AN EXPLORATION OF INSERVICE TEACHERS' IMPLEMENTATION OF CULTURALLY RESPONSIVE TEACHING METHODS IN ALGEBRA WITH AFRICAN AMERICAN STUDENTS

by

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B.A., Hofstra University, 1995
M.S., Hunter College, 2000

AN ABSTRACT OF A DISSERTATION

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Abstract

Moses & Cobb (2001) argue that algebra is a "civil right" and assert that limited algebraic understanding has an unfavorable impact on African American students' entry into post-secondary education. Gay (2000) outlines six pedagogical methods, known as culturally responsive teaching (CRT), which emphasize the importance of teachers creating learning environments that relate to the personal experiences and cultural perspectives of minority students. The National Council of Teachers of Mathematics (NCTM) prescribes five process standards (communication, problem solving, connections, representation, and reasoning and proof) and the Equity Principle (includes setting high expectations, responding to the needs of culturally and linguistically diverse students, and providing support) for effective mathematics instruction. CRT, the NCTM Process Standards, and the NCTM Equity Principle served as the conceptual framework for this mixed-method study.

Thirty-four teachers from two elementary and two middle schools in one school district in the Midwest responded to *The Powell Teaching Mathematics Index* (PTMI), a five-option Likert survey that explored teachers' current "use" and "desire" to use CRT methods, NCTM process standards, NCTM Equity Principle, and teachers' personal efficacy in learning and teaching mathematics in general and in algebra. Results from the PTMI revealed that teachers had a "desire" to use CRT in mathematics with AA students ($M=4.41$, $SD=0.70$); and although there was more variance among respondents, teachers also reported a "desire" to use process standards in algebra with AA students ($M=3.94$, $SD=1.03$). One bivariate correlation revealed a relationship between "use" of process standards in general and "efficacy" ($r=0.681$, $p\leq0.01$). Eight volunteer teachers participated in a professional development workshop on CRT and integrated one of the six pedagogical methods into their classrooms for one month. Teachers reported "strengths" from the implementation phase as: increased student engagement, transition from teacher-directed to student-directed learning and an increase in student confidence in mathematics. Implementation "strains" were reported as: a time consuming process, difficulty in providing individual attention and an increase in classroom noise level. Findings have implications for teacher education programs, local school district and teacher networks.

AN EXPLORATION OF INSERVICE TEACHERS' IMPLEMENTATION OF CULTURALLY RESPONSIVE TEACHING METHODS IN THE MATHEMATICS CLASSROOM WITH AFRICAN AMERICAN STUDENTS

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Table of Contents

List of Figures

List of Tables

Acknowledgements

Giving honor to my Lord and Savior Jesus Christ, I can now say with a new level of certainty that "I **can** do **all things** through Christ who gives me strength" (Phil. 4:13).

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Dedication

I dedicate this completed work to two very special ladies who have traveled this road with me,

My two daughters,

Imani Rose-Marie and **Fadiya Amali**

I pray that each time either of you see this book on the shelf or recall moments of your life in Kansas, you will be encouraged and assured in knowing that you too *"can do all things through Christ who gives you strength".* I dedicate this work to you both, for your level of sacrifice and patience, and for all the times you had to hear Mommy say, "Please, not right now, I am writing."

Thank you for understanding. This is for YOU!

For you are my constant reminders of **FAITH** and **REDEEMING HOPE**

in Christ Jesus.

I love you dearly,

Mommy

Researcher's Perspective

Growing up in the heart of urban life, I experienced many aspects of education. During grades K-12, I recall having only five African American teachers (this is far more than some have experienced). These special individuals were strong and assertive and emphasized the purpose of school as a place where learning took place. The learning environment consistently reflected aspects of my cultural realities and thus cultivated an aura of confidence and integrity that continues to be a source of motivation and ambition for me today.

I enthusiastically entered the teaching profession with a similar perspective and held fast to the belief that all children have the ability to learn. I was determined to make this happen for every student seated in my classroom just like those special teachers did for me. I naively believed that every teacher felt this way. To my dismay, I witnessed children being belittled, watched many fail, saw several students subjected to low teacher expectations, and noticed how the enacted curriculum lacked rigor. As I resisted the negative pull that engulfed that environment, I vowed that I would be an advocate for the children who seemed to have no voice. This study speaks to the unattended concerns of African American students. It is intended to provide a perspective to advance the education of African American students and the teachers who serve them.

Moving to my present environment, there are relatively few African Americans. This reality has motivated me to ask questions about the quality of instruction that these few African American students receive. Do teachers consider the students' cultural background an asset to the classroom? Do teachers include these assets in their instructional plan? Do teachers believe

that all their students can learn? Are teachers committed to facilitating learning for all of their students, regardless of race, ethnicity, gender, and/or social class?

Research on the topics of race, ethnicity, gender, and social class, has encouraged me to consider the extent to which a factor, such as culture, is even considered in the classroom. Are teachers aware that culture does impact the manner in which students learn best? Are teachers aware that culturally responsive instruction provides the direction for effective infusion of a student's background in classroom practices? Are teachers open to include these strategies in the math classroom? If so, what evidence supports this belief?

CHAPTER 1 - Introduction

The Pledge of Allegiance promises "liberty and justice for all." Today we presume that the "all" is inclusive of people from all races and cultures who reside in the United States of America. For more than two centuries, people have sought freedom from oppression as they migrated to the United States in pursuit of the "American Dream." Formal education has been a vehicle by which to attain access to financial security and overall happiness.

African Americans were first denied education and then extended access to separate and inferior schools (Robins, Lindsey, Lindsey & Terrell, 2002). Despite the inequality, African Americans unrelentingly pursued formal education. Although many African Americans successfully completed formal education, the impact of early deplorable conditions can still be noted. Lack of resources and low expectations have contributed to a persistent achievement gap between African American students and their White counterparts (Oakes, 1999).

All children have the capability to learn, regardless of race. However, in order to maximize such potential, educators must be willing to "embrace this knowledge, examine their personal beliefs and practices, and engage in anti-racism for the benefit of all of their students" (Singleton & Linton, 2006, p. 48). The issue of race and culture in American education is apparent. In order to uphold the principle of "liberty and justice for all," educators must do all that is required to ensure that this is truly a standard for "all" students.

Background for the Study

African Americans' Pursuit of Education

African American education has been a concern for more than a century. Prior to the beginning of the Civil War, early advocates of education for African Americans were in one of three classes: slave masters who wanted to increase slaves' productivity for economic gain, missionaries who were spreading Christianity, and those who felt compassion for the oppressed (Woodson, 1915). After the Civil War, African Americans diligently sought education and thus many institutions sprang up to meet this desire, especially in the northern states. Although African American students received a solid education at these institutions, conditions tended to be deplorable, inequitable and often viewed as illegitimate by White society (Woodson, 1915). The Supreme Court case of *Plessey versus Ferguson* (1896), with its focus on equality, was an initial response to the educational conditions for African Americans. The court concluded separate but equal facilities to be the constitutional standard for minority citizens. Although this case did not directly address society's perceptions of Black education, the decision did afford opportunities for African Americans to be educated in their own schools.

The struggle for realized equality continued for many decades after this initial ruling. Some sixty years later, the Supreme Court justices, in their decision of *Brown vs. Board of Education* (1954), ruled unanimously that segregation in public schools actually fostered inequality, because facilities and resources for Black children did not match those for White children. In fact, Kenneth Clark, a Black psychologist argued that Black children were psychologically and emotionally impacted by this separation. Black children perceived themselves as inferior because they were not afforded the same

amenities as White students (i.e., bus transportation). The court perceived that it was not so much the fact that the physical conditions were substandard; but in fact Black students were exposed to other Blacks all day and this was contributed to their educational welfare (Green, 2004). Despite underlying perceptions, this landmark case stimulated other major decisions in the education of African Americans.

While many Black families welcomed the opportunity for their children to attend White schools, the idea of integrating was not readily accepted by Whites, especially in the South. Just three years after the Brown versus Board of Education decision (1954), President Eisenhower sent federal troops to Little Rock, Arkansas to ensure the admittance of nine African American students, known as the "Little Rock Nine", in the all-white Central High School (http://www.arkansas.com/central-high/history/). There were many other instances of resistance to integration in American public schools that occurred during this time period. As a response to such resistance, the elimination of institutionalized racism and discrimination in our nation's schools became the focus of the Civil Rights Movement of the 1960s and 1970s (Hu-DeHart, 2004).

Achievement Gap

The Brown vs. Board of Education Supreme Court's decision to integrate America's schools (1954) envisioned the equality of resources and opportunities for African American students in public schools to be beneficial. According to the National Academy of Education's report on race-conscious policies (Linn & Welner, 2007), the justices on this case recognized that segregation has "the tendency to [retard] the educational and mental development of Negro children" (as cited in Linn & Welner,

2007, p. 17). Despite integration laws and the intentions of the Brown vs. Board of Education decision, achievement by African American students continues to lag that of their White counterparts. As a means to address disparities relating to the "discouraging facts about the achievement of diverse student populations (Patterson, 1989, p. 73)", President Bush's Education Summit with the nation's Governors placed a call for national curriculum goals, thus prompting educational reform (Patterson, 1989).

More recent federal legislation, No Child Left Behind (2001), continues to focus on the disparities in education. Nationally, educators have been given the charge to attend intentionally to the academic achievement of marginalized students, (usually African American and Latino students who have historically underachieved and as well as students from low socioeconomic backgrounds), especially in the areas of math and reading. The educational reform being sought through NCLB (2001) clearly emphasizes the need to narrow the achievement gap among student groups. It proposes to:

- Ensure that students in every public school achieve important learning goals
- Increase student achievement
- Require schools to close the achievement gap between economically advantaged students and students who are from different economic, racial and ethnic backgrounds

(Yell & Drasgow, 2005)

While many educators argue that this expectation is unrealistic due to various obstacles (financial, social, and environmental) in schools across the country, others suggest that this legislature has drawn the attention of those who would have otherwise ignored such issues (Williams, 2003).

Because closing the achievement gap is a national concern, many educational organizations strive to monitor and document the achievement levels of all students, with particular attention to minority student achievement. The National Assessment of Educational Progress (NAEP) noted that although minority students have shown some improvement on standardized tests in recent years (NAEP, 2007a) so have White students. The Nation's Report Card for Mathematics (NAEP, 2007b) reported White, Black, and Hispanic students in grades 4 and 8 as having performed better on standardized tests. This means that overall, the gap between White and minority students was minimally narrowed between 1990 and 2007. More specifically, NAEP (2007b) also reported the composite mathematics score for White 4th grade students as 250 while the composite score for Black and Hispanic students was 221 and 228 respectively. Likewise, White 8th grade students scored 293, while Black and Hispanic students scored 259 and 265 respectively on the composite mathematics test. The achievement trends in reading were similar to those in mathematics. The Nation's Report Card for Reading (NAEP, 2007c) reveals that Black and Latino/a students showed some improvement, giving the illusion that the gap had narrowed; but while Black and Latino/a students made some gains, so did White students. The overall gap may have minimally decreased, but nevertheless a gap still remains.

Why Does the Gap Exist?

The causes of the achievement gap are complex. Lee's (2002) perspective on the complexity and discrepancies related the achievement gap between Black and White students calls for more authentic research. Lee says (as cited in Williams, 2003) that when attempting to understand the complexity of the achievement gap, there is a

tendency to offer unexamined explanations of such gaps among [Black and White student] groups. Lee (2002) clearly speaks to the need to examine the reasons why the gap exists as well as to encourage educators to actively pursue research endeavors that result in a significant narrowing of the gap. He suggested the development of new frameworks for empirical research that would encompass the learning efforts of ethnically diverse students.

A number of theories have been proposed to explain the continued black-white achievement gap: "deficit-deprivation", "structural inequality", "tracking", "the parents-are-at-fault, "fourth grade failure syndrome", "acting white", "the pressure-and-the lure-of-street-life", "underrepresented teachers"," underprepared teachers" "low expectations" and "cultural discontinuity" (Thompson, 2004). These theories can be divided into two broad categories. Deficit-deprivation, parents-are-at-fault, the pressure-and-the lure-of-street-life and acting white all assume that the roots of lower achievement reside in either the individual child or his/her family. In contrast, theories of "structural inequality", "tracking", "fourth grade failure syndrome", "underrepresented teachers", "low expectations" and "cultural discontinuity" assume that schools need to adapt in ways that eliminate the achievement gap.

