms. W demonstrated.

Grounds Classroom Management in Relationships

When it came to classroom management, Ms. W sought to create a productive, respectful environment in which everyone could learn. For example, she insisted that students paid attention. If they asked a question she already addressed, she did not repeat herself. Instead, she told students, “I already answered that question” [W_Int3_120111] and advised them to turn to their teammates for information. In this way, Ms. W taught students to not rely solely on the teacher for information and made them responsible for the instruction of the class, “so there’s more interaction that way and that’s [a] big thing that we practice a lot [during] the first week or so” [W_Int2_111711]. Ms. W indicated that she spent a great deal of time at the beginning of the year teaching students her expectations of them and then built on more expectations as time progressed. In particular, she focused on routines and procedures that students needed to learn in order for the class to run smoothly and for students to reach the expectations set in the class. One way she did this was by reminding them at the end of a class period what they would be expected to do the next day at the beginning of class.

Attention to these routines and procedures early in the year meant that students learned quickly what to do each day as they entered the classroom. By the time observations began in October, Ms. W did not tell students what was expected of them on a daily basis. For example, it was noted that students usually turned in their homework and gathered materials as they entered the class without prompting.

Ms. W was not lenient and expected students to follow rules. In fact, she made certain to enforce the rules she found important and held students accountable for their behavior. For instance, Ms. W was very strict when it came to being respectful and insisted that students not talk out of turn "because not only does [the student] not get information but then [the student's] whole team is messed up" [W_Int3_120111]. Ms. W rationalized this when she stated, "I think that kids need stability and they need to know that 'If I act up, I'm going to get in trouble in this class,' you know, because that's not acceptable" [W_Int1_110311].

The relationship of care and respect that Ms. W established was paramount to how she addressed classroom management issues. Specifically, by drawing on her relationship with students, she was able to convince them to do what she asked:

> I think that because ... I have that sort of rapport or whatever that the kids are a little more respectful and they'll listen a little more and they're more willing to do things that I ask them to do.... They don't see it quite as much like [a chore] ... maybe so much as like, "Okay, let's just get this done." [W_Int3_120111]

Unsurprisingly, Ms. W did not want to damage her relationship with her students when she chose to address misbehavior. Instead, she tried to communicate to them that she was not upset with them, but merely unhappy with the behaviors in which they were engaging. She said, "it's the action, not what you did, it's not that I'm mad at you, I just… this is intolerable behavior...we have to follow up on what choices you've made" [W_Int3_120111]. The following sections describe the ways in which Ms. W addressed classroom management issues.

Treats students as individuals

Ms. W knew her students well and had a close relationship with them. She realized students were individuals who may not have always acted the way one hoped they would, but it did not mean they were acting inappropriately, either:

> There are some kids that don't look engaged and are, and I have to learn that. Like Devon looks like he's sleeping through every class but then you ask a question and he's like, "It's A-K to the fifth."… His head down is not

> defiance. He's listening, he just puts his head down and I have to be okay with that because otherwise it becomes a battle with him. [W_Int2_111711]

Her relationship with students also allowed Ms. W to better understand the reasons behind why students behaved the way they did. As their teacher, she tried to be aware of those reasons and considered them when making management decisions:

> This kid is having a bad day, probably not because of anything I did or anything they've done. It's probably because of something they can't control and I need to be respectful of that. You know, the kid who's sleeping through class is doing that because they [sleep in a car at night.] Okay, let me not ride their case about that. [W_Int3_120111]

Thus, by drawing on her relationship with students and the knowledge she held about them, Ms. W was able to consider each case separately and treat students as individuals when addressing classroom management issues.

Avoids escalating issues

Ms. W avoided overreaction that would escalate minor issues. Again drawing on her knowledge of students, she sometimes ignored misbehavior and instead responded in a casual way, acting as if the behavior was not of major concern to her. Ms. W explained, "I can't force the kid to pay attention.... Everybody has off days, you know.... I try not to make that big of a deal about it" [W_Int3_120111].

Sometimes, when a student acted inappropriately, Ms. W let him or her know but did not reprimand the student. An example occurred when Strom returned to class after a very long visit to the bathroom:

Ms. W: [*Ms. W gave Strom a disapproving look and looked at her wrist, indicating toward her watch.*] Let me just be straight with you. When you disappear that long during B lunch [*Strom smiled*] and when you smile that big, that really makes it look like you went to B lunch. But that's your last pass. [PW_111511]

On another day, Ms. W walked over to a student, pulled his hood off his head (a dress code violation), took the MP3 player he was listening to, wound up the cord, and put it next to him. She did not say a word to the student during this encounter [PW_111711], but her actions let the student know that he had broken rules. In this scenario, Ms. W chose to not make a "big deal" out of minor infractions.

Ms. W did not get upset when students broke rules. She remained calm when a student misbehaved, especially if the student was not. Ms. W explained that by not responding to students' anger, she was often able to diffuse tense situations. "If I'm like, 'Get out!' and ... everybody's mad then it just explodes, but if I can be calm then that will be fine. If I can be funny then that's even better" [W_Int3_120111]. Sometimes, being calm and rational was all Ms. W needed to do to diffuse major classroom disruptions. For instance, she told two students who were threatening to fight:

> "I haven't had to write a fighting referral in years. Don't embarrass me by fighting in my class. You want to fight you take it outside.... Don't do it in here.... If I write you up, you got to go home for ten days. You're only allowed to have six unexcused absences.... Is that person that important to you to fail all your classes for one fight?" And that sometimes is enough for them to be like, "Yeah, no." [W_Int3_120111]

As a result of Ms. W not reacting in a way that escalated disruptions, students' actions sometimes shifted from disruptive to well behaved. As an example, Ms. W described an interaction with a new student who had received multiple referrals from other teachers. His first day in her class, he looked at his assignment and started yelling profanities. Ms. W responded:

> "That's fine, you can choose to not take this test. I know what grade you'll get if you don't take it." You know I was really calm [and he was] like, "Okay, wait, that's not what I thought was going to happen." And so with [that kid, he] started out just like oh my goodness and then by the end of the school year [he was] putting forth effort, [was] trying to stay out of trouble, [and shifted from] "yeah" to "yes ma'am". [W_Int1_110311]

She further explained that when students did misbehave, she did not take it personally:

> A lot of teachers can be in that point where … "these students aren't getting it, or they're mad at me." ... I try not to get to that point. I've been there [and it's] not helpful in a situation to put that, you know, that tension between the class and you. So I try to keep it real light. [W_Int3_120111]

Ms. W asserted that she did not have many disruptions and this was supported by observation data. There was only one instance during the classroom observations that could have become a major disruption, but Ms. W quickly diffused it by sending one of the students involved into the hallway to take a break and later suggesting to the students involved they needed to learn to work out their differences [PW_120211]. She remained calm, insisted they treat each other with respect, and let them know that their behavior was unacceptable.

Provides hints, humor, and sarcasm

Similar to the way she used humor and sarcasm to build a relationship with her students, Ms. W joked with students and provided hints to them as a way to address classroom management issues. For example, students were off task and asked Ms. W about the difference between diet sodas and Coke Zero. She said to them, "I am so glad we have these intellectual conversations" [PW_111411], hinting that they needed to get back on task. This statement also illustrates how Ms. W drew on the sarcastic aspect of her personality to address disruptions.

Ms. W claimed that her use of humor was her most effective classroom management tool:

> The most effective thing is to laugh…. I'll just look at them and just start laughing and be like, "Really? Are you hearing yourself?" And they'll kind of stop. [The situation will diffuse] because I didn't meet it with anger. [W_Int3_120111]

Summary of Psychological Features

Ms. W's classroom was characterized by caring, respectful relationships. She believed relationships were key to her success as a teacher because if students felt cared for, they were more willing to behave and complete their work. She modeled respect, was honest toward her students, and expected them to do the same. Ms. W also demonstrated care by setting high expectations. She identified barriers to her expectations and scaffolded students to overcome those barriers. She also used her humorous, sarcastic personality to her advantage in building strong relationships and demonstrated that she cared for the students on a personal level.

Ms. W's view of classroom management involved a productive, respectful environment in which everyone could learn, and management was grounded in her high expectations and the climate of care and respect that was established. She scaffolded students to succeed by explicitly teaching students appropriate behaviors so they could become self-sufficient. She also used a variety of strategies to address classroom management issues including drawing on her relationships with students, avoiding overreaction that would lead to escalation, and using humor and sarcasm.

Teaching Mathematics

In this section, the ways in which Ms. W addressed her first two goals, building mathematical knowledge and becoming problem solvers, will be described. First, a "typical" day will be outlined to provide context for the discussion of Ms. W's mathematics teaching. Even on a typical day, however, there was great variation in Ms. W's instruction, particularly in the way new material was introduced. She was required to create lesson plans that followed the Gradual Release Model (GRM), which she described in an interview:

> Watch me do this, ok, now let's do this together, do this with your team [or partner,] now do this by yourself.... At the end of class we do like a daily quiz or whatever but the goal is that eventually they're at the point where … they are attempting and showing me something that they're doing on their own. [W_Int2_111711]

Ms. W viewed this model for lesson plans as flexible and therefore included variation in her instruction. Ms. W explained, "I try to throw in enough strategies so it's not stale and then I don't do the like 'everybody raise their hand and wait for me to call on you'" [W_Int2_111711]. Her rationale for this was that she found it boring to teach in the same way every day and explained, "You can't walk in and be fake consistently every day.... I know … if I'm bored with this I know they're bored with this." [W_Int3_120111].

By regularly varying instruction, Ms. W kept students engaged. Even with this variation in instruction, however, there were themes that emerged and some are highlighted in the example. In reality, each element may not have occurred every day. This section concludes with a discussion of the themes in mathematics instruction.

A Typical Day in Ms. W's High School Algebra Class

Ms. W greeted students cheerfully when they entered the classroom. They turned in homework and a student helper returned graded work. Ms. W made announcements to the class about what to expect for that day or the upcoming week and when assignments were due. She also reminded them to turn in any late work:

Ms. W: I was trying to run [grade] reports and some of you are still missing homework.... You need to check online for assignments that [are missing] and you need to get those things turned in. I want to make sure you get all the grades that you have earned [and] worked for. [PW_111411]

After Ms. W made announcements, students worked on the Carnegie program on their computer or completed missing assignments. During this time, Asia graded homework and Matthew assisted students with their work. Students assisted each other as well. Ms. W typically circulated, answering questions, or sat at her computer to take attendance, input homework grades, or request missing assignments from students:

Ms. W: If there is anybody who was absent Thursday and you did not already ask me about making up your test, you need to do that right now.... Tabrishia, you working on that one homework you owe me? ... Ruby, you only have two assignments that you owe me....Tyrion, do you have Internet at home? [*He indicated that he did.*] Do the homework now if you promise to do Carnegie at home. [PW_111411]

This excerpt illustrates a defining element of Ms. W's instruction: she constantly hounded and pestered students to turn in late or missing assignments.

During the time that students worked on the Carnegie computer program, former students often came into the classroom to visit Ms. W. She chatted with these visitors and encouraged them to help her current students. Ms. W also used this time to check in with students about their grades and to remediate them individually or in teams. She explained that the purpose of these conferences was to build their skills for the EOC:

> [Meeting with me] is not in any way, shape, or form punishment. I don't want you to think, "Ahhh I gotta go talk to Ms. W." The point of that is to help you, to show you what's on the EOC so that I can help you move on to 10^{th} grade.... I don't want you in my class again.... I love you too much to want to see you again next year. [PW_110811]

Ms. W frequently focused these sessions on the previous day's exit quiz. In the following example, she spoke to a small group of students:

Ms. W: You all missed it for the same reason, because you put minus, which makes sense, because you're going to this hotdog thing and you eat hotdogs and they disappear so you minus…. But each package contains eight hotdogs. *Each*. That's a big word. What if I said I'm going to give each person in this class $8? How would I find out how much money I needed? [*S 1 began to say something. S 2 cut her off.*] Yeah, but listen to her. She's got something to contribute.

S 1: Multiply.

Ms. W: Right, so I count how many people in the class, multiply it by eight dollars. [PW_111011]

This scenario illustrates Ms. W's frequent practice of referring to money to help students understand a mathematical concept or problem. She also validated students' efforts even though they were incorrect when she told them their strategy "makes sense."

Other times Ms. W remediated students on their homework. In the following excerpt, Ms. W met with a student to discuss her incomplete assignment:

Ms. W: What happened with number two, you got nervous? [*The student indicated yes.*]...Okay, I understand. The taxi driver sets the meter at $2.00 so you gotta pay him what?

S: $2.00

Ms. W: Then, it adds $1.50 for every mile. Then you give him a $2.00 tip….

S: Oh, I got it. Bye. [*The student took the paper back to her desk.*]

Ms. W: That's right. I like when I see that ambition. [PW_110911]

There are several things worth noting. First, Ms. W talked the student through the word problem ("number two") in a way that helped the student understand the scenario being described but did not tell her the answer or a procedure to solve the problem. Second, Ms. W allowed the student to redo the problem, which provided another opportunity for her to succeed. Finally, Ms. W was encouraging. She did not put down the student or reprimand her for not completing the assignment. In another example, Ms. W met with several students and stressed that they need not worry about making mistakes:

Ms. W: Octavius, can I see you please? You know that I cannot grade this if you don't do it all.... Just, just try. I know they're confusing…. Confused is one thing, not done is another. Just write something so I know if you can do it. And if you're not good, then I can talk about it.... Even if it's wrong, that's cool, but just give me something.... It says to write an inequality. So, what is an inequality?

S: A comparison.