The first set of theories include those that attribute lower achievement to the student and/or his/her family structure. The deficit-deprivation theory is supported by scientists (eugenics and biological determinism) who believe that Blacks are intellectually inferior to Whites and Asians (Thompson, 2004). According to this theory, African American students are genetically inferior so they are incapable of excelling at higher levels. This theory has been refuted by Hilliard (1998) and Gould (1981) in *The*

Measure of a Man. Gould (1981) argued that the inherent biases of standardized tests and their misuse have contributed to the inequality of educational opportunity, particularly for African American students. It is this inequality of educational opportunity that is largely responsible for the lower achievement levels. Similarly, Lowen (1995) reflects on the effects of slavery that painted an image that Blacks were inferior to Whites. "In the core…or culture…[we have been conditioned to believe]…that Europe's domination of the world came about because Europeans were smarter. In their core, many Whites and some people of color believe this" (p. 137).

Another theory constructed to explain the lower achievement of African American students is the parents-are-at fault theory. When parents are not involved in the educational endeavors of their child, educators tend to believe that the parents do not care about their child's education (Lowen, 1995). Thompson (2002, 2003) found that most African American parents expressed deep concern for the academic achievement of their children despite the common belief of the opposite. Hale (2001) noted that schools can present deterrents for parental involvement of African American students. In her research, she found that parents from all economic background grew frustrated with schools. She noted that highly educated parents would become just as irritated with teachers as parents from lower socioeconomic backgrounds.

The pressure-and-lure-of-street-life and acting white theories also offer explanations for the black-white achievement gap. The-pressure-and-lure-of-street-life maintains that negative influences from peers, the lure of street life and fast money encourages students to abandon formal education and drop out of school (Thompson, 2004). On the other hand, the acting white theory recognizes that some African American

students deliberately fail to strive for success because of peer and community perceptions that excelling in school is the same as acting white. Some students believe that academic success is seen as abandoning their home culture. In order to maintain communal stature and connections, these students utilize this mask to camouflage their academic aptitude (Thompson, 2004).

In contrast to the focus on individual and family influences, the theories of structural inequality, tracking, fourth grade failure syndrome, underrepresented teachers, low expectations and cultural discontinuity suggest what schools as cultural institutions can do to narrow and eliminate the black-white achievement gap. The theory of tracking builds on the observation that African American and Latino students have been disproportionately represented among the students who are placed in lower academic tracks (Oakes, 1999) and special education classes (Hacker, 1992). As a result, these students are less likely to pursue higher education and usually "tracked [in such a way that results in] less prestigious and lower-paying jobs" (Thompson, 2004, p. 15).

The fourth grade failure syndrome supports the theory of tracking and may further explain the decline in achievement, especially for African American boys. Ferguson (2001) and Kunjufu (1986) found that the achievement of African American boys declines over time. Kunjufu (1986) noted that boys who were achieving at high levels and exhibiting strong potential for success in kindergarten, by fourth grade were relegated to special education and labeled as underachievers by fourth grade. Ferguson's (2001) ethnographic research described the practices of schools, cultural differences and hidden messages that actually perpetuate the failure of African American boys. She posited that the achievement dilemma is attributed to culturally unwelcoming schools as

opposed to peer pressure. Such environments fail to motivate African American students to see themselves as capable of succeeding.

The issue of teacher quality, low teacher expectations and the theory of structural inequality are three other theories that have been used to explain the black-white achievement gap. NCLB (2001) emphasized the importance of a highly qualified teacher in every classroom. According to a report by the U.S. Secretary of Education (2002) (as referenced in Darling-Hammond & Youngs, 2002), there are a high percentage of uncertified teachers in high poverty schools in areas such as special education, math and science. The United States is still far from having a highly qualified teacher in every classroom. The issue of teacher expectations also plays a prominent role in the academic achievement of all students, especially students of minority descent. Thompson (2004) points out that teachers' attitudes and negative beliefs resulting in low expectations and non-challenging curriculum contribute to the underachievement of African American students.

The theory of structural inequality emphasizes that, "schools were designed to perpetuate class differences that exist in the larger society" (Au, 1993 as cited in Thompson, 2004, p. 14). Anyon's (1981) research on educational disparities in New Jersey schools found distinct differences in the questioning patterns and overall school environment between schools that served students from lower socioeconomic backgrounds as compared to the schools that served elite and affluent students. The theory of "structural inequality" assigns responsibility for the achievement gap to the commonness of underprepared teachers in schools serving students from lower socioeconomic classes. Because schools are acculturated with middle-class norms as

benchmarks, standardized tests as a primary way of measuring aptitude, a teaching force comprised of over 80% White middle class females (Tab, 2007); poor children and African American and Latino children may be at a disadvantage from the first day they enter school (Thompson, 2004). Allowing underprepared teachers to instruct diverse students in these environments further perpetuates the perception of inferiority—suggesting that some students are not deserving of high quality educational experiences.

Au (1993) suggested that the achievement gap between Black and White students arises from a mismatch between the home culture of African American students and the school culture, resulting in the theory of "cultural discontinuity." Gay (2000) described the traditional education system as one that promotes and builds upon the positive aspects of European culture. Boykin (1994) pointed out that the cultural tone of schools has not necessarily matched the cultural norms of its students. Gay (2000) described this as "cultural fabric" and noted that school practices (programs, etiquette, structures) are deeply rooted in European and middle-class origins. This system has promoted the underachievement of children of color by ignoring the influence of culture on their learning. Ladson-Billings (1995a, 1995b) maintains that, "the clash between school culture and home culture becomes evident in judgments and labels that teachers place on students with non-mainstream speech and styles of discourse, and through teachers' use of instructional practices and classroom management strategies that are at odds with community norms" (p. 167). Orr (1989) investigated how black students' use of language may in fact impede their ability to grasp mathematics and science concepts. Her research was built on the premise that teachers' transmission of instructional knowledge places black children at a disadvantage when that method of transmission does not match the

methods used in their homes or neighborhoods. This idea is connected to the theory of "cultural discontinuity" (Thompson, 2004).

Although the theories of deficit-deprivation, structural inequality, tracking, parents-are-at-fault, "fourth grade failure syndrome", "acting white", the pressure-and-the lure-of -the-street-life, teachers from underrepresented backgrounds, underprepared teachers, low expectations and cultural discontinuity (Thompson, 2004) attempt to explain the roots of the achievement gap between African-American and White students, the specific theories of structural inequality and cultural discontinuity provided direction for this study.

Gay (2000) proposed "culturally responsive teaching" as a way to combat cultural discontinuity and structural inequality in the educational environment. Culturally responsive teaching can be defined as "using the cultural knowledge, prior experiences, frames of reference, and performance styles of ethnically diverse students to make learning encounters more relevant to and effective for them" (p. 29). There is an urgent need to explore, expand and inform the knowledge base of practicing teachers in working with African American students (Banks, 2006; Gay, 2000; Ladson-Billings, 1994; Robins et al., 2002) while addressing the cultural discontinuity that exists between culturally diverse students and their White teachers (Hilliard, 1995; Tab, 2007; Thompson, 2004).

Overview of the Study

Statement of Problem

The achievement of African American students continues to be a concern. Because the achievement gap between White and African American students (NAEP,

2007a) continues, many researchers have taken a closer look at the quality of instruction that African American students and other students of color receive (Tate, 2004; Moses & Cobb, 2001; Delpit, 1995; Ladson-Billings, 1995a). The reality is that many African American students are not achieving at high levels, especially in mathematics. Some believe that mathematics is culture free and regardless of who is learning or teaching, the tasks remain the same. This notion fails to realize the nature of culture and its impact on cognitive development. Research indicates that teachers' attitudes are directly connected to the unspoken attitudes and behaviors that underpin daily classroom practices (Anyon, 1981). This suggests that teachers' attitudes can positively or negatively influence the quality of instruction.

Swartz (2003) addresses the reality of how schools have been producing generations of White teachers who typically use styles of pedagogy that fit with dominance. These coercive teaching practices rely on transmission pedagogy (Delpit, 1992; Wink, 2005), rote learning and behavior modification to control and track children as a precondition for teaching—particularly if children are of color (Darling-Hammond, 1997; Delpit, 1992; Ewing, 2001; Kohn, 1996, 1999; Oakes, 1999). Because culture is a crucial and integral component in the academic success of African American students [and all students for that matter], there is an inherent need to address the cultural mismatch between the teachers, their students and the instructional process. Additionally, it is imperative to assist teachers in their understanding of the need to adjust instruction to match students' cultural realities. Failure to make such adjustments further perpetuates the achievement gap.

The National Council of Teachers of Mathematics (2000a) emphasizes the importance of success in mathematics for all students. Setting high expectations for all students and providing the necessary supports to reach those expectations is also paramount to NCTM' s vision for mathematics instruction. The Equity Principle (NCTM, 2000a) outlines the need for teachers to create instructional environments that are responsive to the diverse needs of students. In order to achieve and maintain equity in mathematics instruction, NCTM recognizes that teachers "need help to understand the strengths and needs of students who come from diverse linguistic and cultural backgrounds…and also need to understand and confront their own beliefs and biases" (p. 14).

There is little known about what teachers' understand about the cultural influences that are present in the mathematics classroom. Furthermore, there is limited research on teachers' desire to infuse something like culturally responsive teaching into mathematics instruction. This study provided a context to explore teachers' actual responsiveness to cultural differences as well as their desire to embrace these realities in the mathematics classroom.

Description of Study

This study used a mixed method approach (quantitative and qualitative inquiry) to investigate inservice teachers' "use" and "desire" to use culturally responsive teaching methods, NCTM Process Standards, NCTM' s Equity Principle in algebra with African American students in elementary and middle school. Teachers from two elementary and two middle schools responded to a demographic questionnaire and a Likert-style survey.

The Powell Teaching Mathematics Index (PTMI) explored the current "use" and "desire" to use culturally responsive teaching methods in mathematics, specifically in algebra with African American students. The NCTM Process Standards, NCTM Equity Principle, and personal efficacy in learning and teaching mathematics (in general and in algebra) with African American students were also assessed with the PTMI. After the administration of the survey at all four schools, eight teachers volunteered to participate in a four-part professional development series that focused on culturally responsive teaching in algebra, specifically with African American students. Participants self-selected one of the six methods of culturally responsive teaching to implement in algebra lessons over a one-month period. Participants documented their experiences (the "strengths" and "strains") during the implementation process. During the last session, teachers reported their experiences to the rest of the professional development group.

Research Questions

This study answered the following research questions:

1. To what degree do in-service teachers self-report the actual use of or desire to use culturally responsive teaching methods, NCTM process standards and the Equity principle in teaching mathematics to African American students?
2. To what degree do in-service teachers self-report personal efficacy in teaching and learning mathematics in general? In algebra? With African American students?

3. What do in-service teachers report about the process of implementing (the strengths and strains) culturally responsive teaching methods in algebra with African American students?

Purpose of the Study

The achievement gap between African American and White students continues. While literature discusses the importance of cultural connections in the learning environment (Ferguson, 2001; Gay, 2000; Kunjufu, 1986; Ladson-Billings, 1995a and b; Lee, 2002; Lowen, 1995; Thompson, 2004, 2002) especially in mathematics (Hilliard, 1992, 1989; Stiff and Harvey, 1998; Tate, 1995) however, little is known about teachers' understanding of the cultural implications on mathematics achievement. There are a number of theories that have attempted to explain the reasons for the achievement gap between African American students and their White counterparts, such as parents are at fault and the acting white theory. The theories of cultural discontinuity and structural inequality argue that the gap arises from the cultural and socioeconomic mismatch between minority students and their White teachers. The influence of culture in the learning environment is real (Hilliard, 1995) and suggests a need for additional empirical research on teachers' understanding of the impact of culture in the mathematics classroom (Thompson, 2004, Lee, 2002). Teachers need to explore and experience the implementation process of interventions such as culturally responsive teaching as a means to explain, argue and/or validate such theoretical models, especially in disciplines typically seen as culturally neutral, such as mathematics (Banks, 2006; Gay, 2000; Ladson-Billings, 1994; Robins et al., 2002). This study provided a context in which

inservice teachers discussed and implemented culturally responsive teaching as connected to issues of cultural discontinuity and structural inequality in teaching mathematics to culturally diverse students (Hilliard, 1995; Thompson, 2004), specifically in algebra (Moody, 2003, 2000; Moses & Cobb, 2001) and thus expand their range of strategies in working with African American students.

Definition of Terms

For the purposes of this research study, the following terms and definitions were used.

Inservice teacher- As used in this dissertation, an inservice teacher is one who is currently teaching elementary or middle-school (K-8) aged students and has had formal training in education as evidenced by a college degree and an official teaching license and/or certificate.

Efficacy- Efficacy refers to one's confidence in knowing a particular subject area (personal efficacy) as well as one's confidence in his/her ability to deliver known information effectively (teaching efficacy) (Enoch and Riggs, 1990).

Desire- Desire refers to one's willingness to incorporate learning new information with the intent to implement newly acquired ideas (adapted from Bakari, 2000).

Use - The self-reported implementation of a particular teaching practice.

Race- The term "race" refers to the phenotypic make-up of individuals and has been used as a political category (Hilliard, 1995, p. 99).

White- This term refers to being a member of a group or race characterized by light pigmentation of the skin; of, relating to the characteristics of White people or their culture. http://www.merriam-webster.com/dictionary/white

African American /Black- This term is defined as an American of African decent. It is synonymous with the term Black. http://www.merriam-webster.com/dictionary/african%20american

Instruction- This term refers to teacher actions that are instrumental in the construction of students' knowledge (Sheets, 2005).

Practice- Practice is recognized as a pattern of professional activity or professional performance. The patterns of practice includes (1) the design and enactment of professional activity; (2) the situational and cultural context of the activity; and (3) the consequential outcomes for the student (Murrell, 2002).

Culturally Responsive Teaching- "Culturally responsive teaching can be defined as using the cultural knowledge, prior experiences, frame of reference and performance styles of ethnically diverse students to make learning encounters more relevant and effective for them" (Gay, 2000, p. 29).

NCTM Process Standards- NCTM process standards represent a foundational recommendation for all students PreK-12 and highlights ways of acquiring and using math content knowledge. The process standards include: problem solving, reasoning and proof, communication, connections and representation (NCTM, 2000a).

Equity Principle- The equity principle is a "particular feature of high-quality mathematics education that promotes excellence in mathematics through high expectations and strong support for all students" (NCTM, 2000a, p. 11).

Significance of the Study

Findings from this study can contribute to the knowledge base on culturally responsive teaching practices with African Americans students, specifically in the area of mathematics. Currently "algebraic thinking is being infused into arithmetic work at the elementary school level" and "middle-grade mathematics textbooks often include strands of work that is algebraic or preparatory for algebra" (Chazan, 2008, p. 21). Implications of this study can inform the instructional practices of both elementary and middle level teachers. Finally, because mathematics achievement for African American students is a national concern (NCLB, 2001), this study can provide insights on narrowing the achievement gap between African American students and their White counterparts.

Limitations of the Study

Four limitations have been identified for this study. The first is that the actual data collection, data analysis and data interpretation process was directed by the researcher who at times functioned as a participant observer. The data collection process included administering the PTMI and conducting the professional development sessions, of which the researcher was a participant. In order to ensure objectivity, the professional development sessions were videotaped for repeated viewing as part of the data analysis procedure.

The second is the sample selection. Because the sample was derived from one school district and four schools within the same district, data gathered from the PTMI as

well as the findings from the professional development sessions might not be generalizable to other districts. .

The third limitation is the validity and reliability of the *Powell Teaching Mathematics Index* (PTMI). Because the instrument was constructed specifically for this study, checks for validity and reliability were limited to the responses from the expert panel and feedback from the pilot study sample.

Finally, an African American researcher asking predominantly White teachers about their experiences with African American students may have generated some discomfort during the professional development sessions. This limitation was addressed by involving volunteers in the professional development sessions; given that it was more likely that volunteers would be comfortable sharing their perspectives of African American students with an African American researcher. Moreover, the professional development sessions were videotaped, allowing the researcher to review the professional development sessions for evidence of participant discomfort.

Assumptions

Concerns related to this research methodology are that participants do not experience any pressure to respond to the survey questionnaire and/or participate in the professional development sessions. Care was taken to ensure that participants in the professional development workshop felt free to participate in the professional dialogue during all four sessions. This study assumed:

- All participants truthfully answered the questions presented during the PD sessions.

- All answers were based on individual beliefs and experiences.
- The answers provided during the professional development were spontaneous and not rehearsed.
- Participants had the ability to engage in group-discussions.
- All professional development participants actually implemented the selected CRT method to the best of their ability
- All professional development participants responded openly and honestly about their experiences during the research study.

Overview of Remaining Chapters

The remainder of the study is presented in the following chapters. Chapter 2 is devoted to the review of the literature related to the issues of race and culture and its impact on the development of culturally responsive teaching methods. In addition, the cultural influences on mathematics instruction and a review of the national and state standards applicable to mathematics instruction for grades 3-8 are discussed. Finally, the rationale for the components of the theoretical framework for the study is provided.

Chapter 3 provides a description of the research methodology, sample selection and instrumentation. Further description of the instrument development, which includes the review by the expert panel, piloting of survey instrument, and the method and procedure used for data analysis is also presented. Finally, the specifications of the theoretical frameworks that are used in the data collection and analysis process are also outlined.

Chapter 4 presents an analysis of the data gathered from the instruments, professional development sessions, and journal entries on the implementation process. In a case study format, portraits of the professional development participants are presented.

Chapter 5 presents the summary, conclusions and recommendations for the implementation of findings. Additionally, suggestions for further research on the investigation of the use and desire to use culturally responsive methods; NCTM' s process standards and Equity principle in the mathematics classroom with African American students are discussed.

CHAPTER 2 - Review of Literature

Historical Context

The landmark case of *Brown v Board of Education* (1954) was argued on the basis of the 14th Amendment of the Constitution, which states that there is equal protection under the law. This decision mandated racial integration in American schools. Lawyers representing the National Association for the Advancement of Colored People (NAACP) won other court cases, such as *Green v County School Board of New Kent County* (1968) which declared, "the school board had to do more than simply offer the freedom of choice to desegregate its schools" (Watras, 2004, p. 188). *Swann v Charlotte-Mecklenberg* (1971) declared that racially identifying schools was a violation to the 14th Amendment. Schools needed to find way to balance race, so they altered school attendance zones and instituted busing (Green, 2004). The case of *Keyes v Denver School District* (1973) (as referenced in Watras, 2004) acknowledged that the school district had

intentionally segregated schools through the selection of building sites and tampering with school attendance boundaries. The Supreme Court found that the school board had deliberately violated the unconstitutional policy of racial desegregation.

After success in the south, the U.S. Department of Health, Education and Welfare shifted its attention to the northern states. Some twenty years after *Brown v Board of Education*, racial desegregation came to a halt in the case of *Milliken v Bradley* (1974), when efforts to integrate White students with African American students in the suburbs of northern cities and the Midwest were blocked (as referenced in Watras, 2004). The U.S. Supreme Court refused many other cases in the late 1980s and early 1990s and lower courts allowed school districts to dismantle segregation plans and end busing into once segregated schools.

During the same time, educational researchers became increasingly interested in the effect of integration on Black students. In an effort to determine the effects of attending racially integrated versus segregated schools, Crain and Weisman (1972) randomly selected 297 male adults from twenty-five metropolitan cities in the North. Results indicated that integration increased the African Americans' sense of security and minimized feelings of internal aggression. It was presumed that this change would increase academic performance for these African American students, but the authors note that the students did not benefit as much from the integration. (Crain &Weisman, 1972 as referenced in Watras, 2004). In her review of more than 120 studies about the effects of racial integration on achievement, attitudes and behavior of students, St. John (1975) declared the findings to be inconclusive. Despite these inconclusive findings, St. John

believed that “educators should concentrate on helping black students succeed and on improving racial relations within a school” (as referenced in Watras, 2004, p. 186).

Historically, the controversy over an equitable education for Black children has been an on-going concern. Montgomery (1968) believed that “what we do today, tomorrow, next week and in the months to come will have an impact upon every child" (p. 51). He continued with these questions: “What does education mean for black boys and girls? What is education’s purpose?" (p. 49). Although Montgomery (1968) posed these questions over three decades ago, educators still find themselves seeking answers. The concern for equity and positive belief in cognitive capabilities continues to drive much of the research related to Black education in the United States and abroad (Lee, 2008a).

Influence of Race

The influence of race in American education is real (Tatum, 2007). Despite advancements, “we find ourselves still confronting the legacy of race and racism in our society, particularly in our schools” (Tatum, 2007, p. x). Hilliard (1995) defines the term “race” as the phenotypic make-up of individuals, and says that this term has been used as a political term to demarcate achievement levels among students. Ellis and Llewellyn (1997) identify “race” as a construct, social concept or idea that was developed in the late 18th century. They emphasize that the construct of race was “based on the idea that “white” people were superior and “nonwhite” people—particularly “black” people—were inferior” (p. 53). At one extreme, racism can be viewed as habitual unconscious or

impaired ways of thinking about race. At the other extreme, it can be viewed as a malicious response to anyone outside of the dominant race.

King (1991) discussed the first extreme of this spectrum as "dysconscious racism", a form of racism that accepts dominant White norms and privileges" (p. 135). King (1991) defines dysconsciousness as "an uncritical habit of mind (including perceptions, attitudes, assumptions, and beliefs) that justifies inequity and exploitation by accepting the existing order of things as given" (p. 135). King describes the "dysconscious" state of being as not the absence of consciousness but rather an impaired or distorted consciousness.

At the other extreme of the spectrum, Garcia (1999) defines racism as "a vicious kind of racially biased disregard for the welfare of certain people. (…) In its central and vicious form, it is hatred, ill will directed against a person or persons [because] of their assigned race (…). One is a racist when one either does not care at all or does not care enough (…) or does not care in the right ways about people assigned to a certain racial group " (as quoted in Taylor & Whittaker, 2003, p. 110).

Despite scientists' and philosophers' construction of ideas around racial inferiority (Ellis & Llewellyn, 1997), "there is no empirical evidence that race has any real meaning for teaching and learning other than its political meaning and contrary to popular belief, the pedagogical issues associated with race have nothing whatsoever to do with student learning capacity" (Hilliard, 1995, p. 99). Because of this, Howard (2006) encourages educators to be aware of the impact that race has had on society as a whole as well as its impact on pedagogical practices with minority students. While many teachers believe that a colorblind approach to teaching is best, Howard admonishes White teachers

to be cognizant of the "racialized nature of [their] identity as White people" (p. 122). He posits that failure to do so has the potential to perpetuate racial barriers and contribute to racial inequalities in our schools and classrooms.

In her perspective on racial differences, Delpit (1995) seeks to find ways to celebrate differences rather than merely encouraging tolerance. "Not only should teachers and students who share group membership delight in their own cultural and linguistic history, but all teachers must revel in the diversity of their students and that of the world outside the classroom community" (p. 67).

When educators attend to the influence of race in American classrooms, they increase professional growth and raise racial consciousness. In *Courageous Conversations about Race*, Singleton and Linton (2006) discuss the influence of race in education and encourage teachers to challenge their personal passion for equity through courageous conversations. The authors describe courageous conversations as, "a strategy for school systems to close the racial achievement gaps" (pp. 15-16). Through safe and honest facilitated discussions, teachers have an opportunity to consider their own attitudes, develop "racial understanding," eliminate racial unconsciousness and actively attend to racial issues that affect achievement trends in their schools (Singleton & Linton, p. 16).

Role of Culture in Education

The issue of culture in American education is complex, continuing to generate rich discussions among educational researchers (Banks, 2006; Gay, 2000; Ladson-Billings, 1994, 1995a, 1995b; Robins et al., 2002). Although race, gender, and socioeconomic

status often serve as mitigating variables in student learning (Gay, 2000), culture has been known to play a significant role in the teaching and learning process, especially with minority students (Banks, 2006; Delpit, 1995; Gay, 2000; Ladson-Billings, 1994, 1995a, 1995b; Robins et al., 2002). Robins et al. (2002) posit that culture is a predominant force and it is impossible for individuals to not be influenced by it. With this in mind, it is important for educators to recognize that culture influences teacher and student performance and expectations as well as the degree to which classroom interactions occur (Boggs, 1985; Boykin, 1994; Pai, 1990; Philips, 1983; Shinn, 1972).