Ms. W: That's exactly what it is. That's exactly right. So what I want to see is, can you take this information in this problem and make some sort of comparison? I just want to see that you can try it. We can move forward from there. [PW_110911]

Ms. W stressed to the student in this scenario that it was important that he try so that she had something to discuss with him. If students did not do the work, she could not talk to them about what they knew or help them with what they did not know. By encouraging students and telling them it was okay if they made a mistake, she was supporting students to build their self-efficacy for mathematics.

After the first 40 minutes, the class moved classrooms for the second half of the period. Desks were arranged in groups of four. One student from each team gathered the materials listed on the board (e.g., calculators, clickers). On some days, Ms. W began by going over homework, perhaps beginning with student requests or recording answers on the board. Ms. W might choose which problems to go over, which were typically problems on which many students had made mistakes. In other instances, Ms. W asked students to compare their solutions with their classmates and discuss the problems they disagreed on. Sometimes she would answer unresolved questions, but other times students were left responsible for sorting out their difficulties as a team. The way students were grouped when going over homework changed often. They might work with their team or an informal group assigned by Ms. W. For example, students were assigned a "quadrant" and then asked to join their new team in one of the four "quadrants" of the classroom.

After reviewing homework, Ms. W began the lesson, usually by first informally introducing a topic. She told students before their notes would be "nothing formal" [PW_110311] and that they were preparing for something they would need to know in the future. After several days of "informally" learning a topic, Ms. W told students that it was time to learn it "formally," but at that point students already mastered the material. Furthermore, Ms. W treated students as experts who already knew the content she was teaching:

Ms. W: Here we go! In a math class, you know how your teacher will teach you something and you're like "Woooo, I know this!" Today's that day. You already know this stuff from middle school, so today should be like '"Haaaaaa..." It'll be one of those glory days. If you went to middle school. And if you were paying attention. [PW_111411]

In this excerpt, Ms. W encouraged students as a way to build their self-confidence. She did this often as a way of making the introduction of new content casual and nonthreatening.

Next, Ms. W proceeded in the lesson by activating students' knowledge about a topic. On a typical day, this included defining vocabulary. In one instance, Ms. W asked groups to determine what the difference was between a ratio and a proportion:

Ms. W: Let's decide what your team said. There's some good words I heard floating around out there. There's some things we need to get written down in our notes. Strom.

Strom: It's an amount.

Ms. W: Good.… [*She prompted students for more details.*]

S 1: Out of. [*Students started calling out words and Ms. W wrote them on board:*]

fraction 9/12, 9:12, 9 to 12, 9 out of 12

Ms. W: What are you doing with those numbers [in a proportion]?

S 2: Are we comparing them?

Ms. W: It is a way to compare. It's a way of saying, making some sort of comparison, making some sort of relationship. [*She wrote "comparing 2 numbers" near the word "ratio" on the Smart Board and asked if they've seen that in Carnegie, where it says something* *like "2 out of 7 flagships…" Students acknowledge they've seen that before.*] [PW_111411]

In this excerpt, Ms. W questioned students about what they knew about a topic. She took their input, validated it, and, through questioning, led them toward definitions for the vocabulary word, filling in the gaps in their suggestions when necessary.

Next, Ms. W continued to activate their knowledge by posing a review problem for students to solve. Ms. W asked students whether $\frac{2}{3}$ and $\frac{16}{24}$ were equivalent ratios:

[*The students suggested dividing 2 by 3 to turn* $\frac{2}{3}$ *into a decimal on the calculator. Ms. W reviewed how to divide a fraction on the calculator, because, she stated, some students on the test did 3 divided by 2.*]

Ms. W: Can I set up a proportion that is true?

Ss: Yes.

S: Put an equal. [*Ms. W wrote* $\frac{2}{3}=\frac{16}{24}$.] [PW_111411]

Next, Ms. W often posed questions, and students shared ideas of how to solve them. In the following excerpt, she wrote a problem on the board, $\frac{10}{8}=\frac{n}{10}$ for students to solve. Problems of this form (i.e., proportions with monomials in the numerators or denominators) were prerequisite material for the course:

[*Students suggested turning the fraction into a decimal, multiplying through by 10 (i.e., doing the inverse operation), or cross multiplication. Ms. W wrote each of these suggestions on the board. Next, they solved the problem using each of these strategies. Students called out each step and Ms. W wrote it down.*]

Ms. W: Can anybody think of another way to solve it? [*S 1 suggested finding a common denominator.*] What numbers do 8 and 10 both go into?

S 2: 80.

[*Ms. W solved the problem using this fourth strategy: they multiplied through by 80 and then students told her what other steps to take to solve the problem. For each strategy suggested, they reached a point in the solution where the equation was* $100 = 8n$.]

Ms. W: Guess what, we're at the same doggone place we were before [in the other solutions]." [*All four solution methods were on the board. Ms. W reminded them of their trip to Orlando, says there are many ways to get there and she has shown them at least four ways to solve this problem. They can choose the way that works for them. She assigned two more problems to complete in teams.*] [PW_111411]

It was not uncommon for Ms. W to begin lessons with problems that reviewed material with which students were already familiar as illustrated in the above excerpt. This excerpt also highlights Ms. W's practice of regularly discussing multiple solution strategies for a problem, compared those strategies, and encouraged students to choose the method they preferred. Sometimes she also made an effort to point out to students when one strategy was more appropriate than another. In the following excerpt, students were working in teams:

Ms. W: Make sure you're practicing with your team so you're getting ready for your [exit] quiz. I see people doing solo stuff.... [*To one group:*] Go back and look at the examples. Which one is your favorite? [*The student pointed.*] Do it that way then.... [*After a time, Ms. W wrote the problem* $\frac{4}{3} = \frac{8}{x}$ *on the board and asked how to solve it.*]

Makai: Multiply by 8 so the 8 and 8 cancel.

Ms. W: [T*he class considered this suggestion momentarily. Ms. W reminded them that with the reciprocal strategy suggested by Makai, they have to be careful.*] The 8 is being divided by x not the x divided by 8. This problem is tricky ... because you have to multiply both sides by x. So maybe there's an easier way. Maybe we want a method that always works. These four strategies are good, but you might want one that always works.... [*She recalled Octavius' method, which she called 'means extremes'*] but which you might have learned as "cross multiply". [*She told them the means-extremes method will always work.*] [PW_111411]

As illustrated above, rather than beginning the lesson by telling students to use the means-extremes method to solve proportions, Ms. W let students suggest many strategies and slowly led them toward a strategy that resulted in less student errors, which she suggested made the strategy more effective. Usually, as in the example above, Ms. W allowed this strategy to come from the students, but if no one suggested it she presented it as an alternative strategy. She did not insist students used the most effective strategy but discussed the merits of each strategy with the class before pointing out which approach would “always work.” Next, Ms. W posed a problem that appeared different, but she supported students to transfer their strategy and apply it to the new problem. In this example, after discussing the means-extremes method as the most effective, Ms. W asked the students to solve a proportion that contained a binomial in one of the denominators. The students agreed to try to solve it using the means-extremes method and noted that they needed to write parentheses around the binomial and apply the distribution property [PW_111411]. Thus, Ms. W built on a problem type with which students were familiar and supported them to apply the strategy they knew to a new problem type. Similarly, Ms. W asked students to solve problems with simple numbers and then supported them to apply the same strategy in problems with variables.

After supporting students to transfer what they knew to new problems, Ms. W assigned problems for students to practice. There were instances when students practiced individually, but most often they worked on problems in their teams. She also told them, “With your team, pick three. You do not need to do all four” [PW_111411]. Ms. W explained that she allowed students to choose which problems to solve as a way to differentiate instruction. She “[didn’t] like to make them feel cornered” [PW_110211] or as if they were going to fail if they didn’t know a question. She also used this approach on tests and quizzes, and “it [seemed] to work out” [PW_110211].

There were occasions during the course of the study when students did not practice problems on their own or in a team. Instead, Ms. W put one multiple-choice question on the board and students solved it individually and submitted an answer via their clicker. Ms. W then displayed the results on the Smart Board screen, and the class discussed the solution. At times, Ms. W also focused on the most common incorrect answer and asked how someone may have come to that conclusion, therefore supporting students in learning from incorrect answers.

Typically, when discussing a solution, students suggested what strategy to use, Ms. W revoiced the strategy, and students called out each step as Ms. W wrote what they said. In a few instances, Ms. W suggested the strategy and students called out the steps, or she walked students through the entire solution. When this occurred, however, Ms. W explained the solution and focused on reasoning rather than simply stating the procedures. This emphasis on reasoning was common. For example, when students were struggling to understand when the intern, Ms. G, was solving a problem at the board by applying the rule that any variable raised to the power of zero is one, Ms. W stepped in to help them reason through the problem instead of expecting them to apply the rule they did not understand:

[*Ms. G is solving* $7^3 \cdot 7^0$. *She cited the rule that* $7^0 = 1$ *so* $7^3 \cdot 1 = 7^3$. *Students appeared confused.*]

Ms. W: You can think about this the way we’ve been doing it earlier this week, by writing it out. How many 7’s do I write here?

Ss: Three.

Ms. W: And how many 7's do I write here? … [*She pointed to* 7^0.]

S: Oh, zero.

Ms. W: So three 7's and zero 7's is still just three 7's. You can think about it that way, too, if you'd like. [PW_111811]

Some days, at this point in the lesson, Ms. W posed word problems to students similar to the types of problems they might encounter on the EOC exam. She solved these problems at the board, thinking aloud and making her solution strategies transparent. Class concluded with Ms. W assigning homework and an exit quiz (a one-question, one-point assignment) that covered content taught that day. Before administering the quiz, Ms. W told students, "The only way to get ready for EOC is to do your own junk. It's only one problem.... I don't care if you miss it, just do your thing" [PW_110811]. Again, Ms. W was conveying to students that it did not matter to her if they did the problem incorrectly. She wanted them to try so that she could evaluate their knowledge. The next day during Lab, Ms. W met with students who did not perform well on the quiz.

Variations from the Typical Day

There were several variations in the way the mathematics instruction proceeded in Ms. W's class. These opportunities for divergence occurred when students were to take a quiz and when the class engaged in an end-of-semester review.

Twice, instruction varied from the typical format when students took a quiz during the second half of the block period. On the first quiz day, Ms. W reviewed homework before administering an open-note quiz. Students could select which problems to solve as long as they completed a set number of problems in total. The second quiz occurred on a day that they first had to complete the previous day's lesson—finishing notes, the open-note exit quiz, and a worksheet. Next, the class participated in a brief review game during which students solved a problem with a partner, Ms. W announced the answer, and they switched partners before being assigned another problem. Finally, the quiz was assigned.

Another variation occurred when Ms. W provided review for the end-of-semester exam by playing a review game. The students solved a problem individually and then came together as a team to decide upon one answer to submit. Ms. W then reviewed the solutions and compared multiple solution strategies at the board. The students did not take an exit quiz that day. In the next section, common patterns in Ms. W's instruction will be discussed.

Themes in Mathematics Teaching

The description of typical pedagogy highlights several themes related to Ms. W's instructional practices. These themes are the topic of this section.

Begins with what students know

Lessons usually began with Ms. W making a connection to students' prior knowledge. She asked students to solve a familiar problem, discussed their strategies, and scaffolded students to apply those strategies to an unfamiliar problem. She explained how she approached activating prior mathematical knowledge:

> [I] meet them where they are and see, "what do you know?" and ... try to have them recognize patterns, "What did you do last time? How is that related here? What can you predict will happen the next time?" [W_Int1_110311]

Ms. W credits higher standards from the state for her ability to do this: "With the way standards have changed they've had a lot more math background in middle school [making] it a lot easier to access that prior knowledge and ... draw on stuff that they really in fact do know" [W_Int2_111711].

In addition to supporting students to transfer strategies, Ms. W drew correlations daily between money and the problems students were working on. In one example, Strom was struggling to write a representation for one lap if four laps were equivalent to one mile:

Ms. W: Think about money.... Four *what's* make a dollar?

Strom: Quarters.

Ms. W: Yeah. A quarter is what?

Strom: Zero-point-two-five?

Ms. W: You got it. [PW_120211]

She explained that by suggesting that student think about a problem in terms of money, she was "[starting] with what they know [like money] and then...[taking] that scenario and [phrasing] it in a way that maybe they don't think of" [W_Int1_110311].

Allows for multiple solution strategies

Ms. W regularly discussed multiple solution strategies for a problem. She told her class, "there are lots of ways to solve this.... Some will take you longer than others, but there are many ways" [PW_103111]. At times Ms. W moved students toward using the most effective strategy:

> I do try to go back and tell them ... "There's four different ways, but these ways lead to some issues sometimes which is why ... if you want a way that always works do it this way" and ... not to make a kid feel like they're wrong because they didn't pick the option everybody else did. [W_Int2_111711]

In this way, Ms. W validated each student's contributions and knowledge. She also encouraged them to choose the method they knew how to apply without error regardless of efficiency, telling them, “If you have [a strategy] that works, don’t change it. If what you did last night didn’t work, then you need to change your strategy” [PW_110811]. Ms. W explained that encouraging students to choose an effective strategy that they were comfortable with rather than requiring the most efficient method ensured their success:

> I’m trading off efficiency for accuracy and that’s worth it to me. If they can’t do the problem in 30 seconds but they can do it in a minute and get it right, then let’s take a minute and get it right.... I don’t know that at this point I’m ready to [give them the rules as shortcuts] and say, “Hey, let’s confuse 90% of you while the 10% of you get a faster way.” [W_Int3_120111]

Ms. W’s reasons for allowing students to choose for themselves which method to use also honored students’ different ways of thinking. She stated, “Everybody has a creative side.... Do things that make sense to you.... What is the point of making them do it this way when that way makes sense to them?” [W_Int2_111711]. Ms. W also stressed to students that it was important for them to understand the strategy they chose and be able to apply it without error [W_Int2_111711].