Banks (2006) describes culture as a program for survival and notes how it strongly influences the acquisition of knowledge, especially for minority students. In his model for multicultural education, Banks outlines five dimensions (content integration, the knowledge construction process, an equity pedagogy, prejudice rejection and empowering school culture and social structure) for which he encourages further description, conceptualization and research. These five dimensions of multicultural education define what must be considered in the learning environment, with special attention given to the knowledge construction process (Banks 2006).

Bullivant (1984) defines "culture" as being subject to circumstances (environment) in which an individual [society] can be found. He describes three kinds of environments: social, geographical and metaphysical, in which human groups respond when creating culture (as cited in Banks, 2006). Culture consists of dynamic, complex and changing interactions that are symbolic, ideational and intangible aspects of human societies (Kuper, 1999). It is critical to consider these realities in the learning experiences for culturally diverse students.

According to Smith-Maddox (1998), culture involves not only everyday practices (patterns of discrete behaviors, traditions, habits, or customs) but also the way that people understand ideas and ascribe meaning to everyday life. Such practices serve as a foundational support for learning. Because cultural knowledge includes understanding the way that cultural groups respond to and interpret the world around them, Montgomery (1968) would agree that students want to have their cultural differences recognized and appreciated. Furthermore, teachers must learn to appreciate the styles of speech, the mode of dress, the natural hair, etc, which are popular or indigenous to the black culture. Schools tend to implicitly force minority students to assimilate to the norms and mores of mainstream society, thereby stripping them of the cultural identities important to their existence within their home or community culture.

From a historical perspective, Dewey (1938) affirmed the connection between prior knowledge (learning experiences) and the content of new knowledge as meaningful and worthwhile in learning (as referenced in Williams, 2003). In his analysis of the teaching and learning process, Dewey further described the impact of day-to-day experiences on the learning environment. He asserts the importance of educators becoming familiar with and utilizing the local physical, economic and occupational conditions to make learning experiences more relevant for students (as referenced in Williams, 2003, p. 21) This idea supports the integration of students' cultural experiences into learning experiences. Vygotsky's (1929, 1981) discussion of the role of culture and social contexts, Piaget's (1969) portrait of the role of schemes in perception and the process of learning and Dewey's (1938) perspective on the power of knowledge and experience provide a framework for closing the achievement gap for all students.

As a means to integrate cultural realities into the learning environment, Banks (2006) introduces the idea of "equity pedagogy" as the manner in which teachers make instruction more meaningful by including a variety of learning styles from various cultural and social class perspectives in order to increase student achievement. Most teachers assume they are creating equitable learning environments for all students, however the process for addressing issues of race, culture and class as variables in the learning environment can often be uncomfortable for some. Nevertheless, research shows that issues of culture are real and must be considered as integral components in the learning environment (Ladson-Billings, 1995b; Middleton, 2002; Powell, Sobel, & Hess, 2001).

Despite the research that champions the importance of equity in the classroom environment, there is often a reluctance or unwillingness among teachers to voice their personal concerns for fear of being labeled. Roland Barth (2001) refers to such topics as "nondiscussables":

> Nondiscussables are subjects sufficiently important that they get talked about frequently but are so laden with anxiety and taboos that these conversations take place only at the parking lot, or dinner table at home. We are fearful that open discussion of these incendiary issues in polite society--at faulty meetings for example—will cause a meltdown. The nondiscussable is the elephant in the living room. Everyone knows this huge pachyderm is there, right between the sofa and the fireplace, and we go on mopping, dusting, and vacuuming around it as if it did not exist. (p. 9)

Robins et al. (2002) point out that "the oppression of people of color and other non-dominant groups in the United States damages society … [and] to deny the experiences of all members of society is to deny the barriers to cultural proficiency (p. 95)." Each time an African American student is subjected to low teacher expectations or is disproportionately represented in special education classes, he/she is being denied an equitable opportunity to succeed. When this happens, a message of inferiority and worthlessness is communicated (Robins et al., 2002).

Delpit (1995) emphasizes the need for teachers to communicate across cultures and address the fundamental issues of power that impact what is best for poor students and students of color. She says,

> Teachers are in an ideal position to attempt to get all of the issues on the table in order to initiate true dialogue. This can only be done, however, by seeking out those whose perspectives may differ most, by learning to give their words complete attention, by understanding one's own power, even if that power stems merely from being in the majority, by being unafraid to raise questions about discrimination and voicelessness with people of color, and to listen, no, to *hear* what they say. I suggest that the results of such interactions may be the most powerful and empowering coalescence yet seen in the educational realm-for *all* teachers and for *all* the students they teach. (p. 47)

In order for teachers to truly cultivate "a pedagogy of social action and advocacy that really celebrates diversity," they must be prepared to move beyond the random holidays, isolated cultural artifacts, "festivals, and food" (Ayers, 1988 as cited in King, 1991, p. 134). "Teachers need both an intellectual understanding of schooling and

inequity as well as self-reflective, transformative emotional growth experiences" (King, 1991, p. 134). There must be opportunities for teachers to engage in professional dialogue about issues of race and culture in the classroom environment.

Cultural Implications in Mathematics

As described in Chapter 1, mathematics is a discipline for which a significant achievement gap between African American and White students exists (NAEP, 2007a). The reality is that mathematics is often seen as a foreign language and a new cultural experience for students and teachers alike (Hilliard, 1998). It stands to reason that infusing cultural realities into instructional methods may be difficult for many educators. One notion is that [math] "education has nothing to do with cultures and heritages" (Gay, 2000, p. 21). When it relates to cultural implications in mathematics instruction, Hilliard (1995) makes this poignant observation:

> For the mathematics teacher, however, two topics are of primary importance for consideration when responding to ethnic/cultural diversity. On the one hand, the ethnic/cultural content of the mathematics curriculum is important. On the other hand, the process of teaching and learning is also important. Both are matters that tend to have a direct relationship to what teachers can do in mathematics. (p. 100).

Patterson (1989) notes the critical need for the acquisition of mathematical skills as it relates to students' future educational and economical opportunities. It was projected that by the year 2000 "entry level jobs that traditionally have required only basic reading and mathematical fluency will demand expertise in reasoning, information processing, and other higher order skills" (Johnston & Packer, 1987 as cited in Patterson, 1989, pp.

74-75). Current research indicates that mathematics and scientific proficiency is not only seen as a gatekeeper for access to and the maintenance of prestigious employment (Moses & Cobb, 2001; Tate, 2004), but also plays a significant role in raising students' self esteem (Cummings, 1978; Barrett, 1992).

Despite the relevance of culture in the classroom, most mathematics teaching reforms have traditionally failed to accept the needs of minority students (Brenner, 1998). Conversely, the National Council of Teachers of Mathematics (2000) takes a marked position on the mathematics education of students in K-12 classrooms. This position offers hope for the academic achievement of all students particularly as teachers adopt and adhere to such guidelines.

National Council of Teachers of Mathematics

Position Statement

The National Council of Teachers of Mathematics' *Professional Standards* (2000a) emphasizes the importance of mathematics pedagogy and encourages teachers to be conscious of pedagogy and its impact on mathematics achievement for all students. NCTM (2000a) has developed instructional, assessment and professional standards as a means to facilitate mathematics literacy for both students and teachers alike.

NCTM' s vision for school mathematics as described in *Principles and Standards for School Mathematics* "is highly ambitious" (NCTM, 2000a, p. 3). This professional organization recognizes the necessity for mathematics in a changing world, the importance for continued improvement in mathematics education and the significance of standards-based instruction in mathematics for grades K-12.

The Equity Principle

The National Council Teachers of Mathematics' *Principles and Standards for School Mathematics* (2000a) clearly recognizes the instructional decisions made by teachers and administrators and the subsequent impact on mathematics achievement. Six distinct principles (Equity, Technology, Curriculum, Teaching, Learning, and Assessment) guide this decision making, one of which addresses the theme of equity. "Excellence in mathematics education requires equity', which is characterized by "high expectations and strong support for all students" (p. 11).

The overarching theme of equity as "a core element" of the vision for mathematics education is most relevant to this study. NCTM posits that some students may require special assistance to meet the expectations set for them and thereby encourages teachers to develop supports and accommodations for differences among students as a means to help them learn. "Mathematics can and must be learned by all students" (p. 13) is the premise on which effective mathematics teaching is based. Learning opportunities should be meaningful and carefully selected. Learning should include various instructional tools and curriculum choices enhance students' mathematical understandings. NCTM also establishes the importance of teachers responding to the needs of culturally and linguistically diverse students by sensitively accommodating for differences. As teachers set high expectations and provide adequate assistance to help students meet those expectations and understand and confront their own biases related to cultural differences, they are constructing equitable environments in mathematics.

Process Standards

NCTM outlines five process standards as vehicles for the effective instruction of all mathematical concepts. According to the vision for school mathematics, content and process standards are well linked. In fact, teachers should utilize the process standards in their instruction of any and all mathematical content areas. The five process standards that are integral components in the learning of mathematical content are: (1) problem solving, (2) reasoning and proof, (3) communication, (4) connections, and (5) representation.

Problem solving should enable all students to:

- Build new mathematical knowledge through problem solving
- Solve problems that arise in mathematics and in other contexts
- Apply and adapt a variety of appropriate strategies to solve problems
- Monitor and reflect on the process of mathematical problem solving.

(NCTM, 2000a, p. 52)

The teacher plays a significant role in the selection of mathematical tasks that will foster the development and application of problem solving skills. Teachers should create learning opportunities through problem solving that are related to students' real-world experiences in grades K-12.

Reasoning and proof is "a formal way of expressing particular kinds of reasoning and justification used in mathematics. The reasoning and proof process standard should enable students to:

- Recognize reasoning and proof as fundamental aspects of mathematics
- Make and investigate mathematical conjectures

- Develop and evaluate mathematical arguments and proofs
- Select and use various types of reasoning and methods of proof.

(NCTM, 2000a, p. 56)

This process standard clearly promotes the discovery process in mathematics learning. Students are encouraged to express conjectures and describe their thinking as well as explore mathematical concepts with concrete manipulatives. This process standard encourages mathematical justification from students as early as kindergarten as a means to support learning mathematical concepts.

Communication in the mathematics classroom has several implications. Students are encouraged to formulate their mathematical discoveries in ways that make sense for them as well as strive to make their thinking transparent to others. The communication process standard should enable students to:

- Organize and consolidate their mathematical thinking through communication
- Communicate their mathematical thinking coherently and clearly to peers, teachers and others
- Analyze and evaluate the mathematical thinking and strategies of others
- Use the language of mathematics to express mathematical ideas precisely.

(NCTM, 2000a, p. 60)

Reflection and communication are meant to be integral components of mathematics learning. In this effort, it is imperative that teachers cultivate learning environments in which students are risk-takers. By the end of high school, all students should be able to develop mathematical conjectures and clearly articulate their mathematical understandings and clarify their thinking.

The ability to recognize connections between mathematical concepts and apply mathematical concepts to everyday contexts is an important component of mathematics learning. The connection standards dictate that students should be able to:

- Recognize and use connections among mathematical ideas
- Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
- Recognize and apply mathematics in contexts outside of mathematics.

(NCTM, 2000a, p .64)

The world is rich with mathematical connections. As students work to find these mathematical connections in their world, the role of teachers is to facilitate these endeavors in the mathematics classroom. This facilitation process not only serves to pique the interests of students, but also to cultivate the understanding that mathematics is important and applicable in the environment in which we all live.

Finally, the process standard of representation presents many opportunities for students to display their mathematical understandings in different ways that make sense for the student and the audiences. The representation standards should enable students to:

- Create and use representations to organize, record, and communicate mathematical ideas
- Select, apply and translate among mathematical representation to solve problems
- Use representations to model and interpret physical, social and mathematical phenomena.

(NCTM, 2000a, p. 67)

It is important that students learn ways to express their mathematical understandings in ways that make sense to them and others. When it comes to capturing the essence of culturally responsive teaching, the five process standards provide opportunities and the Equity principle reflects the value of varied instruction, carefully selected learning opportunities in which students might communicate and represent their mathematical understandings from their cultural perspectives.