Finally, Ms. W explained that giving students options about which solution method to use was a step toward supporting them to be able to handle unfamiliar problems:

> When it comes time to [choose a strategy] and they’re given a weird problem they’ve never seen before, then hopefully ... they can reach into their bag of multiple ways and say, “Okay, I think maybe I can do this strategy that worked somewhere else.” [W_Int2_111711]

Thus, by allowing students to choose from a variety of solution strategies, Ms. W was working toward her goal of supporting students to become problem solvers.

Emphasizes reasoning over rules

Reasoning was emphasized over rules, formulae, and procedures. Ms. W explained it was the role of mathematics teachers to help students understand mathematics:

> I think mathematicians are excellent at math and I think that math teachers are excellent at … the concept in a way that's real and applicable to a kid, and I think that's why not everybody who can do math makes a great math teacher, you know. There's this level of patience and "How can I phrase this differently? How can I make this make sense?" [W_Int2_111711]

An example of emphasizing reasoning over rules occurred in the discussion regarding multiple solution methods, when Ms. W made it clear that students needed to understand the strategy they chose. She also did not teach the rules for exponent operations but rather supported students to understand how to reason through exponent operations, explaining, "I've probably spent more time up front than I normally do on [exponents], but I think that – my goal is at least – that that will produce more effective results in the end" [W_Int2_111711]. She indicated in an interview that students needed to understand and derive rules rather than memorize them. This was evident during an observation when the class was solving $5-5x=0$. Students suggested Ms. W add five to both sides of the equation in order to "cancel" the leading coefficient, so Ms. W wrote "$+5$" on both sides:

[*The following was displayed on the board:*]

$$\begin{array}{l} 5-5x=0 \\ +5 \qquad +5 \end{array}$$

Ms. W: That doesn't make sense. [*She indicated toward the* $5+5$ *on the left-hand side of the equation.*] That's like saying I have five dollars and you give me five more and now I'm broke! That's bad math! [PW_110111]

In this scenario, Ms. W did not emphasize the inverse operations rule that is often used to solve two-step equations. Rather, she took up the incorrect suggestion to "add five" and then asked students to think about what five plus five was; the result would not be zero, as they needed it to be. Ms. W elaborated on this situation, stating she repeatedly asked students to think about the meaning behind procedures:

> To go back to, logically, like, “Why? Why can’t you cross out five plus five? … Otherwise it’s just a rule and then what does that mean? [We need to make sure] what you’re doing makes sense [and talk] about why it doesn’t work. [W_Int1_110311]

Engages students in cooperative learning teams

Ms. W encouraged students to work in heterogeneous teams every day. When she began teaching, she did not utilize the practice of teaming:

> My first year I pretty much only did direct instruction type things.... [Over time] I would do small team projects [and now] it’s a rarity that they’re not in a team, just because I think they gain so much from the discussions. [W_Int3_120111]

Now, students completed the majority of their assignments (even some tests) as teams.

Ms. W explained that she used a Kagan strategy to assign students to their group so there was one high-performing student, two mid-range students, and one low-performing student per team. The factor she used to group them changed periodically. First, students were grouped based on pretest scores, but later in the year this shifted to focus on grades, homework completion scores, or students’ test-taking abilities. Ms. W tried to balance teams in terms of gender and, when she changed groups, she preferred not to partner students with someone they had already worked with. She explained,

> I try to seat them also so that when we’re doing like work with face partners or work with shoulder partners that the high is never like having to drag along the low so to speak, so that it’s more like they’re always working with people that are closer to them, but that it’s also not so obvious like, “Oh, you’re the smart one on our team.” [W_Int3_120111]

Ms. W also did not give students a choice about who they were partnered with and taught students about working together by stressing that they needed to approach their teammates with a positive attitude.

There were several reasons Ms. W believed teaming was an effective teaching strategy. First, she suggested teaming rather than lecturing was more consistent with how she believed students of color learned:

> Culturally it's more of a conversation type of learning. [Teaming] goes along with backgrounds, you know, it goes along with how are they learning when they're younger.... How can I meet the strengths of you know the culture? [W_Int3_120111]

This contrasted with her belief about how white, middle class students learned, which was more consistent with direct instruction:

> [That] population is very used to like a structured non-verbal kind of school and…coming from my experience, the way that families operated and the ways that you know just community operated was less based on conversation and more based on just taking in information and I think that's different from the [black] kids here. [W_Int3_120111]

This was not to imply that white, middle class students could not learn well from teaming but rather that their culture had taught them to learn from a teacher-directed approach.

Second, Ms. W stated that teaming worked because it was congruent with how the real world functions and provides practice for the real world:

> That [is] very counter-intuitive, to me, to have kids in rows raising their hands and doing that back and forth thing.... It's not how our society works.... I want to mirror the real world as much as I can. [W_Int1_110311]

Third, Ms. W claimed teaming "[encouraged] them to depend on one another" [W_Int1_110311] and helped keep students accountable. At times she assigned a team test with too many problems for one student to complete individually so all the team members had to contribute. If a student was not prepared, that affected the entire team:

> They know that checking out may mean that they're looking like the one person on their team who doesn't know what's going on…. Their team's going to let them know, like, "You are slowing us down. Why don't you know how to do that problem? Let me show you," and then they're taking their time to show somebody else how to do it. [W_Int2_111711]

Finally, Ms. W engaged students in cooperative learning teams because it allowed them to demonstrate their knowledge to peers when she was unavailable:

> Because they're with those people for like six weeks, they [become] comfortable talking with those people and even if they don't ever show me that they know what's going on but they can show their team that they know what's going on then that's a step in the right direction. [W_Int2_111711]

Provides multiple opportunities to succeed

Ms. W provided students with multiple opportunities to meet the high expectations she set for them. She constantly reminded students to turn in missing assignments and accepted late work. She expressed that she was especially persistent before grades were due because it was important for students to complete assignments even if they were late. She told them at the beginning of class, "If you didn't do today's homework, you know what your first priority should be" [PW_111511]. Ms. W also indicated that students were more willing to complete those assignments if she awarded them partial credit for their late work:

> I used to be "if it's late no points"... but then there were so many arguments from kids [year after year], "I don't understand why I'm getting a zero and I still have to do it. I'm doing the work." And then I stepped back and listened and I was like, "They're right," you know, like okay, so they don't get 100, they get a 20%, but they did the work. [W_Int3_120111]

Ms. W further explained that it would be inconsistent for her to be flexible in some of her decisions if she did not also allow students with multiple opportunities for them to demonstrate their success by accepting late work:

> [I'm flexible in that] I teach something a bunch of different ways or I try to give them several strategies to solving a problem.... I can't be flexible in one way and rigid in another. So if I say to a kid, "No, you should have learned it Tuesday. Why did you learn it Thursday?" That's not fair to them either. So okay, it took them two days longer to get it. Let's still reward the fact that they got it. [W_Int3_120111]

Supports students to build self-confidence

Ms. W did several things to support students to build their mathematical self-confidence. First, she often began a lesson by telling students they were capable and introducing a topic in a casual manner. She expanded on this in an interview:

> I try to let them know like "Hey, let's go ahead and master it now so that when it comes you're already a professional at it" and I'll use that next week. I'm like, "You've been practicing this all week. You're a professional. Now we know how to do [this.]"… So they kind of get to that level where like "Okay, I can try, trial and error now," and then when it matters they have a level of confidence or whatever in themselves. [W_Int1_110311]

For example, when Ms. W taught students how to find the degree of a polynomial, she encouraged students by telling them, "All you need to know to do well today is count. If you can count, you can do it" [PW_113011]. Ms. W also frequently began class by telling students that they were "[previewing] what [they're] doing next week" [PW_110311] or "we're practicing for what's coming" [W_Int1_110311]. These practices served to make new material less intimidating and helped students feel more confident in their mathematics abilities.

Ms. W also focused on what students did well in a problem during remediation sessions before correcting them as a way of building their self-confidence for mathematics. She told students, "You're on the right track" [PW_110111] in addition to helping them understand what they did wrong. Furthermore, Ms. W let students know that it was okay for them to make mistakes. During one observation, after the solution to a problem was put on the board, one student indicated, "I totally didn't get that." Ms. W responded, "That's okay if you didn't get that." [PW_112811]. Moreover, Ms. W tried to support students to build confidence by asking them to try in non-threatening situations:

> One little thing is like I've said before in that class, "Some of you don't talk and that's fine that you don't but maybe one time when you think you know

> the answer just kind of very low under your breath just say it and see if you got it right. Nobody can hear you, just say it real quiet and see." [W_Int2_111711]

Ms. W also scaffolded instruction to build students' sense of confidence over time, particularly focusing on assessments, and stated, "[I try] to give them all a sense of confidence in like, 'Okay, I can do this,' now let's build…and scaffold it really so they get to the point where they're not intimidated by a test" [W_Int1_110311].

Ms. W stated that supporting students to build their sense of self-confidence was particularly important when working with students who traditionally did not perform well in mathematics. During her daily consults, she told students,

> "Oh my gosh you're so close!" … I'm trying to build confidence in them.… I don't want him to look at a page and see "Okay for nine days in a row on a quiz I made a zero, a zero, a zero." [W_Int2_111711]

By focusing on positives rather than students' grades, Ms. W's conveyed to her students that they were capable, thus supporting their self-confidence to succeed in mathematics.

Prepares students for the EOC exam

The way Ms. W taught was not determined solely by the EOC exam, but the exam did play a role in influencing her instructional practices. For instance, Ms. W taught test-taking strategies. As an example, she asked students to consider the reasonableness of their answers by asking, "Does our answer make sense? … That's the good thing about story problems. You can think if the answer is reasonable" [PW_111411]. At other times, Ms. W focused on eliminating incorrect answers when possible:

> [*The question required students to solve and graph* $n-2\frac{1}{2}>\frac{1}{3}$. *Each of the four multiple-choice options had a graph with an endpoint at* $2\frac{5}{6}$ *and various combinations of open and closed*

circles and arrows shaded in different directions. Ms. W said that the answer must have something to do with $2\frac{5}{6}$*, since that's really their only numerical option.*]

Ms. W: We don't need to even really solve this problem, or know what to do with the fraction (though we could turn it into decimal) because we can eliminate answers. [*They eliminated the graphs with closed circles, then they eliminated the ones that are 'less than' shaded (i.e., shaded to the left). This left one option that they selected as the answer.*] ... We just eliminated the wrong answers. [PW_110811]

Another way Ms. W sought to prepare students to take the EOC was by giving students regular practice with word problems in order to support them to become comfortable and confident in their ability to pass the exam:

> I say, "Here's how you'll see this question." … I just want them to be aware that this is a big deal.… I also don't want them to be nervous. So the more that I talk about it and the more I show them like "Here's some things you may see, here's some ways that." … That kind of lets them into the test without being like "Oh crap I've got to pass this or I'll fail 9th grade." [W_Int3_120111]

Teaching test-taking strategies and providing EOC practice occurred with more frequency as the semester progressed. Ms. W explained that in the past she had students who did not try on the EOC exam and by addressing it frequently, she hoped to change that.

Uses multiple assessments

Ms. W used several types of assessments to reinforce student learning. First, she gave a daily exit quiz and explained that the purpose was to determine whether or not students understood the material:

> [It] gives me a sense of, "Were they paying attention in class?" and it's worth such a tiny, little amount of point that I hope … they're going to be taking chances there and then ... we remediate the next day. [W_Int2_111711]

Homework also helped her to determine, “Do they have a clue of what they’re doing?” [W_Int2_111711]. She also used the clicker systems for instant feedback and administered traditional assessments such as tests and quizzes. The exit quizzes, homework, and clickers served as formative assessments, as Ms. W used them to make decisions instantly about how to proceed with instruction and remediation. Ms. W occasionally allowed students to use notes on tests.

Finally, Ms. W stated,

> I really want them to get to the point where they’re dealing with a concept as a class and it’s not like teacher-student [all the time]…. Like today in class [Reagan said], “It’s a two”… and the other students are like, “Wait, wait, wait, wait,” and they like want to stop him and fix him…. That shows me more assessment than anything else. If they can catch a mistake … or support a student who’s doing something right and say, “Yeah, I agree with that.” … Even if they’re wrong if they feel like you know, “I can talk about this” then that’s a good sign, too. [W_Int2_111711]

Thus, in Ms. W’s classroom, the interactions between students during discussions were her greatest form of formative assessment.

Summary of Ms. W’s Pedagogy

A day in Ms. W’s Algebra I course began in the computer lab. Students worked on a self-paced computer program while Ms. W reminded students repeatedly to turn in missing work and met with students for remediation. Half way through the period, the students and teacher moved to a standard classroom. Ms. W began by informally introducing a topic and activating students’ prior knowledge about a topic by asking them to define vocabulary or solve a problem. Next, Ms. W reviewed students’ solution strategies to the problem, then posed another problem and supported students to transfer their strategy to that new problem type. Later, Ms. W assigned practice problems, and students completed these problems either in their teams or individually.

Individual solutions were often submitted via a clicker system, which allowed the class to discuss the solution and incorrect answers. Finally, Ms. W assigned students word problems as EOC exam practice and completed the lesson with a one-question exit quiz. Throughout the lesson, Ms. W often gave students choices about which problems to solve and which strategies to use. She focused on building students' knowledge and their self-efficacy for mathematics, as well as understanding the reasoning behind rules and procedures. She also frequently utilized the practice of teaming and encouraged class discussions.

Influences on Teaching

The ways in which Ms. W taught were driven by several factors. First was the issue of time, which Ms. W struggled to use efficiently:

> There's like so much more in teaching than just getting to be in your class and teach, you know? And given unlimited time, I feel like I could accomplish whatever I wanted to, but you know [I'm] trying to be efficient and trying to get the things done that need to happen. [W_Int2_111711]

She did, however, have an extended class period with her students each day, as well as student aides who helped her with time-consuming tasks such as grading, which afforded her the opportunity to meet one-on-one with students. In particular, the student aides checked homework and returned it immediately so students could discuss the assignment that same day. Ms. W explained her struggles about whether it was appropriate to use student aides to assist with grading:

> [I really don't like] having student aides check homework … but for me to be able to remediate [and do consult with] the kids who need it … that time has to come from somewhere and so what I try to do is you know provide that discussion time in the class and then let them ask me questions, so even if I didn't see [what mistakes students made on their homework] they at least can talk to each other about that. That's a struggle for me is just to find the best use of teaching time … I could take all those papers home and grade

> them but then I think with homework kids need that [immediate] feedback. [W_Int2_111711]

Ms. W also explained she tried to balance the time she put into teaching with taking personal time for herself. Asking aides to help her with some of her more time-consuming tasks allowed her to better balance that time and focus her energy on being the best teacher she could be:

> I have a lot of external things that pull me away from teaching that I enjoy ... and that's sometimes a struggle with me.... But the flip side of that is ... I've done where I've run myself into the ground ... and that does not make for an effective teacher either because then you come in the next day dead and you can't do this job dead. So I feel like it's a good thing ... when I can have other people have the opportunity to do [grading] and it's not in a way that's detrimental to like my success with the students, then I'm willing to give that up for being fresh, being energized, having the ideas that I need to be successful at teaching. [W_Int3_120111]

Additionally, Ms. W struggled with how much time to spend on class discussions. She felt compelled to curtail conversations for the sake of time even though she believed students learned a great deal from the conversations:

> I have to be very aware of ... how far we can go down a road of thought, because I want them to be able to flesh it out themselves and be able to generate a concept but then I don't want to do that at the sacrifice of "we're not getting to the material we need to get to." So I'll really want to promote that thought but then at some point in time I feel like I have to call this and say, "No, that's wrong. Here's what's right and let's move forward with that." And I always feel this little pang of, "Ah, I wish we had time to talk about it because it's so great and they really remember it." [W_Int2_111711]

Related to the issue of time management was the pacing calendar distributed to teachers by the district. Ms. W did not feel confined by the pacing calendar. In fact, she stated in an interview that she purposefully veered off the pacing calendar to present topics in a sequence that would better facilitate understanding of the meaning behind rules.

Finally, as described earlier, the requirement that students pass the EOC exam influenced the way in which Ms. W taught. Specifically, she referenced the EOC much more frequently than she did in the past when students were expected to take the state standardized achievement test:

> When we were doing FCAT ... I would say you know, “Oh by the way,” you know the two weeks before, “let’s do some FCAT practice problems” and it seemed like such a separate thing. Now I feel like [the EOC is] more ingrained in the daily instruction and how what we’re doing now is related to how you’ll be tested. [W_Int3_120111]

Also, the EOC exam caused Ms. W to alter some of her instruction during the course of this study. She indicated during the study that the school had achieved a 47% passing rate on the Algebra I EOC exam. This was concerning to the mathematics department, so all the Algebra I teachers changed their teaching strategies in an effort to improve that score for the current school year. Specifically, that was when Ms. W began administering a daily exit quiz and using that quiz as the basis of the small group remediation.

Summary of Case Two

Ms. W held several goals for her students: to build mathematical knowledge, to become problem solvers, and to feel cared for. These goals directly influenced how Ms. W approached teaching as it related to the psychological environment and mathematics instruction.

Ms. W strove to create an atmosphere in the classroom where students felt comfortable, supported, and cared for. She held high expectations for students and scaffolded them to reach those expectations. She also frequently used humor and sarcasm when communicating with students and believed honesty and respect were important virtues for her to convey to them. Furthermore, Ms. W remained calm when disruptions occurred and conveyed to students that it was their behavior, not the students themselves that she disapproved of. In this way, classroom management was grounded in the caring relationships Ms. W had with students.

Ms. W's mathematics instruction was characterized by an emphasis on understanding rules, teamwork, multiple solution strategies, and learning test-taking strategies for the EOC exam. She sought to support students to build confidence in their mathematical abilities, as well as to attribute success in mathematics to the amount of effort one put in. Ms. W met regularly with students to remediate them and gave them multiple opportunities to submit work.

CHAPTER 6
CROSS-CASE ANALYSIS

Introduction

The findings presented in Chapter 4 (Ms. J) and Chapter 5 (Ms. W) provide a detailed picture of the way two teachers identified as highly effective supported their students of color to learn mathematics. The focus was to examine the perspectives and practices of these teachers pertaining to how they engaged their students with mathematics content. This chapter integrates the findings from the case studies. The cross-case analysis was conducted using the lens of the two pedagogical approaches described in the literature review (Chapter 2), culturally responsive teaching and standards-based mathematics instruction. The findings will be described in terms of these two pedagogical approaches.

Culturally Responsive Teaching

The description of CRT included in Chapter 2 (Literature Review) contained eight themes:

- Teachers' goals for students;
- Teachers' expectations for students;
- Teacher-student relationships;
- Students' knowledge and experiences;
- Supporting students to develop a critical disposition;
- Classroom environment;
- Culturally responsive classroom management; and
- Instruction.

One theme, supporting students to develop a critical disposition, will not be addressed in this chapter because neither teacher demonstrated evidence of this behavior. The other themes have been clustered into four sections to reduce overlap and facilitate cross-case analysis. The four clusters are: a) goals for students; b) relationships (encompasses teacher-student relationships and classroom environment); c) insistence (encompasses teacher's expectations for students and culturally responsive classroom management); and d) pedagogy (encompasses students' knowledge and experiences and instruction). These four clusters form a framework for CRT. Using this framework, the observed teaching practices of Ms. J and Ms. W were compared.

Goals for Students

In her study of effective teachers, Ladson-Billings (1995b) outlined three goals of culturally responsive teachers: (a) to ensure the academic success of all their students; (b) to build students' cultural competence, or acceptance and affirmation of their culture; and (c) to develop students' sense of critical consciousness, or ability to understand, analyze, and critique the existing social order. These teachers also seek to support students to become confident, courageous, and have a sense of personal and social agency (Bonner, 2011; Gay, 2000; Gutstein et al., 1997)

There were similarities and differences in the goals Ms. J and Ms. W held for their students. Both indicated it was important for students to learn the mathematics being taught and to perform well on their end-of-year standardized tests (FCAT or EOC). Additionally, both believed students should to be able to apply the mathematics they learned in out-of-school contexts, and Ms W further indicated her students needed to become problem solvers who could reason, think logically, and solve unfamiliar problems. Additionally, Ms. J held a goal that her students learn to like mathematics. These goals for students align with the first goal of culturally responsive teachers: to ensure the academic success of all their students (Ladson-Billings, 1995b).

Ms. W also held a goal that her students felt cared for at school. This goal was a driving force behind many of her actions as a teacher, and was enacted in terms of her priority of building relationships with her students. Ms. J cared for her students and, like Ms. W, viewed caring relationships as necessary to her success as a teacher. By supporting students to feel cared for, both Ms. J and Ms. W demonstrated an acceptance of and appreciation for students' cultures. Additionally, Ms. W used instructional practices that she believed aligned with students' cultures, valued each student's contributions to the class, and did not reprimand students for speaking Black English Vernacular. Ms. W's practices helped students build their sense of cultural competence, which aligns with Ladson-Billings' (1995b) second goal of culturally responsive teachers.

Ms. J held two other goals for students. First, she stated it was important for her students to care about school, believing that if they cared more they would be more successful. Second, Ms. J sought to enable students to learn social skills. Some teachers believe social skills are necessary for the future success of students (Gay, 2000), but Ms. J did not express it this way. She simply suggested that everyone should learn manners and morals, and she took it upon herself to teach these to her students. Ms. W also modeled the use of manners for her students, but the reasons behind this were different. For Ms. W, teaching students manners was not a goal in the same way that it was for Ms. J, but rather was one way she demonstrated respect and supported her students to feel cared for. These actions are not necessarily contradictory to the goals of culturally responsive teachers outlined by Ladson-Billings (1995b) but they are not necessarily characteristic of CRT.

Furthermore, Ms. W supported her students in developing their sense of self-confidence in mathematics in service of the first goal of mathematics achievement. In this way, she was supporting students to feel empowered to achieve, which is consistent with culturally responsive teaching (Bonner, 2011; Gay, 2000). She did this by casually introducing topics so as to not intimidate students, telling them they were capable, and focusing on what they did well during remediation.

Relationships

Culturally responsive teachers, and warm demanders specifically, have caring and personal relationships with their students (Bondy & Ross, 2008; Dixson, 2003; Ladson-Billings, 1995b; Ware, 2006) and consciously demonstrate care for students (Gay, 2000; Garza, 2009; Ladson-Billings, 1995b). Ms. J frequently expressed to her students how much she cared about them, Ms. W made building relationships a priority in her classroom, and students in both classrooms returned the caring feelings toward their teachers. In fact, Ms. W's relationships with her students were so strong that former students visited her daily. Both teachers built their relationships by getting to know students on a personal level, learning about their interests outside the classroom, treating students with respect, attending students' extracurricular events, and asking questions to show students they remembered something about them; this is consistent with how culturally responsive teachers build relationships (Bondy & Ross, 2008; Delpit, 2006; Garza, 2009; Gutstein et al., 1997; Ladson-Billings, 1995a; Peterek, 2009; Nelson-Barber & Estrin, 1995; Ware, 2006).

Culturally responsive teachers, and particularly warm demanders, may be described by outsiders as tough, harsh, strict, or mean, but students do not interpret this as a lack of caring (Bondy & Ross, 2008; Delpit, 1995; Ladson-Billings, 1997; Peterek, 2009; Ross et al., 2008; Ware, 2006). Both Ms. J and Ms. W used the term "mean" to describe themselves but suggested their "meanness" was a necessary part of their insistence that students met their behavioral and academic expectations. Furthermore, students' actions in both classrooms such as fighting over who got to hug Ms. W first or making Ms. J a "get well" card suggested they liked their teachers and perceived the care their teachers displayed.

At times, the caring relationship between teacher and student may mirror that of parent and child, and there are several studies (e.g., Bonner, 2011; Ladson-Billings, 1994; Ware, 2006) that provide examples of culturally responsive teachers who act as students' extended families. Ms. W adopted a mothering stance toward her students, evident particularly in her physical affection toward them. She did not seek to replace students' families by adopting this stance. Instead, she stated that when students viewed her in a mothering role, she knew her connection with them was strong. Conversely, Ms. J strove to be a role model for her students because she believed students had insufficient support from home. She conducted home visits like many teachers who adopt a CRP approach (Ladson-Billings, 1994; Sheets, 1995), but she also believed her students of color living in poverty did not have someone at home who held high expectations for them or who cared about their education. These beliefs are what Gutstein and colleagues (1997) referred to as the "messiah complex" (p. 728) and are characteristic of holding a deficit perspective of students, which is inconsistent with a culturally responsive approach.

The environment in a culturally responsive classroom also promotes relationships. The classroom serves as a safe learning environment (Gay, 2002), interdependence and group effort are valued over independence and individual effort (Gay, 2000; Sheets, 1995), and students are encouraged to accept responsibility for the success of their classmates (Gay, 2000, 2002; Ladson-Billings, 1995b). Ms. W's classroom embodied these characteristics. In particular, she worked hard to create an environment where students felt cared for and safe. She also required students to work in groups and complete joint assignments, thus holding students accountable for each other's success. At times, students also encouraged each other without prompting from Ms. W, and the community of care and respect in her classroom was shared among the students.

Ms. J and Ms. W both stated that relationships with their students were an essential aspect of their teaching, and they would not have been as successful as they were had it not been for those relationships. For example, similar to the teachers in Ware's (2006) study, Ms. J and Ms. W grew to know students well and thus were able to use what they knew to motivate them. In particular, Ms. J incorporated students' names and interests into the problems she assigned as a means of engaging them with the problem, and Ms. W made a point to connect with students through praise, joking, teasing, or sarcasm in order to encourage them to put forth effort.

Ms. W and Ms. J also drew on their relationships with students to facilitate classroom management. For instance, Ms. J communicated her disappointment when students did not behave appropriately and drew on those relationships to stress students' abilities. Similarly, Ms. W's relationships with her students allowed her to use humor and sarcasm and to better understand the reasons behind the ways in which students behaved. Ross and colleagues (2008) stated that warm demanders ground classroom management in their relationships with students, and Dixson (2003) suggested that the warm demander's discipline approach is effective because students trust the teacher and feel cared for.

Insistence

Culturally responsive teachers insist upon the achievement and appropriate behavior of their students. Specifically, warm demanders hold a pervasive belief in their students' strengths and abilities (Ross et al., 2008), believing all students can learn regardless of previous behavior or grades (Gay, 2000; Ware, 2006), and they challenge their students (Delpit, 2006; Ladson-Billings, 1997; Sheets, 1995; Ware, 2006). These teachers communicated high expectations for both achievement and behavior and they stressed the importance of perseverance and persistence (Bondy & Ross, 2008). Thus their pedagogy was consistent with that of warm demanders, who are explicit about their expectations, use varied strategies during instruction about expectations to keep students engaged, provide examples and nonexamples of appropriate behaviors, and require students to practice the actions through which they will meet their teacher's expectations (Ross et al., 2008).