Algebra in School Mathematics

Algebra Instruction for All

The study of mathematics presents barriers of its own (Hilliard, 1998). "Illiteracy in math is acceptable the way illiteracy in reading and writing is unacceptable. Failure is tolerated in math but not in English" (Moses & Cobb, 2001, p. 9) and math interventions are not as common for learners as are reading interventions (Jordan, Kaplan, & Hanich, 2002). In their book, *Radical Equations*, Robert Moses and E. Cobb, Jr. (2001) clearly note that African Americans make up 15% of the country's population, yet in 1995 they earned 1.8% of the Ph. Ds in computer science, 2.1% of those in engineering, 1.5% in the physical sciences and 0.6% in mathematics (p. 11). African Americans are often weeded out of the advanced classes required for college admission. Currently, the weeding is generally done based on performance in algebra classes (Gaitan, 2006). As the gatekeeper for access into higher education and beyond, algebra has been designated for a select few and is an issue of civil rights (Moses & Cobb, 2001). Strong and Cobb (2000) believe that any conversation about the appropriate role and importance of algebra in school mathematics curriculum eventually boils down to answering these four questions:

- If not algebra, then what?
- If not for all children, then for whom?
- If not at all schools, then in which ones?
- If not now, then when?

Moses and Cobb (2001) believe that the struggle for equality for minority people is directly linked to mathematics and scientific literacy. Strong and Cobb (2000) specifically argue that in order for students to be mathematically proficient, all students should successfully complete pre-algebra by grade seven, a full year of algebra by grade eight and four years of mathematics in high school.

Strong & Cobb (2000) and Moses and Cobb (2001) present a strong case for exploring teachers' understanding and efficacy in teaching algebraic concepts to African American students. Algebraic reasoning in the early elementary grades provides a solid foundation for deeper exploration of these concepts in later grades. The upper elementary grades (4-6) is often the time when African American students' achievement in mathematics lags that of their White counterparts, limiting these students' exposure to algebraic concepts to their last two years of high school. The NCTM' s *Changing the Faces of Mathematics* (2000b), present a compilation of the experiences of African American students in mathematics. Smith, Stiff and Petree (2000) report that students enrolled in regular pre-algebra and algebra receive much more whole class instruction as compared to those who are enrolled in more advanced algebra courses. Consequently, these students tend to complete worksheets individually as opposed to having the opportunity to build the deeper understanding that often arises in small group discussion. Unfortunately,

> Working in groups or engaging in active, manipulative-based mathematics learning in prealgebra and algebra is not a common experience for most students in school, especially African American students. As a result, many African American students never experience mathematics as communication. They never reason verbally about mathematics or explain and justify their work to others. They grow accustomed to and expect problems whose solutions are of the simplest form. It is not surprising that open-ended problem situations create academic discomfort in African American students who have not developed strategies for accommodating mathematical complexities. (pp. 89-90)

The reality is that the lack of hands-on discovery and opportunities for communication about discoveries are two major barriers to sustained achievement for African American students.

Through case studies, Moody (2000) presents examples of African American students' success with school mathematics. Moody (2000) departs from the deficit models that have been constructed to explain African Americans' poor achievement in mathematics in order to highlight those who have been successful in this area. Moody presents two cases of African American students' success. The first case is that of a college student (Ashley) pursuing a degree in mathematics. This student attributes her success to strong parental involvement (although her parents divorced early in her childhood) and caring educators during her elementary years. "Ashley stated that her sixth grade mathematics teacher 'was amazing to me because she was the first black woman mathematician that I had ever seen'" (p. 54). The account also mentions how Ashley took an algebra placement test at the end of seventh grade despite her fears,

because her teacher believed in her ability to do math and [her teacher] knew the importance of entry in higher-level mathematics courses.

In the other case, Sheliah attributes her success in mathematics to witnessing her mother achieving a degree in pure mathematics and to her 5th grade African American teacher. In addition to Sheilah's teacher displaying a sense of caring for her, the teacher also communicated high levels of expectations that directly influenced Sheilah's achievement levels. In both cases, the presence of knowledgeable and caring teachers who set high levels of expectations were significant factors in the success of these African American students in mathematics.

Standardized Testing and Algebra

Although standardized tests should not be considered the only indicator of student achievement, they do play a prominent role in the measurement of academic success. In the state of Kansas, the mathematics assessment framework for grades 2 through high school establishes the minimal mathematics instruction for students. The assessments are constructed based on five cognitive categories across five content strands (geometry and measurement are combined at the state level) for grades 2 through high-school (www.ksde.org):

- number/number systems
- algebra
- geometry/measurement
- data

The five instructional categories are:

- Memorize facts/definitions/formulas
- Perform procedures

- Demonstrate understanding of mathematical ideas
- Conjecture/Generalize/Prove
- Solve Non-routine Problems/Make Connections

The five categories and content strands are aligned with the expectations set by the National Council of Teachers of Mathematics (NCTM, 2000a). Even though there are some distinctions, all five cognitive categories indicators can be easily associated with algebraic concepts, because the concepts often overlap. The emphasis on algebraic mathematical understanding is evidenced in the increase of test items for algebra from grades 2 through high school.

As shown in Table 2-1 there is a significant increase in the number of algebra test items from grades 2 to 3, 6 to 7 and 8-9. By high school, more than half of the test (54.8%) is devoted to algebraic concepts. The state's distribution of testing items speaks profoundly to the importance of algebra instruction for students as early as grade 2 but no later than grade 3 (actually algebra concepts/algebraic reasoning is taught in prekindergarten). In Kansas, standardized testing begins in grade 3. Because students are expected to demonstrate proficient knowledge of algebraic concepts in grade 3, and realizing the significance that is placed on proficient performance, early instruction is an urgent concern.

Table 2-1-Number of Test Items Related to Algebra on the Kansas State Mathematics Assessment

	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9/10
% of test	11.5%	17.1%	19.2%	16.4%	14.0%	33.3%	26.7%	54.8%
# of questions	*6*	*12*	*14*	*12*	*12*	*28*	*23*	*46*

(KSDE, 2005)

Culturally Responsive Teaching

Many researchers have explored pedagogical approaches to integrating cultural heritage and prior experiences of minority students into the learning environment (Taylor & Whittaker, 2003; Ladson-Billings, 1995a, 1995b; Darling-Hammond & Youngs, 2002; Orr, 1989; King, 1991; Gay, 2000). These pedagogical approaches generally utilize different names to present the same idea about the importance of making "classroom instruction more consistent with the cultural orientation of ethnically diverse students" (Gay, 2000, p. 29). Terms such as "culturally relevant, sensitive, centered, congruent, reflective, mediated, contextualized, synchronized and responsive" are common (Gay, 2000, p. 29). Like Gay (2000), this study employed the term of "culturally responsive teaching" (CRT) as a means of describing instructional behaviors that are responsive to the cultural needs of students.

Gay (2000) defines culturally responsive teaching as a multifaceted approach to teaching and learning and defines six components:

- Validating
- Comprehensive
- Multidimensional
- Empowering
- Transformative
- Emancipatory

According to Gay (2000), these components of culturally responsive teaching "simultaneously develop along with academic achievement, social consciousness and

critique, cultural affirmation, competence and exchange; community building and personal connections; individual self-worth and abilities and an ethic of caring" (p. 43). Culturally responsive teaching is a conceptual framework that can be utilized in providing effective instruction in all subject areas with culturally diverse students.

The first component of CRT is "validating". This component communicates the importance of students' cultural heritage. It acknowledges that students have a natural connection to cultural backgrounds; so much so, that teachers look to build meaningful bridges between home and community in order to make school experiences more meaningful. The "validating" component of CRT incorporates a variety of instructional techniques that are related to different learning styles (Banks, 2006) and instructs students to know and praise their cultural backgrounds as well as that of others. Finally, the "validating" method of CRT incorporates multicultural information, resources, and material in all the subjects and skills usually taught in schools (Gay, 2000).

"Validating" in a culturally responsive learning environment can be beneficial to all students, not just minority students. Taylor & Whittaker (2003) approach culturally responsive instruction from the perspective of home-school relationships. The researchers have compiled a series of case studies that characterize the meaning of diversity, changing patterns in education in the United States as well as partnerships with families and communities. Taylor & Whittaker point out how teachers can be helpful in introducing all students to different cultures, especially when these students do not learn this information at home. In order for this to be effective, "teachers need awareness and knowledge of different cultures in order to teach about them responsibly and accurately" (p. 120).

CRT is also "comprehensive". Ladson-Billings (1994) provides insight into the range of learning (intellectual, social, emotional and political) by utilizing cultural references to impart knowledge. In her work with a group of elementary teachers, Ladson-Billings (1994) observed a commitment to high expectations and social action. She saw skills taught explicitly and witnessed interpersonal relations as a collected effort to not only academic, but also cultural excellence. This approach to learning is dedicated to helping students of color preserve their cultural identity, maintain connections to their ethnic backgrounds and communities through social awareness, and challenge status quo norms. There is a shared responsibility toward this effort and students are held accountable to one another through a communal effort. There is also a strong belief that all students are called to be a part of a supportive group of high achievers (Foster, 1995, 1997; Irvine & Foster, 1996; Ladson-Billings, 1995a, 1995b; Lipman, 1995) and low teacher expectations are never an option.

CRT as a "multidimensional" approach to instruction encourages curricular alignment across disciplines. Teachers of language arts, music, art, social studies, math, science and other areas may each agree to teach a particular concept from the perspective of their own discipline. Students may be challenged to demonstrate critical understanding of the concept from these various disciplines or may also provide a candid representation of the concept. Additionally, teachers can collectively decide how performance will be evaluated. This form of teaching requires teachers to use a wide range of cultural knowledge, experiences, perspectives and contributions.

The "empowering" aspect of CRT enables students to cultivate personal integrity and academic success. Students who are empowered are confident, competent,

courageous and ambitious. They are risk takers and willing to pursue excellence toward mastery. These students develop and maintain intrinsic motivation through the planned structures of support that scaffolds them toward high levels of academic achievement. Mehan, Hubbard, Villanueva and Lintz (1996) refer to a system of "social scaffolding" with low-achieving Latino and African American students as the supports that fostered high-level academic skills for students who were encouraged to enroll in advanced placement classes. Shor (1992) highlights the effect of empowering education when he says,

> The goals of this pedagogy are to relate personal growth to public life, to develop strong skills, academic knowledge, habits of inquiry, and critical curiosity about society, power, inequality and change…. (p. 15-16)

Shor (1992) further stresses how students are the primary source and center, subjects and outcomes, consumers and producers of knowledge. This aspect of culturally responsive instruction clearly places the student at the center from which all learning evolves and seeks to extract the internal power to learn. Students are encouraged to find their own voices and make knowledge personal and relevant.

Gay (2000) also adds that culturally responsive teaching is "transformative" in that it helps "students to develop the knowledge, skills and values needed to become social critics who can make reflective decisions and implement their decisions in effective personal, social, political and economic action" (Banks, 1991, p. 131). The transformative agenda is two-fold: it confronts the mainstream view of learning and it develops social consciousness in students so that they might apply knowledge while combating various forms of oppression, such as racism and prejudice. Students are

encouraged to transform classroom knowledge in ways that address societal issues and students are motivated to search for tangible solutions.

Finally, CRT is "emancipatory". This instructional component liberates students from the constraints of hegemonic ways of knowing (Asante, 1991/1992; Au, 1993; Erickson, 1987; Gordon, 1993; Lipman, 1995; Pewewardy, 1994; Philips, 1983). In other words, the veil of authority is lifted and students begin to see themselves as able to obtain and transmit knowledge. Students see themselves as scholars. They are "emancipated," are able to have insight on how to apply knowledge to the world outside of the classroom. The "emancipatory" component infuses authentic experiences into the learning environment that are applicable to students' own cultural and social realities. Students recognize that they have the ability to gain knowledge. They don't look solely to the teacher to provide answers, but rather realize that knowledge is available to anyone who desires it—and they are inspired to seek out whatever knowledge they need.

Overall, CRT is concerned with cooperation, community and connectedness in the instructional environment. Interdependence and reciprocity are integral components that challenge the notion of individualism and competition typical of mainstream classrooms. When applied, this cohesive instructional framework in the math classroom presents promising options for the academic success of many minority students, including African American students.

Despite the arguments that cultural background has no significant impact on the manner or degree to which students understand and engage with mathematical concepts, for African Americans and other students of color, CRT is a pedagogical and attitudinal approach which offers hope for marked success. Because CRT can build on the thinking,

experiences, and traditions of African American students (Gay, 2000; King, 1991; Ladson-Billings, 1995a, 1995b; Tate, 1994), implementation of these methods can have positive outcomes. Effective implementation requires teachers to embrace sensitivity to the cultural styles associated with prior experiences and learning styles of African American students even in the mathematics classroom. The learning processes should not only to be compatible with family cultural patterns, but are also seen as an equitable approach ways to mathematics instruction for culturally diverse students (Hilliard, 1992, 1989).