Warm demanding and high expectations enable teachers to insist, firmly, respectfully, and in a calm, warm tone that students achieve (Bondy & Ross, 2008; Irvine, 2003; Ross et al., 2008). Teachers who adopt a warm demander stance also assume the responsibility for making sure students learn (Ware, 2006) and never give up on their students (Ross et al., 2008; Wilson & Corbett, 2001). This was not characteristic of Ms. J's stance. She reminded students to complete assignments but did not accept late work after the first semester and told students it was their responsibility to learn. In doing this, Ms. J was holding students to high standards, but she failed to scaffold the students to success. For instance, after providing instruction on a topic, she did not repeat herself or support students in learning how to work through a difficulty. Instead, she conveyed the content and then told students who were still struggling to “figure it out”. This is inconsistent with the actions of culturally responsive teachers, who do “whatever it takes” to ensure students master the material (Ross et al., 2008; Wilson & Corbett, 2001). By taking these actions, Ms. J seemed to communicate to students that once she fulfilled what she believed to be her duties as a teacher, she was no longer responsible and it was up to her students to succeed without her help.

Ms. J at times also blamed students for their lack of success, stating that students failed because they didn't care about school. She additionally blamed students’ families and difficult home situations. Culturally responsive teachers do not blame students or their families for their lack of success but instead work to overcome any identified barriers and create the environment necessary to support students in meeting the high academic and behavioral expectations they hold (Bondy & Ross, 2008; Ross et al., 2008; Ware, 2006). Despite this blame, Ms. J maintained that she challenged students academically by assigning difficult word problems. Her instructional approach, however, suggested she did not believe that students could solve problems without her first showing them how, which calls into question whether she in fact held high expectations for her students. Ms. J also stated that she adopted a “no excuses” attitude with her students. To her, no excuses meant that she did not tolerate excuses for not completing assignments and students deserved a zero if the assignment was not turned in. Ms. J suggested that by failing students, she was holding them to high expectations, but she did not take time to understand the reasons why students were not understanding the content or completing assignments. This is inconsistent with the approach adopted by culturally relevant teachers, for whom “no excuses” means there are no acceptable reasons for students to not learn (Gay, 2000, 2002; Ladson-Billings, 1994, 1995b; Ware, 2006; Wilson & Corbett, 2001), and they dedicate themselves to removing any barriers to learning in order to ensure students’ success (Ware, 2006). By blaming students and their families and not supporting students to overcome the barriers to their success, Ms. J did not, from a CRT perspective, have high expectations for her students.

Ms. W, on the other hand, adopted a stance of high expectations for academics and no excuses that was consistent with CRT. Each time students reached an expectation she held for them she raised that expectation higher. She addressed lack of success by identifying barriers to students’ success and working with them to eliminate those barriers. Ms. W viewed students’ struggles in mathematics as societal issues, suggesting that society at large expected these students to fail and that their previous teachers held low expectations for them. She also stated that traditional mathematics instruction, during which students are typically lectured to and which does not allow them opportunities to work with their peers, conflicted with how students of color learn. To overcome some of these barriers, Ms. W met with struggling students regularly for remediation rather than leaving them to figure out how to succeed on their own and did not seat students in rows or teach through a direct instruction model, instead allowing students to work in teams – a practice also consistent with standards-based instruction. Ms. W also created a safe and comforting space in her classroom as a way of addressing the instability some students faced at home. Furthermore, she pushed students to reach their full potential to combat the low expectations she believed their previous teachers might have held for them. She did not tolerate excuses, constantly reminded students to turn in missing work, and provided multiple opportunities for students to demonstrate their knowledge and become successful. Culturally responsive teachers will nag, pester, and bribe their students to work hard (Ladson-Billings, 1995b). This does more than just support students to meet high expectations. By fussing at students and taking an authoritative stance, these teachers are communicating that they believe in their students and expect more from them (Dixson, 2003), thereby strengthening the relationships that are so characteristic of warm demander pedagogy and CRT in general.

In terms of behavior, both teachers' expectations were that students would behave appropriately in her class. Ms. J noted differences in the behavior between students of color and their white, middle class peers, and she did not blame students of color when they did not engage in appropriate behaviors. Instead, similar to warm demanders (Ross et al., 2008), Ms. J explicitly taught students how to reach her expectations for behavior by providing reminders, pointing out positive behaviors, and modeling for students what she wanted them to do. Ms. W engaged in these actions as well. She also remained calm and rational during disruptions and did not interrupt instruction to address discipline. These actions are consistent with the ways in which warm demanders encourage students to meet their behavioral expectations (Bondy & Ross, 2008; Ross et al., 2008; Ware, 2006).

In addition to high expectations, warm demanders are characterized by an insistence on respect (Ross et al., 2008). For the warm demander, respect is nonnegotiable. Students are expected to demonstrate respect for the teacher and their classmates, and the teacher shows respect for students (Bondy & Ross, 2008; Ross et al., 2008; Ware, 2006). An insistence on respect was a defining characteristic of the psychological environment in both of the participating teachers' classrooms. Ms. J and Ms. W modeled respect for their students. Furthermore, Ms. W was deliberately honest with her students as a way of building respect, and Ms. J took time to explicitly instruct her students on how to be respectful. Both teachers also modeled and encouraged the use of manners as a means of demonstrating respect.

Pedagogy

Each teacher's pedagogy as it relates to standards-based mathematics teaching will be described in detail in a later section. There are, however, some characteristics of pedagogy common to all culturally responsive teachers regardless of content. The ways in which Ms. J's and Ms. W's teaching aligned with those characteristics are the topic of this section.

Culturally responsive teachers emphasize conceptual understanding (Tate, 1995) and strive to support students in learning to think critically and creatively, problem solve, analyze, make connections between concepts, and engage in discourse (Haberman, 1991; Ladson-Billings, 1997; Sheets, 1995). Teachers use multiple instructional strategies including discussion, peer teaching, problem solving, and grouping (Delpit, 2006; Gay, 2002; Haberman, 1991; Ladson-Billings, 1995b; Sheets, 1995; Wlodkowski & Ginsberg, 1995) and they incorporate technology into instruction (Haberman, 1991). These teachers also use students' knowledge and experiences as a foundation upon which to build learning experiences (Delpit, 2006; Gay, 2000; Gutstein et al., 1997;

Ladson-Billings, 1997; Wlodkowski & Ginsberg, 1995) and provide students the opportunity to construct their own knowledge (Gutstein et al., 1997).

Many of the pedagogical practices of culturally responsive teachers are consistent with Ms. W's practices. She valued understanding over memorization of rules and procedures, engaged students in cooperative learning activities and classroom discourse, and used the clicker system on a regular basis for formative assessments. She began lessons by activating students' prior knowledge about a topic and built upon what they knew, thereby supporting students to construct their own knowledge.

Ms. W additionally recognized the different learning needs of her black students and implemented practices such as grouping in order to meet those learning needs. This is another practice consistent with CRT (Delpit, 2006; Gay, 2000, 2002). Ms. J, on the other hand, did not believe students of color had different learning needs than white, middle class students. She utilized the same instructional practices with both groups, though she acknowledged that the white students responded more quickly and more willingly to her instruction.

Culturally responsive teachers teach more than just content to students; they provide opportunities for students to acquire the cultural capital (e.g., ways of interacting, test-taking strategies, note-taking skills, standard English) necessary for school success (Gay, 2000; Ladson-Billings, 1995a). Ms. J and Ms. W both modeled the use of manners for students, and Ms. J made an explicit effort to teach students the manners and other life skills she believed were important. Furthermore, Ms. W addressed test-taking strategies and note-taking skills on a daily basis, and taught students to speak Standard English without demeaning their use of Black English Vernacular.

Providing students with multiple opportunities to practice, demonstrate knowledge, and revise and resubmit work, as well as the use of varied and formative assessments are other practices common to culturally responsive teachers (Gay, 2000; Haberman, 1991; Wlodkowski & Ginsberg, 1995). Ms. W and Ms. J both provided students the opportunity to submit late work (though Ms. J ended this practice after the first semester), and Ms. J encouraged students to revise incorrect answers on assessments so that they could recover points lost. They also both used a variety of assessment techniques, including traditional tests, quizzes, and homework. In addition, Ms. J employed the use of personal white boards, and Ms. W frequently used the clicker system, daily exit quizzes, and class discussions as sources of data on student understanding.

Another characteristic of culturally responsive classrooms is that the teacher does not act as the ultimate holder of knowledge and power; students and teachers share these roles and students act as arbitrators of knowledge (Bonner, 2011; Gutstein et al, 1997; Ladson-Billings, 1995a; Wlodkowski & Ginsberg, 1995). Ms. J believed it was her role to show and tell students how to solve problems and never assigned a problem for which she had not provided procedures. Ms. J thus was the authority of knowledge in the classroom. In contrast, Ms. W often asked students to provide suggestions for which strategies to use, and she built on these suggestions rather than telling students how to solve problems.

Finally, culturally responsive teachers utilize students' cultures as part of their instruction. They invest time to learn about their students' culture and use what they learn as resources for teaching and content (Gay, 2000, 2002; Ladson-Billings, 1995b, 1997; Tate, 1995). Similarly, these teachers emphasize multicultural content (Gay, 2000, 2002) and address relevant world issues that students care about and that reflect students' cultures (Haberman, 1991). Neither Ms. J nor Ms. W engaged in these actions. Ms. J did alter word problems to include topics of interest to students (e.g., their names, the school mascot, locations they were familiar with). These changes, however, were superficial and did not address critical issues of interest to students and their families.

Summary

Neither teacher's practices and perspectives aligned entirely with CRT. Ms. J made the learning of mathematics her main priority, had caring relationships with students, insisted on respect in the classroom, and held high expectations for behavior. She also provided students with multiple opportunities to demonstrate success. These practices are aligned with CRT, but this pedagogical stance as a whole, however, was not characteristic of Ms. J's instruction. She tended to blame students and their families for lack of achievement, did not support students to overcome the barriers to success that students of color living in poverty face, often did not always provide students support in working through difficulties, and acted as the authority on knowledge in the classroom.

Ms. W's instruction as a whole was not entirely characteristic of CRT. She did support students to acquire the cultural capital necessary for their future success, valued students' different ways of thinking and approaching problems, and altered her instruction to meet the needs of her black students. Like Ms. J, however, she did not incorporate students' cultures into her instruction or support students to develop a critical disposition. Even so, Ms. W was firm yet caring, built strong relationships with students, insisted that they meet her expectations, and worked to remove barriers to students' success. She treated each student with respect and demanded they do the same. She also provided students multiple opportunities to achieve success and did not give up when students struggled. Ms. W's practices and perspectives, then, were aligned with those of a warm demander even though the entirety of her instruction was not characteristic of CRT. In the next section, the perspectives and practices of each teacher as they relate to standards-based mathematics instruction will be described.

Standards-based Mathematics Instruction

The literature review described many aspects of standards-based instruction. These include attention to the process standards of problem solving, reasoning and proof, communication, connections, and representation (NCTM, 2000) and the Standards for Mathematical Practices (CCSSI, 2010) that align with the process standards (NCTM, 2010) and strands of mathematical proficiency (Kilpatrick et al., 2001). Discourse was also highlighted as an important aspect of reform. Using this description of standards-based in mathematics instruction, the observed teaching practices of Ms. J and Ms. W were compared. The results will be described in sections that communicate a) the sequence of learning activities, b) the focus of instruction, and c) discourse and norms.

Sequence of Learning Activities

The participating teachers adopted a dissimilar sequence of learning activities. Ms. J's teaching was characterized by "breaking down" the mathematics, and she taught through direct instruction. Lessons followed the “I do, We do, You do” format that Ms. J stated was required by her administrators. She began by stating a formula and explicitly outlining a step-by-step procedure for solving a particular type of problem, usually a word problem. Students were required to memorize the formula, and Ms. J taught them to look for key words that would help them determine which formula to apply. She then showed students how to apply the procedure in one or more example word problems, guided students through several examples, and assigned additional problems for students to solve individually.

Ms. W’s instruction was characterized by an emphasis on understanding rather than memorizing rules and procedures. She stated that her lessons followed the GRM format, but Ms. W implemented this format flexibly and varied many of her instructional practices daily. She always began lessons, however, by activating students’ prior knowledge about a topic and guiding them through solutions in a way that supported students to understand how to reason through unknown problems and apply familiar strategies in new situations. Ms. W provided guidance to students as they solved problems rather than explicitly showing or telling them how to proceed through the solution.

The GRM that Ms. W stated she followed to sequence learning activities is suggested by the State of Florida as a “best practice” and was required by her administrators. The GRM, widely used for reading and literacy instruction, is based on Pearson and Gallagher’s (1983) Gradual Release of Responsibility Model and stipulates that the teacher moves from assuming “all the responsibility for performing a task…to a situation in which the students assume all of the responsibility” (Duke & Pearson, 2002,

p. 211) through a gradual fading of support. The FDOE (*n.d.*) described the GRM as having four steps: (a) explicit instruction, (b) modeled instruction, (c) guided practice, and (d) independent practice. Explicit and modeled instruction were described as the "I do" phase of the lesson, in which the teacher explicitly tells and then shows students step-by-step how to use the strategies and concepts being taught. Guided practice is described as the "We do" phase during which students work on problems under the teacher's direct supervision and then receive feedback. Finally, independent practice requires students to complete a task without the teacher's guidance and is referred to by the FDOE as the "You do" phase. Based on this description and the fact that the county in which both teachers taught adopted the GRM lesson sequence, Ms. J was also following the GRM format, though she referred to it as "I do, We do, You do". Ms. J thus used the GRM as a structure for modeling procedures in a manner consistent with traditional mathematics instruction (Hiebert et al., 2005; McKinney & Frazier, 2008). Ms. W's instruction, however, did not adhere to this description of the GRM. Specifically, she did not explicitly show and tell students what procedures to follow but rather modeled her thinking, encouraged students to suggest strategies, and guided them through problem solutions by using their input and building upon it. These practices are consistent with standards-based instruction as described by NCTM (2000).

Focus of Instruction

There were few similarities in the way the participating teachers approached the teaching of mathematics. In Ms. J's class, there was only one correct way to solve each problem and it almost always required starting with a formula. If students did not follow the procedure outlined by Ms. J then their solution was considered incorrect. Ms. W, on the other hand, valued students' different ways of thinking about a problem and allowed them to suggest multiple strategies and choose one of these strategies when solving problems. Her only requirement regarding multiple solution strategies was that students understood the strategy they employed. Most often, Ms. W wanted students to find the solution strategy that they understood best and to know when to apply it, even if that strategy took longer than applying a rule or algorithm. Inventing, applying, and adapting multiple solution strategies is an important part of problem solving and standards-based mathematics (NCTM, 2000).

The type of mathematics teaching in which Ms. J engaged is what Gersten and colleagues (2009) refer to as explicit instruction. Specifically, she routinely demonstrated problem-specific step-by-step procedures for students to solve problems and did not provide students with a heuristic for solving multiple types of problems. Additionally, she encouraged students to use the procedure she demonstrated rather than an invented strategy or one they learned elsewhere. Explicit instruction is common in classrooms that adopt a direct instruction approach. Furthermore, explicit and direct instruction are characteristic of traditional mathematics teaching, which is also typified by other instructional strategies employed by Ms. J, including infrequent opportunities for group work, conversation, or problem solving (McKinney & Frazier, 2008); emphasis on procedures; and an overall focus on lower-level mathematics skills rather than concepts (Hiebert et al., 2005).

The traditional mathematics instruction adopted by Ms. J adheres to what Haberman (1991) referred to as the “pedagogy of poverty” and is a common practice in schools with high numbers of students of color and who live in poverty (McKinney et al., 2009; McKinney & Frazier, 2008; Weiss, 1994). Teachers in these settings often lower their expectations for struggling students, simplify content, and emphasize procedures and skills rather than concepts (see Davis & Martin, 2008; NCTM, 1999; Watson, 2002; Webb & Romberg, 1994; Weiss, 1994). Ms. J explained that she strove to "break down" the mathematics for her students as a way to support them to learn, but Watson (2002) describes this as "dumbing down" the content and making it more procedural. This approach to mathematics teaching also undermined Ms. J's goal that her students learn to solve real world problems, which, by their very nature, are problems to which the solution method is not immediately evident.

Scholars argue that traditional instruction, or a pedagogy of poverty, does little to support the mathematical learning of students of color living in poverty. While traditional methods of teaching mathematics can result in procedural fluency (Boaler, 1998; Schoenfeld, 1988), this is only one aspect of mathematical proficiency. Conceptual understanding, strategic competence, adaptive reasoning, and a productive disposition are also strands of mathematical proficiency that mathematics educators should strive for (Kilpatrick et al., 2001). Traditional instruction, which by definition does not take into account all five strands of mathematical proficiency, does not support diverse learners (Boaler, 2002) because they are not pushed to develop their mathematical thinking (Watson, 2002) and thus struggle to transfer knowledge to new settings and display low levels of conceptual understanding (Boaler, 1998; Bottge & Hasselbring, 1993; Schoenfeld, 1988).

In contrast to Ms. J's pedagogy, Ms. W did not explicitly teach a procedure and require all students to follow that one procedure. Instead, Ms. W began lessons by activating students' prior knowledge and building upon what they knew, which aligns with standards-based instruction (NCTM, 2000). She did not believe memorizing rules or procedures was necessary for (or beneficial to) her students, and she spent much of her instructional time supporting students to understand mathematical concepts so that they could derive formulae. Ms. W stated repeatedly that sense-making was important to her and she sought to support students to reason and think mathematically. Being able to apply a strategy to unfamiliar problems and provide a rationale for their choices was an indication to Ms. W that her students had learned the content taught. Her instruction thus emphasized understanding rather than rules and procedures, which is consistent with standards-based instruction (Kazemi & Stipek, 2001; Kilpatrick et al., 2001; NCTM, 2000).

Discourse and Norms

The discourse and sociomathematical norms in the participating teachers' classrooms varied greatly. Ms. J rarely asked students why they chose to solve a problem in the way that they did but when she did ask, she accepted surface-level responses that were usually one or two words rather than responses that were focused on mathematical meaning. In fact, exchanges between teachers and students often followed the IRE questioning pattern (Herbel-Eisenmann & Breyfogle, 2005; Zevenbergen, 2000) that is common in traditional mathematics classrooms. The norms in Ms. J's classroom emphasized procedures and rules over meaning or understanding.

Explanations in Ms. W's class, on the other hand, focused on processes rather than just procedures, multiple strategies for solving problems were discussed, and students were supported to understand the relationships between those strategies. These norms were identified by Kazemi and Stipek (2001) as sociomathematical norms that promote conceptual understanding with ethnically diverse urban students in reform classrooms. Ms. W did not require multiple strategies, but she did allow for and value them. Students often suggested several ways to solve a problem, and Ms. W wrote these on the board. She then engaged the class in a discussion of the multiple solution strategies including when one strategy would be more appropriate than another. She also encouraged students to choose the strategy with which they were most comfortable as long as they could explain how and when to apply it. This explicit discourse about strategies is an key aspect of standards-based instruction (Lubienski, 2000a; Schoenfeld, 1987) and it allows students the opportunity to explain their thinking, make their methods explicit, learn from others, develop more efficient methods for solving problems (Hiebert, 2003; Schoenfeld, 1987) and understand how to interpret new problem-solving situations (Lesh & Zawojewski, 2007). Also, developing, discussing, explaining, and justifying solution strategies are important parts of solving problems (Lesh & Zawojewski, 2007; NCTM, 2000; Polya, 1985; Schoenfeld, 1987), and encouraging students to invent and adapt strategies may support the development of multiple representations (Bostic & Jacobbe, 2010).

Kazemi and Stipek (2001) also found that errors were a natural part of the learning process and provided opportunities to extend learning and understanding in these classrooms. Unlike Ms. J, who pointed out common errors to ensure students came up with the correct answer and ignored or dismissed students' incorrect answers, Ms. W took up incorrect answers and discussed them with students. She questioned students about why someone may have chosen that answer, thereby providing the opportunity for students to learn from their mistakes. A final norm identified by Kazemi and Stipek was that collaboration among peers was necessary, and groups were required to reach consensus about their solution through reasoning and argumentation. As described in the cases, students in both classes were grouped heterogeneously according to a Kagan strategy (see Kagan & Kagan, 2009). Ms. J's students did not actually engage in collaboration or mathematical discourses within their teams. Instead, students mainly turned to their team members to check the correctness of their answers. In Ms. W's class, students engaged in cooperative learning activities in their groups on a daily basis. They were given multiple opportunities to work and communicate with their peers, and groups often had to come to consensus about problem solutions before submitting their assignment. Studies have shown that students who work with their peers on problems tend to perform better (Charles & Lester, 1984; Dees, 1991; Ginsburg-Block & Fantuzzo, 1998).

Discussion

Ms. J's and Ms. W's instruction differed on many aspects. This may be due to the different ways in which each teacher viewed mathematics and mathematics teaching, which were evident not only in the way they spoke during interviews but the ways in which they taught. For example, Ms. J displayed what Boaler (1998) referred to as a rule following behavior, believing mathematics to be only about rules, formulae, and equations that lead to correct answers, and she stated that mathematics teaching is about explaining to students how to solve unfamiliar problems. Thus, Ms. J believed her role was to show them how to solve problems when they did not know how. This view of the teacher as the holder of knowledge, which emphasizes teacher demonstration of procedures and correct answers, is characteristic of a traditional view of teaching. Ms. J's instruction, then, was not characteristic of standards-based mathematics teaching but adhered to a pedagogy of poverty. In contrast, Ms. W viewed mathematics as a creative process and suggested that mathematics teaching was about sense-making and helping students to understand the content. Her instruction thus highlighted the importance of understanding the meaning behind rules and procedures, allowed for multiple solution strategies, and stressed communication with peers. Norms regarding how to communicate about mathematics were established in Ms. W's classroom that guided the way students explained their thinking, made their methods explicit, and allowed students to develop more efficient methods for solving problems. Furthermore, errors were a natural part of the learning process, instruction of new material built on the knowledge students held, and students worked cooperatively in heterogeneous groups on a daily basis. Given these characteristics, Ms. W's instruction was aligned with standards-based mathematics teaching.

With its emphasis on teacher demonstration and modeling of procedures, the GRM is not well aligned with reform mathematics teaching and is more aligned with direct instruction – and a pedagogy of poverty. One might argue that Ms. J adopted a pedagogy of poverty because of the requirement that she structure lessons around the GRM, but Ms. W was also required to utilize the GRM and she did not adopt such a pedagogy. Instead, Ms. W found the GRM flexible and adapted it suit her needs. For example, she required students to conduct the practice required by the GRM in groups, and she modeled thinking rather than modeled the correct application of procedures. The GRM does not then explain the differences in instruction between the two teachers.

Summary

Ms. J and Ms. W both had strong relationships with their students and elements of Ms. W's instruction were aligned with CRT. Their perspectives and the practices they employed to support students of color to engage with mathematics differed greatly. Ms.

J, who had a high course failure rate, adhered to a pedagogy of poverty inconsistent with reform mathematics teaching, and students were taught little more than procedural skills. Data on Ms. J's students' FCAT/AYP scores were only available for her first year of teaching, and given her high failure rate coupled with the literature that describes the negative effects of traditional mathematics instruction (Davis & Martin, 2008; Watson, 2002; Webb & Romberg, 1994; Weiss, 1994), it is unclear whether Ms. J was consistently effective, if her first-year scores occurred by chance, or if the pedagogy of poverty aligned well with the assessment. Even so, Ms. J was identified by the secondary mathematics curriculum specialist as a highly effective teacher and was well liked and respected by students, other teachers, and her administrators.

Conversely, Ms. W can be characterized as a warm demander because of her caring relationship with students and insistence on respect and achievement. The warm demander stance can support the academic engagement and achievement of students of color living in poverty (Bondy & Ross, 2008; Ware, 2006). Additionally, Ms. W taught in a way that was more closely aligned with standards-based instruction. Data on her test scores were also not available, but again, she was identified for the study as a highly effective teacher. Ms. W also worked closely with mathematics teacher educators at State University and regularly hosted college interns, suggesting she was respected in the educational community for her instructional practices.

CHAPTER 7
CONCLUSIONS

The purpose of this dissertation was to understand how teachers who are successful with low-achieving students of color living in poverty supported their students in learning mathematics. Students of color and students who live in poverty have struggled with academics and tend to perform poorly in mathematics, especially when compared to their white, middle class peers (Dewan, 2010; Post et al., 2008; Rothstein, 2002; Tutwiler, 2007). Prior research indicates mathematics instruction for high poverty students of color typically focuses on skills and procedures rather than concepts (Davis & Martin, 2008; McKinney et al., 2009; McKinney & Frazier, 2008; NCTM, 1999; Webb & Romberg, 1994; Watson, 2002; Weiss, 1994). Standards-based instruction has been suggested as one solution to the struggles these students face in mathematics. This type of instruction is characterized by a focus on processes such as problem solving, reasoning and proof, communication, connections, and representations (NCTM, 2000). Additionally, standards-based instruction requires students to engage in the mathematical practices outlined by the CCSSI (2010), which include practices such as learning to reason abstractly, model with mathematics, make sense of problems, and persevere in solving problems. To achieve the goals of the NCTM (2000) and CCSSI, teachers need to consider a way of teaching that differs from the traditional direct instruction model (Kepner, 2011), and research indicates that standards-based instruction may be beneficial to students (Boaler, 1998, 2002; Kilpatrick et al., 2003; Lesh & Zawojewski, 2007; Post et al., 2008; Schoenfeld, 2002; Silver et al., 1995; Van Haneghan et al., 2004). Other researchers (Gee, 2008; Lubienski 2000a, 2000b, 2002; Zevenbergen, 2000) point out, however, that students of color or who live in poverty may struggle with standards-based instruction if teachers do not provide the appropriate supports to bridge students' vernacular cultures with school culture.

Culturally responsive teaching is a pedagogy adopted by effective teachers of students of color living in poverty and is characterized, in part, by attention to students' cultures. CRT may support students of color to achieve academically (Banks et al., 2005; Bonner, 2011; Gay, 2000, 2002; Gutstein et al., 1997; Ladson-Billings, 1994, 1995a, 1995b, 1997; Peterek, 2009; Tate, 1995). Gutstein and colleagues (1997) examined the role of standards-based instruction and CRT in middle school classrooms, but more research focusing on both these approaches to mathematics teaching is needed. This study extends prior research by explicitly examining both standards-based and CRT practices within mathematics classrooms and how (or whether) teachers draw on these two pedagogies to influence students' mathematics achievement.