Culturally Responsive Mathematics Instruction

Wagner, Roy, Ecatoiu and Rousseau (2000) discuss the parallel between culturally relevant teaching (Ladson-Billings, 1994) and mathematics. NCTM (2000b) emphasizes the need to acknowledge the role of culture and the inclusion of diverse cultures' contributions to the development of mathematics for effective mathematics learning for diverse students, even at the secondary school level. The authors note that barriers to implementing culturally relevant mathematics instruction include structural constraints of the classroom environment; low expectations associated with teacher beliefs, and classroom norms such as assessment and tracking. Although the notion that all students can learn mathematics is often cited (Ladson-Billings, 1994), there are still many instances where minority students are considered "at risk of failure" or "unteachable" (Ladson-Billings, 1994, p. 44).

Because culturally diverse students often have different frames of reference, it is important for educators to consider these cultural differences as a platform for

constructing learning experiences that might assist students in their pursuit of success in mathematics. Wagner et al. (2000) constructed a culturally relevant mathematics application that combines socially critical knowledge and math skills necessary for college entrance exams (algebra and systems of equations). Students investigated and analyzed the HIV/AIDS epidemic in their community, providing evidence that the material covered in math classrooms can be rigorous and socially relevant at the same time.

Stiff (1990) illustrates the conflict between African American students' cultural frame of reference and the culture of the traditional mathematics classroom (Hilliard, 1998; Tate, 1994, 1995). Smith, Stiff and Petree (2000) provide a perspective on the factors that affect African American students' entry in algebra courses. They discuss the issue of African American students taking computer-based, low-level mathematics courses in seventh, eighth, and ninth grades and lacking the opportunity to develop strong problem-solving skills. In their research, Smith et al. (2000) realized that African American students prefer activity-based learning; however, working in small interactive, manipulative-based groups in prealgebra and algebra in not common for African American students (Heid & Jump, 1993; Stiff, 1990). As a result many African American students never learn how to utilize the language of mathematics appropriately. When presented with terminology in open, abstract problems, many African American students are overwhelmed and experience levels of discomfort.

In their study, Smith et al. (2000) presented problem-solving vignettes to African American students. Through group discussions of real-life problem situations, they found that students were able to approach complex mathematics problems more effectively and

with much more success. Overall, they found that when students understood the basic ideas of the problems, they learned important algebraic concepts and their self-efficacy and overall interest in algebra increased

Professional Development in Math Education

In *We Can't Teach What We Don't Know*, Gary Howard (2006) presents a poignant perspective of diversity in the public schools. He explains that "diversity is not a choice, but our responses to it certainly are" (p. 4). Howard asserts that educators have not adequately addressed or considered the complexities associated with teaching a multicultural student population. He calls for teachers to take a more proactive approach in understanding the needs of their diverse student population and making pedagogical choices accordingly. Wagner, Roy, Ecatoiu & Rousseau (2000) acknowledge that, "achieving more equitable mathematics education is not an easy task" (p. 120), yet they also emphasize the need for teachers to transcend traditional perspectives about African Americans' achievement in the mathematics classroom. Unfortunately, teachers' "cultural blindness " often stems from the belief that "good teaching is transcendent [and] identical for all students and under all circumstances" (Gay, 2000, p. 21). Additionally, there is a belief that for students of diverse cultural heritages, education is a means of assimilation into mainstream society and all students should have the same experiences (Gay, 2000).

Professional development can provide a domain for meaningful dialogue as well as personal and professional reflections as inservice teachers endeavor to increase their pedagogical knowledge for appropriate and effective mathematics instruction with a

diverse student population. The National Council of Teachers of Mathematics Standards (NCTM, 2000a) emphasize a need for teachers to "not only upgrade their knowledge of mathematics but also develop a greater understanding of how students think about and learn mathematics and broaden their toolkit of pedagogical strategies from which they can grow" (as cited in Heck et al., 2008).

The mathematics community has taken action to upgrade inservice teacher professional development opportunities (Heck, Banilower, Weiss, & Rosenberg, 2008). While there is limited research on professional development in mathematics with African American students, empirical findings on mathematics professional development with inservice teachers in general can provide a rationale for a need for this particular type of research.

Zaslavsky and Leiken (2004) conducted a five-year reform-oriented in-service professional development project with 120 high school math teachers focused on helping teachers to: (a) learn challenging mathematics in ways that they are expected to teach and (b) engage in alternative models of teaching (Zaslavsky and Leiken, 2004) Their research focused on mathematics teachers who participated in the program (MTs), the project staff members who served as mathematics teacher educators (MTEs) and the project director/leading researcher who was seen as the teacher educators' educator (MTEE). They borrowed Jaworski's approach (1994), which includes management of learning, sensitivity to students and the mathematical challenge as the theoretical framework for their work. This study also utilized teacher reflections as a means to incorporate instructional variety into the learning environment that would be more appropriate for the students. A collection of personal stories from participants and team members indicate

discoveries ranging from the critical nature of revising an original task to meet the needs of learners to appreciating the power of open-ended mathematical tasks as a window into the cognitive abilities of learners.

Garcia, Sanchez and Escudero (2006) build on the research of Zaslavsky and Leiken (2004) and also borrowed from Jaworski (1994). Garcia et al. (2006) focused on the ideas of reflection-on-action, community of learning and situated knowledge in a professional development context for preservice teachers in mathematics. According to Garcia et al. (2006), these preservice teachers were reflective members of a community. Along with other mathematics educators, they engaged in situated learning and the community of learning as elements used in their practice as mathematics teacher educators. In the discussion of their work, these preservice teachers observed that not only should they be aware of theoretical models, but in fact make use of them to improve their practice. They also note that theory provides a foundation to make practice "operative" and "enables us to develop our professional activity with the support of theoretical referents" (p. 13).

The influence of professional development on mathematics teachers is also noted in Heck, Banilower, Weiss, and Rosenberg's (2008) study, sponsored by the National Science Foundation (NSF). This 7-year study of 48 projects investigated the relationship between professional development and standards-based instruction in mathematics. Results indicate that most teachers only participated in a moderate amount of professional development trainings (100-130 hours), which was less than what Heck et al. (2008) recommended. For the professional development that teachers did receive, the effects on dimensions such as attitudes and preparedness had positive impacts on their teaching

practices. However, greater effects were evident as teachers' participation in professional development increased. These findings indicate that more extensive, content-focused professional development beyond what teachers currently receive would have beneficial outcomes.

Gellert's (2008) research presents a phenomenological study through a group interview method that was designed to expose the effectiveness of teacher development through a professional development model. The professional growth model reveals that the collective process can be seen as an obstacle because "an over-confirmed framework of collective orientations can prevent professional development" (p.19). There is a sense of validation through camaraderie, which can hinder authentic pedagogical change. Additional findings indicate that in order to notice systemic authentic change in mathematics teaching, professional development within communities of teachers of mathematics must be made public.

According to Gellert (2008), in order for pedagogical change to be authentic teachers have to do three major things: (1) find ways to transfer the knowledge that they attain from professional development opportunities into actual changes in classroom instruction; (2) turnkey (share) their insights with others in the educational community by providing exemplars of pedagogical improvements—making their experience public; and (3) maintain self-reflection (as a group and individually) toward continual growth. Gellert (2007) notes a tendency for teachers to return to former ways of doing things after professional development. Focusing on these areas is critical to preventing "consolidated routines" (p. 107).

Conceptual Framework

This study was built on three perspectives: culturally responsive teaching (Gay, 2000), NCTM process standards (NCTM, 2000a) and NCTM' s Equity principle (NCTM, 2000a). Integrating the three areas provided a comprehensive framework for examining the extent to which teachers self-report the actual "use" and "desire" to use these components in mathematics instruction with African American students. Table 2-2 summarized the elements of culturally responsive teaching methods, NCTM Process Standards and NCTM Equity Principle.

Table 2-2 Integrated Framework

Culturally Responsive Teaching Methods (Gay, 2000)	NCTM' s Process Standards (NCTM, 2000)	NCTM' s Equity Principle (NCTM, 2000)
• Validating • Empowering • Comprehensive • Multidimensional • Transformative • Emancipatory	• Connections • Communication • Problem Solving • Representations • Reasoning and Proof	• High expectations • Understand strengths of students • Respond to the needs of linguistically/culturally diverse students • Understand and confront biases • Provide assistance to help students meet expectations • Support differences • Careful selections of learning opportunities • Accommodate effectively and sensitively • Use of community resources

Summary

A number of researchers have explored issues of race and culture and how these issues impact the learning environment for African American students in the math classroom (Ladson-Billings, 1995a, 1995b; Gay, 2000; Lee, 2002; Lipman, 1995; Moody, 2000; Tate, 1994, 1995), especially in the area of algebra (Moody, 2000; Moses and Cobb, 2001; Smith et al., 2000; Wagner et al., 2000). NCTM' s (2000a) five process standards and the Equity principle provide guidelines for effective and equitable mathematics instruction. While there has been some research on the impact and instructional effectiveness of culturally responsive teaching methods (Ladson-Billings, 1995a, 1995b; Tate, 1995) in the learning environment, there is a need to continue to research the application of these methods in mathematics classrooms (Tate, 1994).

CHAPTER 3 - Methodology

This study used a mixed method approach (quantitative and qualitative inquiry) to investigate in-service teachers' "use" and "desire" to use culturally responsive teaching methods, NCTM Process Standards, NCTM' s Equity Principle in algebra with African American students in elementary and middle school. Additionally, general mathematics efficacy and efficacy specifically in algebra was also explored. Teachers from two elementary and two middle schools responded to a 50-item demographic questionnaire and a Likert-style survey called *The Powell Teaching Mathematics Index* (PTMI). The PTMI explored teachers' self-reported use of CRT methods as well as their desire to use such methods in mathematics. Additionally, NCTM' s process standards, NCTM' s Equity Principle, and personal efficacy in learning and teaching mathematics (in general and in algebra) with African American students were also assessed with the PTMI.

After the completion of the survey, eight teachers volunteered to participate in a four-part professional development series that focused on using culturally responsive teaching in algebra instruction with African American students. During the third session, participants selected one of the six CRT methods for implementation in algebra lessons over a one-month period. Participants documented experiences (strengths and strains) during the implementation process through written journal entries. During the fourth and final session of the PD sessions, teachers reported their experiences to the larger group.

Research Questions

This study answered the following questions:

1. To what degree do in-service teachers self-report the actual "use" and "desire" to use culturally responsive teaching methods, NCTM process standards and the Equity principle in mathematics with African American students?
2. To what degree do in-service teachers self-report personal efficacy in teaching and learning mathematics in general? In algebra? With African American students?
3. What do in-service teachers report about the "strengths" and the "strains" in implementation process of culturally responsive teaching methods in algebra with African American students?

Conceptual Framework

Table 2-1 presented the conceptual framework for this research. This integrated conceptual framework was used to guide the development of all instruments used to collect data as well as to shape the design of the four part professional development sessions. Table 3-1 presents the instruments developed for the study as they related to the conceptual framework and demographic information collected on the participants. The *Powell Teaching Mathematics Index* assessed in-service teachers' "use" and "desire" to use CRT methods in mathematics, "use" of NCTM' s process standards; "desire" to use process standards with AA students, "agreement" with NCTM' s Equity principle, "confidence" in teaching and learning mathematics in general and in algebra content area

of algebra for grades K-8. The professional development component was designed to investigate the "strengths" and "strains" (Boyer, 1990; Robins et al., 2002) of the implementation process of culturally responsive teaching. The professional development protocol describes the content and process elements of the four professional development sessions. These sessions were videotaped and used for purposes of analysis. Journal response prompts were designed to facilitate the reflection process during the professional development sessions and during the implementation period. All data sources were combined and utilized for analysis.