This study sought to understand how highly effective teachers of students of color living in poverty helped their students to engage with mathematical content. Specifically, I examined the perspectives and practices of these teachers. There were two participants, Ms. J and Ms. W. Ms. J is alternatively certified and taught seventh grade mathematics, and Ms. W, who is traditionally certified and holds a master's degree in mathematics education, taught high school Algebra I. Both teachers' backgrounds were different from those of their students. Data were collected through classroom observations and interviews and were analyzed using qualitative methods.

Both Ms. J and Ms. W had caring relationships with their students. They believed these relationships were essential for their success as teachers. Furthermore, Ms. W acted as a warm demander (Bondy & Ross, 2008; Dixson, 2003; Kleinfeld, 1975; Ross et al., 2008; Wilson & Corbett, 2001) because she insisted that students act respectfully and meet her high expectations for academics and behavior. She additionally supported them to overcome barriers to their success in a demanding yet caring manner. Ms. J also insisted upon respect and held high expectations for behavior but, unlike Ms. W, sometimes blamed students and their families for lack of achievement and did not understand the societal barriers to students' success.

While both teachers utilized the GRM required by the county in which they taught to structure their lessons, their mathematics instruction differed greatly. Ms. J believed she needed to show students how to solve problems and thus "broke down" the mathematics into easily followed procedures. She required students to follow the procedures she outlined and emphasized correct answers and key words. She played nonmathematical games to engage students and strove to make problems interesting and relatable by changing the context of word problems to include students' names and interests. Ms. J's emphasis on procedures, formulae, and explicit demonstration followed by drill and practice characterized her instruction as a pedagogy of poverty (Haberman, 1991). Despite this, Ms. J was well liked and respected as a quality teacher by students, colleagues, and her principal.

In contrast, Ms. W began lessons by activating students' prior knowledge and supported them to build on what they knew and to apply known strategies in new contexts. Students were given multiple opportunities to succeed and were supported to build their sense of self-confidence in mathematics. Ms. W emphasized understanding and reasoning over formulae and procedures, established norms for communication about mathematics, modeled her thinking as she solved problems with students, required students to work regularly in heterogeneous groups, and encouraged the use of multiple solution strategies. Ms. W's instruction thus aligned with standards-based mathematics teaching.

Discussion

This study sought to extend prior research by examining the ways in which CRT and standards-based instruction manifest in the classrooms of mathematics teachers identified as highly effective with traditionally underachieving students of color. The two cases yielded very different results. Ms. J's instruction was traditional and could be characterized as adhering to a pedagogy of poverty (Haberman, 1991). She did not acknowledge the societal barriers to school success that students of color face and sometimes blamed students or their families for their failures. Conversely, Ms. W adopted the insistent and caring stance of a warm demander. She understood that her black students had a different culture and way of learning than white, middle class students, and she adapted her instruction to match their learning needs. She taught in a way that valued understanding over efficiency, engaged students in cooperative learning, and encouraged them to express their unique ways of thinking by allowing them to choose one of several solution strategies when solving problems. The main similarity between the participating teachers was the relationships they had with students. They both made a point to let students know they were cared for, and the evidence suggests that students perceived and returned these feelings.

Why is it that even though the pedagogy of poverty that Ms. J adhered to is directly contradictory to standards-based instruction, she was a viewed as a successful, respected, and well-liked teacher? Haberman (1991) provided an explanation:

> The pedagogy of poverty is sufficiently powerful to undermine the implementation of any reform effort because it determines the way pupils spend their time, the nature of the behaviors they practice, and the bases of their self-concepts as learners. Essentially, it is a pedagogy in which learners can "succeed" without becoming involved or thoughtful. (p. 292)

Explicit, traditional instruction is what students are familiar with and it takes the guesswork out of what to do in order to successfully solve a problem. Furthermore, mathematics reform, and particularly classroom discourse, may be difficult for students whose cultural backgrounds are not aligned with the cultures valued in school (Gee, 2008; Lubienski, 2002; Zevenbergen, 2000). Standards-based instruction requires students to take an active role in their own learning in a way that the pedagogy of poverty doesn't (Haberman, 1991). Teachers who do not provide students with the appropriate supports to ensure their success with reform-based mathematics may encounter the struggles that Lubienski (2000a, 2000b, 2002) and others described, where students were not only resistant to classroom discourse but explicitly stated they would prefer more directed instruction.

When we consider the question of the nature of standards-based instruction and CRT in the classrooms of highly successful teachers of students of color, Ms. W can provide us with some insight. First, she is a warm demander. This pedagogical stance is one aspect of CRT but it does not define it. CRT is characterized by teachers who ensure the academic success of all their students and build students' cultural competence (Ladson-Billings, 1995b). Ms. W achieved both of these goals. The data suggest she supported students to become successful academically by creating a safe environment in her classroom in which students felt comfortable trying and motivated to put forth effort. She also reminded them constantly to turn in assignments, and by supporting students in learning to reason mathematically she may have improved their chances of success when encountering unfamiliar problems (e.g., on the EOC). Additionally, Ms. W validated each student's unique ways of thinking and speaking, and used instructional practices such as teaming that were grounded in their cultures rather than clashed with them, thereby potentially supporting students to build their sense of cultural competence. Ms. W did not, however, work to develop students' abilities to understand, analyze, and critique the existing social order. This, coupled with praxis, the iterative cycle of reflection and action (Hinchey, 2004), is a key component of CRT (Gay, 2002; Ladson-Billings, 1994, 1995b). Thus, Ms. W taught in such a way that was aligned with but not precisely defined by CRT.

Similarly, Ms. W's instruction aligned with standards-based instruction but she did not enact every element of reform. For instance, her students did not engage in true problem solving. Problem solving requires students to work (individually or with peers) through problems for which no solution method is known in advance (NCTM, 2000). Instead, the class often solved problems as a whole, and Ms. W let ideas come from her students, took up their suggestions, and guided them toward the application of a strategy for unfamiliar problems. She did, however, establish norms for classroom discourse and encourage students to use and discuss multiple solution strategies, which is one important aspect of standards-based instruction (Lubienski, 2000a; Schoenfeld, 1987). Ms. W also required students to work in heterogeneous groups, took up incorrect answers as an opportunity to learn, and built upon students' prior knowledge of mathematics; all of these practices are consistent with standards-based instruction.

While not a perfect example of CRT or standards-based instruction, Ms. W's practices embodied elements of each. Gutstein et al. (1997) stated that the two pedagogical approaches are complementary but that teachers need to explicitly actualize the connections. Ms. W did this by adapting her instruction to align with the way she believed students of color learn best, specifically, by engaging students in teamwork and class discussions. Most evident in Ms. W's instruction, however, was the strong, caring relationships she had with her students, and she drew on these relationships in an effort to support students in learning mathematics. The participating teachers' meaningful relationships with their students were a significant similarity between these teachers and align with research that suggests relationships and trust are a foundational aspect of CRMT (Bonner, 2011). Models of effective mathematics teaching of students of color need to highlight the importance of these relationships. The affective support a teacher gives influences students' sense of belonging, academic self-efficacy, enjoyment, and effort (Sakiz et al., 2012), and teachers who fail to connect in personal ways may be unable to support achievement motivation (Patrick et al., 2003). Research indicates that care, a component of CRT, is a crucial element of student success (Garza, 2009; Tutwiler, 2007; Wald & Losen, 2007). In contrast, the literature on standards-based instruction does not address the importance of care or the psychological environment (Patrick et al., 2003) in the classroom. Without strong relationships, it may be that the mathematics instruction – standards-based or not – is less effective.

Perhaps the way in which Ms. W taught is what is realistic and attainable for practicing teachers. Researchers and mathematics educators paint a picture of what an ideal teacher is, but it may not be practical for teachers to embody everything educational researchers, teacher educators, NCTM, and politicians say they should. Teachers have innumerable constraints placed upon them – limited time, standardized tests, paperwork, even requirements for the type of lesson plan format to use – and these constraints certainly make focusing on teaching students more difficult. As Ms. W stated, “there’s like so much more in teaching than just getting to be in your class and teach” [W_Int2_111711].

Teachers strive to do the best they can with the knowledge that they have. Ms. J, for example, was aware of her lack of formal education in both content and pedagogy, and she sought out every possible opportunity to attend training or collaborate with more veteran teachers so that she could improve the way in which she taught. She also asked me on a weekly basis during observations what I was learning about teaching from the other participating teacher (I promised her I would share my results once the study was complete). What we might glean from these cases is that even teachers identified as highly successful teach in very different ways. In addition, both teachers expressed a willingness and eagerness to improve. Are the ways in which Ms. W embodied elements of CRT and reform “enough”, or should we not be satisfied because her instruction isn’t a perfect example of what the literature suggests it should be? Ladson-Billings (1994) noted that cultural responsiveness is not pedagogy specific, but this is not the case for the NCTM standards (NCTM, 2000) and CCSSM (CCSSI, 2010). The State of Florida supports a model of instruction called gradual release (see FLDOE, *n.d.*) that, as described by the state, is aligned with a direct instruction approach and is contradictory to the problem-based, discussion-rich, student-driven nature of mathematics reform. Some teachers, such as Ms. W, may implement this model flexibly, but overall this type of mandate undermines the pedagogy that mathematics educators are striving for. It is important for mathematics teacher educators to consider the challenges teachers face and work to identify ways to integrate elements of reform into their instruction in a realistic manner.

Implications

This study provides a thick description of two teachers' perspectives and practices. It may offer concrete examples for teacher educators as they prepare future teachers or conduct professional development with inservice teachers. Specifically, the case study of Ms. W characterizes one way that standards-based teaching can occur in a setting with high numbers of students of color. The case may be a model for conducting mathematics instruction that aligns with mathematics standards (e.g., CCSSI, 2010; NCTM, 2000). Ms. W's teaching was not a perfect example of standards-based instruction but it provides a realistic illustration of the way one teacher effectively supported traditionally underperforming students to become successful in mathematics. The case additionally provides an example of a warm demander. This may afford teachers insight into how one might structure the psychological environment of a classroom to promote strong relationships and a feeling of belongingness as a way of improving mathematics achievement. This study may also help teacher educators to support preservice and inservice teachers to develop an assets-based belief system as described by Gutstein and colleagues (1997).

The findings indicate a problematic issue related to teaching students of color effectively. Ms. J taught in a way that was not entirely aligned with standards-based instruction nor CRT. Her instruction, characterized by elements of a pedagogy of poverty, undermined the kind of teaching that the literature suggests is necessary for the success of students of color who live in poverty. Ms. J, however, was nominated as an effective teacher, her superiors and colleagues believed her to be a successful and caring teacher, and her students performed well on standardized tests. Furthermore, her instruction was aligned with GRM that the FLDOE (*n.d.*) indicates as a "best practice". The GRM as described by the FLDOE encourages teachers to adopt a traditional approach to instruction that is inconsistent with standards-based reform and which does not support students in learning much more than procedural knowledge (Boaler, 1998; Schoenfeld, 1988). This suggests that what society values regarding teacher practice and educational outcomes is not aligned with what mathematics educators seek for the children of our society (e.g., problem-solving and communication skills, conceptual knowledge). Students who do not perform well in mathematics are less likely to attend college and gain the skills necessary for success in our globalized society (Friedman, 2005; NCTM, 2000; NRC, 1989), and they need more than just the procedural knowledge they gain from a traditional model of instruction. Teaching that does not prepare students to engage in critical mathematical thinking (Gutstein et al., 1997) certainly is not preparing them for future success outside of the school setting. Mathematics educators thus need to attend not only to the practices of teachers but also to the beliefs in our society about what constitutes mathematics, effective teaching of mathematics, and mathematical proficiency in order to support teachers to make the changes the education research community is calling for.

This study also highlights the issue of teacher education, certification, and the state's vision for teachers. Ms. W was traditionally certified and held degrees in both mathematics and education. Ms. J, on the other hand, was alternatively certified and she had no advanced mathematics training. Moreover, all her formal pedagogical training occurred in professional development sessions provided by her district or state. Ms. W taught in a manner aligned with standards-based reform, and Ms. J's practices were contradictory to mathematics reform. It is possible that other teachers are following a path similar to that of Ms. J so it is important for states to examine the pedagogy that is being perpetuated through the professional development sessions they offer and the policies they implement to determine their consistency with standards that are being described as the end goal. For instance, the CCSS require students to construct arguments and critique the reasoning of others (CCSSI, 2010) but the GRM adopted by the State of Florida does not provide students with an opportunity to engage in this practice. If the policies and professional development provided by states perpetuate a way of teaching that does not afford students an opportunity to engage in the mathematical practices necessary for their success in mathematics, then teachers who have not learned alternative methods of instructing may struggle to implement reform in a manner that would scaffold their students to succeed.

Limitations and Suggestions for Further Research

There are several limitations to this study that need to be addressed. First, the nomination process employed necessarily limited the findings of the study. This study relied on nominations provided by only one person, the secondary mathematics curriculum specialist. I spoke with each participant's principal and colleagues as a way of verifying whether the teacher was indeed perceived as "highly effective," but other studies (e.g., Ladson-Billings, 1994; Peterek, 2009) utilized a process that allowed for school personnel as well as community members to nominate participants. Related to this limitation is how we define “effective teaching”. Some may regard this as high passing rates on standardized tests or low course failure rates, but other ways of measuring teacher success exist, including student motivation, conceptual understanding, self-efficacy, attitudes toward mathematics, and problem-solving ability. The participant pool may have differed had community members been part of the nomination and had “effective” been more clearly defined. Finally, in regards to the nomination process, this study was necessarily limited by teachers’ willingness to participate. Seven teachers were nominated but only two met all the requirements for this study and agreed to participate. There are certainly other depictions of effective mathematics teaching of traditionally underperforming students that were not captured in this study.

Another limitation is that I was unable to acquire FCAT and EOC scores for the participating teachers. One hundred percent of Ms. J’s students made AYP her first year teaching, but this study occurred during her third year and it is unclear whether her success occurred by chance or was consistent year after year. A further limitation is that Ms. W’s students practiced word problems on a daily basis on the Carnegie Learning computer program. This is a confounding factor, as the reason for Ms. W’s effectiveness as a teacher may be attributed to Carnegie rather than to the practices in which she engaged. Given the literature that suggests feeling cared for and standards-based instruction may contribute to student success (Boaler, 1998, 2002; Garza, 2009; Kilpatrick et al., 2003; Post et al., 2008; Schoenfeld, 2002; Silver et al., 1995; Tutwiler, 2007; Van Haneghan et al., 2004; Wald & Losen, 2007), this may not be the case but this alternative hypothesis needs to be acknowledged.

In addition to correcting these limitations in future studies, there are additional areas that warrant further research. To begin, the design of this study did not utilize interviews with students as a form of data collection. There are many studies on effective teaching (Boaler, 1997, 1998, 2000, 2002; Ladson-Billings, 1994, 1995a, 1995b; Peterek, 2009; Tate, 1995; Ross et al., 2009) but few that turn to students as a source of data. Future research that includes this method may be of benefit for adding the voices of traditionally underperforming students of color to the conversation on effective teaching practices.

One goal of this dissertation study was to examine how standards-based teaching and CRT intersect in a mathematics classroom. These two pedagogies are theoretically compatible but literature on them is rather disparate, with few studies examining the way both reform and CRT are manifested by teachers (e.g., Gutstein et al., 1997). Other researchers suggest that when adopting a standards-based approach for teaching mathematics to students of color or who live in poverty teachers need to be cognizant of the struggles students may face with this approach due to the differences between school culture and vernacular culture (Gee, 2008; Lubienski, 2000a, 2000b, 2002; Zevenbergen, 2002). Thus, the cross-case analysis aimed at not only comparing the two cases, but also understanding whether reform or CRT characterized the instruction of each teacher. Ms. W adopted a warm demander stance and, although her instruction did not incorporate all elements of standards-based teaching, it was fairly well aligned with a reform-oriented teaching approach. She thus provides us with some detail about the way reform and CRT may be enacted jointly. More studies in settings to which these results are not transferable are needed to help us to further understand culturally responsive mathematics teaching.

Additionally, a study of this kind would benefit from a discourse analysis of classroom practices. Lubienski (2000a) revealed that the lower SES girls in her study struggled with whole class discussions. They found it difficult to distinguish between correct and incorrect answers during the discussions and didn’t know how to react when a classmate disagreed with their answer or mathematical statement. Lubienski (2002) and Gee (2008) suggested that the difficulties students of color face in school may be related to a disconnect between students’ school and home cultures. A discourse analysis in an effective teacher’s classroom may provide insight into the ways in which that teacher was able to bridge that cultural gap to successfully engage students of color in the mathematical discourse that is an integral part of standards-based instruction.

A final area of potential studies includes examining conceptions of teacher effectiveness and what it means for a student to be successful in mathematics. Ms. J was identified as an effective teacher: her students showed growth on the FCAT; she was well respected and liked by her students, colleagues, and superiors; and she was nominated for the Teacher of the Year award at her school. Many of Ms. J’s students were failing her course, however, and her instruction was skill-based and procedural. She held a goal for her students to learn to solve real-world problems, but she did not provide them with an opportunity to solve such problems, nor did she engage them in the mathematical thinking, discourse, and problem solving that mathematics educators have been calling for for many years (CCSSI, 2010; NCTM, 2000; NRC, 1989).

Furthermore, students may want teachers to provide explicit, procedural instruction (Lubienski, 2000a). This contradiction suggests that school administrators, parents, and even students have a different perspective of what and how students should learn than mathematics educators. In particular, it would appear from these results (and the current climate surrounding standardized testing and teacher evaluations) that society at large values students who can recite formulae and apply rules and teachers who explicitly show students how to solve problems. Mathematics educators, on the other hand, value students who are able to reason through unfamiliar problems, communicate their thinking, and derive and understand – rather than memorize – formulae. They suggest that teachers must engage students in processes that allow students an opportunity to learn the type of knowledge they value. Studies that further examine these discrepancies in effectiveness and mathematical success would help researchers and mathematics educators to better understand the challenges they are facing in regards to changing the way mathematics is taught to better enable all students to learn.

APPENDIX A
INFORMED CONSENT FORM

Dear Educator,

I am a doctoral candidate in the School of Teaching and Learning at the University of Florida conducting research for a dissertation on the teaching practices of successful teachers of low-income students of color. I am conducting this research under the supervision of Dr. Stephen Pape. The purpose of this study is to understand how teachers who are successful with low-achieving students of color who live in poverty support their students to learn mathematics. I am asking you to participate in this study because you have been identified as a highly successful teacher.

With your permission, I would like to observe one of your classes for a total of six weeks. Together, we can select a class. During data collection, I will observe the class every time it occurs as well as conduct several informal interviews and three formal interviews with you about classroom practices and student interactions. I will take field notes during these observations and interviews. Informal interviews may be audio recorded but will not be transcribed. Formal interviews will last no more than one hour, will be audio recorded, and will be scheduled at your convenience. You will not have to answer any question you do not wish to answer. Only I will have access to the audiotapes. The formal interviews will be personally transcribed by me, removing any identifiers during transcription and replacing your name and any other names mentioned with pseudonyms. The tapes will be kept locked in a cabinet in my office. Your identity will be kept confidential to the extent provided by law and will not be revealed in the final manuscript.

There are no anticipated risks, compensation or other direct benefits to you as a participant in this study. Your participation is voluntary and you may withdraw your consent at any time without penalty.

If you have any questions about this research protocol, please contact me at (352) 359-8417 or my faculty supervisor, Dr. Stephen J. Pape, at (352) 273-4230. Questions or concerns about your rights as a research participant may be directed to the IRB02 office, University of Florida, Box 112250, Gainesville, FL 32611; (352) 392-0433.

If you agree to participate in this study, please sign and return this copy of the letter to me. A second copy is provided for your records. By signing this letter, you give me permission to report the data I collect in interviews with you and observations in your classes. This report will be submitted to my faculty supervisor as part of my dissertation requirements. Also, by signing, you give me permission to use these data in academic presentations and publications.

Thank you,

Karina K. R. Hensberry

____

I have read the procedure described above for Karina Hensberry's study on teaching practices. I voluntarily agree to participate in the interview and I have received a copy of this description.

________________________________ ________________

Signature of participant Date

APPENDIX B
FORMAL INTERVIEW PROTOCOL 1

1. Tell me about your academic background. Where did you attend college? What was your major? Did you attend graduate school? If so, where? What was your major?

2. How long have you been teaching? How long have you been at this school?

3. Describe a time you felt proud to be a teacher.

4. What are your goals for your students? What do you do to help them reach these goals?

5. Can you think of a student you taught who was a real success story academically? Tell me about this student. Where was he/she at the beginning of the year? At the end of the year? (Probe for definition of academic success.) What factors do you think contributed to this student's success?

   Can you give me another example?

6. Think of a time when a student was struggling to understand the content being taught. How did you figure out that he/she was struggling? What do you think contributed to his/her struggle? What did you do to help the student gain stronger understanding?

   Can you give me another example?

7. Think of one student of color who stands out to you as a success story. What do you think was the key to your success with this student? Can you give me another example? Are the keys to success different with this student? Are there any guiding principles that you think define successful teaching for students of color?

8. What types of teaching methods have given you the most success with students of color and who live in poverty? Where did you learn to do that? As a group, what do you feel it is that your students need from you as their teacher?

9. I noticed that you [provide specific example of classroom interaction]. Can you talk to me more about that? What was going through your mind during that interaction? (Probe for reasons behind the teacher's choices.) Now that you've had time to look back on it, would you have done the same thing if you had a chance to do it over? If so, why? (Repeat questions as necessary.)

APPENDIX C
FORMAL INTERVIEW PROTOCOL 2

1. When did you decide to become a teacher? What made you choose mathematics? What do you think are the differences between being a mathematician and being a mathematics teacher?

2. What grades have you taught? What other mathematical content areas have you taught? How do those experiences compare to what you now teach?

3. Describe a typical day in the math class I am observing.

4. Let's talk about the math lesson you taught [today or yesterday]. What did you think about when planning the lesson? Is planning a time consuming process for you? Why or why not? What resources do you use when planning your lessons?

5. Think about the unit you are currently teaching. What are your goals for math teaching? What are your goals for students as math learners? How do you evaluate these goals? Are there some goals you feel successful in reaching fairly consistently? Which and why? Are there some that are hard to reach? Which and why?

6. Think of a student you would describe as the "ideal" math student. Tell me about this student. What is she/he able to do? What characteristics/traits help him/her be successful? In what ways do you support your students to become like this ideal mathematics students? (Probe for specific examples.)

7. Describe a student who has struggled in your class. How did you handle it? Do you have other strategies you use to support struggling students? How did you learn to do that?

8. Think of a time when you would say your students were highly engaged in a math lesson. Tell me about that lesson. What did you do to support their engagement? (Probe for specific examples.) How did you learn to do that?

   Can you describe another time when students were highly engaged – perhaps for different reasons? (Go through all the questions again.)

9. During the last interview, you mentioned [use teacher's own words here]. Can you tell me more about that? (Repeat question as necessary.)

10. During the last interview, you mentioned [use teacher's own words here]. Can you help me understand what you meant when you said [use teacher's own words here]? Would you give me an example of that? (Repeat questions as necessary.)

11. During the last interview, you mentioned [use teacher's own words here]. Would you give me an example (of that/of what you meant by) [use teacher's own words here]. (Repeat question as necessary.)

APPENDIX D
FORMAL INTERVIEW PROTOCOL 3

1. Describe your approach to teaching. Has it changed since you began teaching? If so, how?

2. What characteristics, if any, do diverse students bring to the classroom?

3. You have been identified as a highly successful teacher of low-income students of color. What do you think you do that makes you so successful? What else? (Probe for specific examples.) What else? Do you think this would differ if you were teaching predominantly white, middle class students? If yes, how might it differ?

4. Do you think the experiences in math class of white students in middle-class communities/classrooms differ from those of low-income students of color? If so, how?

5. What strategies do you use for classroom management? What routines and procedures do you have set up? (Probe for specifics.) How did you learn to do that? (Repeat question as necessary.) How do you deal with lateness to class? How do you deal with failure to do homework? How do you deal with inattentiveness? How do you handle major classroom disruptions? Would these strategies differ if you were teaching predominantly white middle class students? If so, how?

6. I noticed that you [provide specific example of classroom interaction]. Why did you decide to do that? (Repeat question as necessary.)

7. Was your instruction in the class I observed over the last few weeks typical of your instruction in other classes this year? In previous years? If so, how so? If not, how was it different?

8. During the last interview, you mentioned [use teacher's own words here]. Can you tell me more about that? (Repeat question as necessary.)

9. During the last interview, you mentioned [use teacher's own words here]. Can you help me understand what you meant when you said [use teacher's own words here]? Would you give me an example of that? (Repeat questions as necessary.)

10. During the last interview, you mentioned [use teacher's own words here]. Would you give me an example (of that/of what you meant by) [use teacher's own words here]. (Repeat question as necessary.)

11. Based on the feedback I have shared from observations, is there anything you hoped I would see, but didn't? Was there anything I saw that surprised you?

APPENDIX E
INFORMAL INTERVIEW PROTOCOL

Note: These informal interviews will be based on the teachers' behaviors during the class observations. They are open-ended and semi-structured to allow for flexibility in terms of the actual teacher behaviors that will be examined. The forms of the questions are reflected below.

1. I noticed that you [state classroom behavior]. Can you tell me more about what was happening there? What was going through your mind when you did that? (Probe for reasons behind the teacher's choices.) Now that you've had time to look back on it, would you respond differently if you had the opportunity to do it again? If so, why? (Repeat questions as necessary.)

2. I noticed that [student's name] asked a question about [state topic of student's question]. Can you tell me about that? What was going through your mind when [student's name] asked that? What were you thinking about when you responded? (Probe for reasons behind the teacher's choices.) Now that you've had time to look back on it, would you respond differently if [student's name] asked that question now? If so, why? (Repeat questions as necessary.)

3. I noticed that you [provide specific example of classroom interaction]. Can you talk to me more about that? What was going through your mind during that interaction? (Probe for reasons behind the teacher's choices.) Now that you've had time to look back on it, would you have done the same thing if you had a chance to do it over? If so, why? (Repeat questions as necessary.)

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BIOGRAPHICAL SKETCH

Karina K. R. Hensberry graduated from the University of Florida in August 2006 with a Bachelor of Science in mathematics. After graduation, she taught mathematics at Gainesville High School for two years. Karina also acted as an instructor for the Engineering GatorTRAX program at the University of Florida. While teaching at Gainesville High, she earned a Master of Education in curriculum and instruction from the University of Florida in August 2007. One year later, she enrolled at the University of Florida to begin working on a Doctor of Philosophy in curriculum and instruction with an emphasis in mathematics education. Karina graduated in August 2012 and joined the School of Education at the University of Colorado Boulder as a Research Associate for the PhET interactive simulations project. She continues to research equity in mathematics education and mathematics simulation design and use.