Table 3-1- Data Sources

Source	CRT	Process Standards	Equity Principle	Efficacy	Demographic Information
PTMI	X	X	X	X	X
Professional Development Protocol	X	X	X	X	X
Journal Response Prompts	X	X	X	X	

Instrumentation Development

The Survey Instrument

The *Powell Teaching Mathematics Index* (PTMI) (Appendix M) is divided into two parts, the first is a demographic questionnaire designed to collect information on variables that research has shown to be relevant to teachers' knowledge of and

willingness to implement culturally responsive teaching methods (Gay, 2000). It poses eight multiple-choice questions covering gender, ethnicity, background (location and ethnic composition of high school), current teaching grade level, total years teaching, number of years teaching at the current grade level, and racial composition of current class. Because this study was concerned with cultural implications, it was necessary to assess the cultural/racial background of the participants. Collecting information about high school racial/cultural breakdowns provides insight into the cultural/geographic history of participants (Anyon, 1981; Bakari, 2000, Ladson-Billings, 1995b). The information collected provided insight into the relevance of these variables for this study (i.e., teaching experience, ethnic background of teachers, teaching experiences at the current teaching level and teacher background information). Research emphasizes the influence of exposures to diverse people as one indicator of overall attitudes toward diverse students in the school setting (Middleton, 2002; Powell et al., 2001; Sprott, 2007; Ukpokodu, 2004), hence the questions relating to "ethnic composition of high school class". Additionally, inquiring about gender and ethnic identification of the teachers provided demographic information as well.

Table 3-2 presents the distribution of items in the second part of the *Powell Teaching Mathematics Index* (PTMI) relative to the seven areas probed. The PTMI is a 61-item (62 for grade 6-8), 5-point Likert-scale instrument designed to assess in-service teachers' "use" and "desire" to use culturally responsive instructional strategies, NCTM process standards and Equity principle in mathematics instruction with African American students. The instrument also assessed in-service teachers' learning and teaching efficacy

in mathematics in general and in the specific content area of algebra and in teaching algebra to African Americans.

As shown in Table 3-2, approximately 42% of the instrument was devoted to assessing teachers "use" and "desire" to use CRT methods in mathematics with African American students. The next sizable portion of the survey assessed teachers' "use" of process standards with all students and "desire" to use process standards with African American students and made up 26% of the survey. The next two sections made up about 20% of the survey and were designed to assess teachers' "agreement" with the equity principle and general efficacy in learning and teaching mathematics,. The last section on the PTMI was grade specific (K-2, 3-5 and 6-8). This section made up approximately 13% of the PTMI and was designed to assess teachers' efficacy with algebra concepts. The Grade 6-8 section contained one additional item.

Table 3-2 -Distribution of Items on the Powell Teaching Mathematics Index (PTMI)

Culturally Responsive Teaching	NCTM Process Standards	Equity Principle	Efficacy (General)	Efficacy (Algebra) (K-2)	Efficacy (Algebra) (3-5)	Efficacy (Algebra) (6-8)	Total
26 (42%)	16 (26%)	6 (10%)	5 (9%)	8 (13%)	8 (13%)	9 (15%)	61 or 62 Items

The development of the PTMI was based on Hart's (2000) Mathematics Belief Instrument (MBI), Bakari's (2000) Teaching African American Students Survey, National Council of Teachers of Mathematics (NCTM) five process standards, and Equity principle for mathematics (NCTM, 2001a). Finally, a modification of the Science

Teaching Efficacy Belief Instrument (originally by Enochs and Riggs, 1990 and revised by Bleicher, 2004) as well as other theories and research findings (Banks, 1991, 1996, 2006; Gay, 2000; Stiff and Harvey, 1998) were utilized. Each is described in the paragraphs that follow.

The MBI (Hart, 2000) is a three-part instrument based on the Standards Belief Instrument (SBI) (Zollman & Mason, 1992), which assesses the alignment of teachers' beliefs to NCTM evaluation standards. This survey assessed change in teacher beliefs about teaching and learning mathematics in and outside of the school setting and included two items on teacher efficacy in learning and teaching mathematics. The two items on efficacy were included in the PTMI.

Bakari's (2000) *Teaching African American Students Survey* includes two subscales: cultural sensitivity and efficacy/willingness. The PTMI utilized the term "desire" to probe in-service teachers' willingness to implement culturally responsive teaching methods. In her instrument *Teaching African American Students* (TAAS) Bakari used the term "willingness". The sentiment of willingness was adapted to "desire" for this study.

NCTM's Equity Principle (2000a) provides a guideline for ensuring equal access to mathematics for all students, especially those of diverse backgrounds. The Equity principle emphasizes the importance of high expectations for all students. Six of the items on the PTMI were developed to reflect the essence of this principle:

- High expectations and strong support for [African American] students
- Well-documented examples demonstrate that all children can learn mathematics when they have access to high-quality mathematics instruction

- All students, regardless of their personal characteristics, backgrounds, or physical challenges, must have opportunities to study-and support to learn-mathematics (NCTM, 2000a, p. 12-14)

Enochs and Rigg's (1990) Science Teaching Efficacy Belief Instrument guided the direction of for the efficacy section of the PTMI. Two of the five items on the *Powell Teaching Mathematics Index* were adapted from the Enochs & Riggs' (1990) instrument on efficacy. Research, (Stiff & Harvey, 1998; Ladson-Billings, 1995a, 1995b; Lee, 2002; Lipman, 1995; Moody, 2000; Tate, 1994, 1995) highlights the importance of cultural considerations such as motivation and experienced success, in the classroom as a basis for effective instruction. These ideas were also integrated into the PTMI.

The *Powell Teaching Mathematics Index* used a five-point scale designed to allow participants to choose the magnitude of their agreement or disagreement with statements and included an option for neutrality. Separate questions addressed actual use and desire to use culturally responsive teaching methods, NCTM process standards and Equity principle and efficacy in mathematics and with African American students.

The culturally responsive teaching section was divided into two parts. There were thirteen items in each section. The first part assessed teachers' "present use" of culturally responsive teaching with African American students. The second part assessed teachers' "desire" to use culturally responsive teaching methods with African American students. For each statement, participants were asked to select their degree of agreement. This information was analyzed as the degree to which participants "use" and "desire" to use culturally responsive teaching methods in mathematics with African American students.

The process standards section was also divided into two parts. There were eight statements for each section. The first part assessed teachers "present use" of process standards with all students. The second part assessed teachers' "desire" to use process standards with African American students. For each statement, participants were asked to select their level of agreement on a scale of 1 to 5.

The equity section was titled "attitudes/perceptions". There were six statements in this section. Participants were asked to indicate their level of agreement with each statement. The efficacy section was titled "confidence". The first part of this section contained five statements and participants indicated their degree of confidence for each statement. The last efficacy section was grade specific; divided for grades K-2, 3-5 and 6-8. Each item in this section came directly from NCTM' s algebra content standards (NCTM, 2000a). Participants also indicated their level of confidence with teaching each mathematics standard.

Bakari's (2000) research revealed pre-service teachers reported a higher willingness to teach African American students but a lower willingness to demonstrate cultural sensitivity to African American students' needs in the learning environment. This suggests that teachers were welcoming and comfortable with teaching African Americans students, but did not see the need nor were they willing to adjust their teaching methods to respond to the cultural needs of African American students. In her work with in-service teachers Ladson-Billings (1995a, 1995b) reported that when teachers are cognizant of the social and cultural realities of their students, they structure the learning environment accordingly. The PTMI was developed as a means to assess teachers' "use"

and "desire" to use CRT in mathematics instruction, with special attention on African American students.

Expert Panel

An expert panel was utilized to evaluate the clarity and consistency of the items on *The Powell Teaching Mathematics Index* (PTMI). The group consisted of three individuals who were proficient in mathematics instruction and/or knowledgeable of culturally responsive instruction, with expertise ranging from 5-15 years in the field. Table 3-3 presents the character of the expertise that each panel member brought to the study. Appendix A presents the questions to which the members of the expert panel were asked to respond

The panel was provided with the objectives and research questions for the study. Respondents were asked to review the PTMI but did not actually respond to any of the items. Expert panel feedback suggested the following ideas related to the overall quality and clarity of both the demographic survey and the PTMI.

1. *How well do you think the items on this instrument are aligned to the research questions presented?*

   All respondents believed that the items on both the demographic survey and the PTMI were appropriately and adequately aligned to the study's research questions. One suggestion for the demographic survey, however, included looking closely at the discrepancy in responses related to items 4 (asked for percentages) and 8 (asked for specific numbers). The panel suggested both items use the same response format.

2. *How do you rate the clarity of the stated directions?*

The expert panel suggested that the directions be provided for each of the other five specific categories on the PTMI (NCTM process standards, Confidence in Mathematics (efficacy), Attitudes Toward Mathematics (Equity Principle), and Teaching Algebra Content) because many participants may be unfamiliar with the content of the survey. There also seemed to be a need for additional directions/clarity related to how participants should be thinking about this part of the statement. The second column ("I would like to….) may be a source of confusion for actual participants. Providing examples in addition to what is provided (i.e., "How I would like to believe") may prove helpful. Along the same lines, the third suggestion was to replace the wording, "I would like to….", with "I desire to". This may provide the additional clarity for what participants should be thinking about while completing this section of the survey.

3. *How do you rate the clarity of each of the statements?*

   Panel respondents believed that each of the statements on the PTMI was clearly stated.

4. *Which items would you add? Why?*

   Suggestions were to add A.A. as an abbreviation for African American in instances in which the term African American is not used (i.e*., I provide adequate assistance in order to ensure that all students meet high mathematics expectations.)* so that more general statements are not misinterpreted to mean "all students." Additionally, it was suggested that a statement be added that addresses peer interaction in the learning environment among African American students.

5. *Which items that you think should be eliminated? Why?*

Panel suggestions included the elimination of the second column ("I would like to…) from Part 4: Confidence in Teaching Mathematics. Reasons were, "if the reader is not confident in any area and rate themselves 1 or 2, they might go directly to the "I would like to" columns and rate themselves a 5. If this were the case, would these responses affect the data analysis for this section if only response per item is anticipated?"

6. *General Comments and Suggestions*

Suggestions for revision included evaluating the number of items on the survey to ensure that the length of time associated with completing the survey would range from 10-12 minutes, which is deemed as acceptable for survey completion. Based on the suggestions/comments from the expert panel, adjustments were made in accordance with the overall objectives of the study.

Table 3-3 Expert Panel Demographics

Expert Panel Participants	**Area of Expertise**
Expert Panel Member #1	Algebra Instruction-Grade 9 (5 years) Masters in Curriculum and Instruction
Expert Panel Member #2	Algebra Instruction-Grades 6-8 (20 years) Doctorate in Curriculum and Instruction Research Design
Expert Panel Member #3	Mathematics Instruction /Elementary (15 years) Doctorate in Curriculum and Instruction Culturally Responsive Teaching Methods

Pilot Study

A sample of teachers from two schools from a neighboring district were administered the *Powell Teaching Mathematics Index* (PTMI) and responded to a set of open-ended questions for the purpose of feedback. Appendix B lists the question to which the pilot participants were asked to respond. African Americans represented 18% of the total student population at both schools (which is the highest in the school district). The participants involved in the pilot study were not a part of the sample for the actual study. This process served as another check on the clarity of the items appearing on the PTMI.

The feedback from the pilot study participants indicated that most teachers felt that the instructions were clearly stated and most were able to complete the survey in the time frame indicated in the directions. One teacher commented on the conflict of responding to a survey about African American students that was developed and administered by an African American researcher. As a result, this comment was included as a limitation for the study.

Journal Writing Prompts

Wink (2005) admonishes teachers to think deeply about their pedagogy as a means to grow professionally and written reflections can prove purposeful. Jaworski (1994) encourages teachers to maintain self-reflection of pedagogical practices as a means to not only expand their professional toolkits but also make instructional adjustments as necessary. The journal writing prompts were developed as a means to assist teachers in their reflective process during the professional development sessions and during the implementation period. (See Appendices E) The seven questions for the

first two sessions were related to teachers' personal reactions to the professional development (PD) session, reflections from the assigned readings, algebra instruction and reflection on the implementation of CRT methods. The implementation guide provided a mind mapping structure for teachers to identify their self-selected CRT method as well as record the "strengths" and "strains" of the implementation process (See Appendix F).

Population and Sample

Although teacher demographics may vary somewhat, research indicates that in general, over 80% of all teachers are White females (Tab, 2007). It was anticipated that the in-service teachers participating in this study would closely reflect this finding. Because this study focused on in-service teachers' "use" and "desire" to implement culturally responsive teaching methods, NCTM process standards and NCTM' s Equity principle in algebra with African American students, it was reasonable to target schools that serve a significant number of African American students. The sample was drawn from one school district serving 7,052 students during the 2007-2008 school year. As a district, 48.80% students were White, 22.67% African American, 19.76% other and 8.78% Hispanic. There were 51.62% male and 49.38% female students. Finally, 38.67% of students were from low socioeconomic backgrounds (KSDE, 2009). The choice of this population reflected convenience with attention given to maximize the number of African American students served.

Two middle schools (only two in the district) and the two elementary schools that served the highest percentage of African American students (18%-42%) were selected for this study. Table 3-4 contrasts the percentage of African American students who

met, exceeded or scored exemplary on the standardized math assessment in 2008 with their White counterparts, given the relative proportion of African American student enrollment at each school. (Note: There was no 2008 score for African American 5th graders at Elementary Site #2, so the 2007 score was used). While standardized exam scores are only one form of assessment, they provide useful information related to instructional improvements.

A significant number of African American students across the four schools scored well on the standardized exam. At Elementary Site #1, 100% of both African American and White 4th grade students scored at or above proficiency. At Elementary Site #2, 100% of African American 4th graders also scored at or above proficiency, while 93% of White students scored at or above proficiency. In general, middle school students did not score as well as their elementary peers. Additionally, White 6th grade students at both middle schools outperformed African American students, by a substantial amount. This data suggested that elementary school teachers might have been implementing strategies that yield higher levels of mathematics achievement with their African American student population.

Table 3-4 Percent of White and African American Students Who Scored at the Met/Exceed/Exemplary Levels on the 2008 Kansas Math Assessment

Site	African American Students	Percentage of White Students who Met/Exceed/Exemplary Standards	Percentage of AA Students who Met/Exceed/Exemplary Standards
Elementary Site #1 (Grades 3-5)	42.21%	3rd-84% 4th-100% 5th-100%	3rd-70% 4th-100% 5th-92%
Elementary Site #2 (Grades 3-5)	21.45%	3rd-100% 4th-93% 5th-100%	3rd-90% 4th-100% *5th-88% *(This is from 2007, no score reported for 2008)
Middle #1 (Grades 6-8)	24.13%	6th-90% 7th-66% 8th=68%	6th-70% 7th-73% 8th-68%
Middle #2 (Grades 6-8)	18.10%	6th-82% 7th-89% 8th-73%	6th-46% 7th-84% 8th-68%

(KSDE, 2009)

All teachers, grades K-8, from the four identified schools were invited to participate in the study when taking the PTMI. They then had the option to volunteer for the four-part professional development sessions. There were a total of four 3-hour sessions (12 hours), over the course of four months (November –February) during the 2008-2009 school year. All four sessions were videotaped. All four sessions were held in the same building and three of the four sessions were held in the same room. Each session began with a short meal and relaxed dialogue among the participants. A power point presentation was made at each session. Participants received handouts of the power

point presentations (either during/after the sessions), related readings from educational journals/publications, journal writing prompts and follow-up emails over the four-month data collection period. Detailed outlines of each session can be found in Appendix D.

Session one outlined the background, description and purpose of the study as well as the overall purpose of the professional development sessions. The related research question was also outlined. Discussion questions included:

- Participants' rationale for their participation in the PD sessions
- Algebra as a content focus
- Equity in mathematics
- Overall experiences with AA students during mathematics instruction
- Degree to which cultural backgrounds/experiences are included in the construction of mathematics lessons
- Reflection on mathematics instructional practices

An introduction to culturally responsive teaching was also presented. This included the CRT methods and their relationship to the achievement dilemma with minority students (Gay, 2000). A brief explanation of the 6 components was also provided. Journal writing prompts and research articles were distributed. The session ended with additional time for questions/concerns.

Session two began with reflections from session one on the related readings distributed during session one. Discussion questions centered on:

- Attitudes/perception (efficacy) toward mathematics instruction
- Attitudes/perception (efficacy) toward algebra instruction
- Use of math manipulatives

- Experiences with AA students in mathematics
- Overall mathematics pedagogy
- The degree to which CRT is incorporated in the mathematics classroom
- Two video examples of CRT

Participants then examined three of the six culturally responsive teaching methods (empowering, validating, comprehensive). The group also watched a math lesson in which a mathematics educator (Deborah Ball) provided an example of culturally responsive teaching with a group of African American students. PD participants discussed the extent to which CRT methods were utilized. Lastly, participants discussed evidence of CRT and possible ideas for incorporation in elementary and middle school classrooms.

Session three began with an outline of its purpose. Participants discussed highlights from the readings and addressed further thoughts about implementing CRT methods into their mathematics instruction. Participants reviewed the first three CRT methods from session two and then examined the last three methods (multidimensional, transformative and emancipatory). While taking all 6 methods into account, participants reflected on the method that seemed most applicable to their African American student population and math instruction. Teachers utilized the Game Board of Change, which invites them to first consider their ideal culturally responsive classroom, reflect on the classroom components that they currently had in place and finally identify the necessary steps to move them from their current classroom practices to a more culturally responsive environment. The end of the session was devoted to participants brainstorming about how each CRT method might be incorporated into mathematics classrooms. Finally, the

implementation guidelines were reviewed. Participants selected a CRT method and began to identify specific ways to incorporate the method into math lessons over the one-month implementation phase.

During session four participants were each given 10-15 minutes to share results from the implementation phase, the selected CRT method, mathematical content, student responses, and "strengths" and "strains" of the implementation and professional discoveries. The session ended with reminding participants that final research findings would be shared and monetary "thank you" for their participation in the PD sessions would be provided. Words of gratitude and appreciation were also extended.

Data Collection

Part 1: Administration of Instrument

The PTMI was administered via an online portal to 50 teachers in four schools (two elementary schools and two middle schools) within one school district. The researcher established contact with the district's superintendent and assistant superintendent. An overview of the research project was outlined. Once permission was granted, one-on-one conversations were scheduled and conducted with each of the four building level administrators.

At these meetings, the research project was further discussed and any pertinent questions/concerns were addressed. At the middle school level, the principal initially served as the primary point of contact with teachers. Both building principals provided the researcher with a list of teachers to contact, and communication was established via email.

Details regarding the follow-up professional development sessions were also provided. At the elementary schools, the researcher personally met with the teachers during a faculty meeting and outlined the purpose of the research project survey as well as the follow-up professional development sessions. These meetings provided time for questions/concerns. At all sites, teachers were provided with an abstract of the study.

P*art 2: Professional Development Sessions*

The process of integrating theoretical research into everyday classroom teaching can be challenging (Heid, Middleton, Larson, Gutstein, Fey, King, Strutchens and Tunis, 2006). However, this study focused on this integration process. The professional development component was designed to explore the "strengths" and "strains" (Boyer, 1990; Robins et al., 2002) of the implementation of culturally responsive teaching in algebra with African American students. All professional development participants responded to the PTMI before the beginning of the professional development sessions. Each professional development session was 3 hours and the four sessions were conducted over the course of 4 months (November, December, January, February), for a total of 12 hours. Specific locations for the sessions were based on availability of space and convenience for participants. At the end of the third session, each participant self-selected one culturally responsive teaching method for implementation in her mathematics classrooms during algebra lessons. While all participants were encouraged to attend all 4 sessions, they were also informed of the voluntary nature of participation. They had the right to withdraw at any time without notice or rationale. Finally, participants were informed that all sessions would be videotaped.

At the beginning of each session, the researcher provided some basic background of the research study and brief personal background of the researcher (place of origin, education, etc) as a means to cultivate rapport with the group. In order to provide each person with an initial opportunity to speak, participants were also invited to introduce themselves to the group.

Because the professional development sessions were meant to provide participants with instruction on CRT methods as well as provide deeper understanding of the factors that influence the implementation of NCTM' s process standards and the Equity principle in mathematics classrooms for African American students, these sessions were designed for the fluid exchange of ideas among participants. The researcher provided questioning prompts to engage participants in conversation based on culturally responsive teaching methods, NCTM' s process standards and equity principle from the components represented in the survey instrument (See Appendix C) as well as specific information on CRT methods in the algebra setting. These sessions provided data that was later analyzed.

In order to optimize the effectiveness of the sessions, the researcher served as the facilitator, posing questions taken directly from the PTMI, while concentrating on facilitating group interactions. Participants were encouraged "to express their points of view in an atmosphere of mutual respect and to facilitate interaction among the participants in order to understand underlying attitudes and beliefs related to CRT methods during algebra instruction" (Kleiber, 2004, p. 91) as well gain additional knowledge of the actual CRT methods.

Part 3: Action Research and Implementation

This study utilized an action research approach during the implementation phase. Action research is a process used by teachers for the purpose of examining their own instructional practices. Teachers who engage in action research often become more effective as they evaluate their own practices toward sustained change (Ferrance, 2000). Krathwohl (1998) states, "the knowledge we trust most is that which grows out of our own experiences" (p. 591). Because action research is about teachers paying attention to what they do and how they think about the important decisions to improve, it was appropriate to incorporate the action research approach for this study.

During the third session, each participant self-selected one CRT method that they thought would be most feasible for their implementation. They were to intentionally employ the selected method during algebra lessons during a one-month period, with particular attention on their African American students. Each participant was reminded to respond to journal prompts during the implementation month. Journal responses were designed to evoke reflection during the implementation process ranging from: strengths, strains and student and professional discoveries (See Appendix F). The importance of recording reactions was emphasized. Participants were informed of the specific timeline for implementation as well as the date of the final session. Additionally, all participants were provided with the researcher's contact information (phone number/ email), if questions were to arise during the process. The researcher also made email contact with all participants during the one-month implementation phase.

While the researcher provided guiding questions and information about the methods, implementation of the CRT method was subject to teachers' interpretation of the method. Furthermore, at the end of the implementation phase, teachers reported the "strengths" and "strains" of the implementation process. It was important for teachers to experience and report their experiences from their implementation phase. Results from the implementation phase provided information for the teacher and the researcher alike.

Data Analysis

Table 3-5 shows how each of the data sources relates to each research questions. Transcripts from all professional development sessions (videotaped) were compiled. Collected data was analyzed for recurring and emergent themes during the professional development sessions. All journal entries were collected from the participants and also analyzed for themes related to strengths, strains and discoveries of student performance during the implementation process. The data collected for each of the PD participants is presented in a case study format. According to Stake (1995) case studies allows for an "analysis of multiple sources of data to determine evidence" (as cited in Creswell, 1998, p. 153). The researcher described each implementation case, looked for patterns within cases and developed generalizations between cases. Participants were assigned a pseudonym that was used in the written description of individual cases. Sections of the PTMI were correlated and statistically significant relationships were revealed.

Table 3-5 Data Sources and Research Questions

Data Sources	Purpose	Research Question
PTMI	Assess use and desire to implement culturally responsive teaching components, NCTM process standards, Equity Principle and efficacy in algebra	• To what degree do inservice teachers self-report the actual use and desire to use culturally responsive teaching components, NCTM process standards and the Equity principle in mathematics with African American students? • To what degree do inservice teachers self-report confidence in teaching and learning efficacy in mathematics, in general? In algebra? With African American students?
Professional Development Sessions (PD Sessions)	Group discussions about (CRT, NCTM process and Equity Principle) Professional development model Provide further instruction on CRT Implementation of CRT component in algebra	• To what degree do inservice teachers self-report the actual use and desire to use culturally responsive teaching components, NCTM process standards and the Equity principle in mathematics with African American students? • To what degree do inservice teachers self-report confidence in teaching and learning efficacy in mathematics, in general? In algebra? With African American students? • What do inservice teachers report as strengths and strains to using culturally responsive teaching methods in algebra with African American students?
Journal Entries	Reflective practices in the implementation of CRT component in algebra	• What do inservice teachers report about the process of implementing culturally responsive teaching methods in algebra with African American students?

CHAPTER 4 - Presentation of Data

Research supports the importance of cultural connections in the learning environment (Ferguson, 2001; Gay, 2000; Kunjufu, 1986; Ladson-Billings, 1995a, 1995b Lee, 2002; Lowen, 1995; Thompson, 2004, 2002) and especially in mathematics (Hilliard, 1992, 1989; Stiff and Harvey, 1998; Tate, 1995). This study provided a context in which in-service teachers discussed and implemented culturally responsive teaching as connected to issues of cultural discontinuity and structural inequality in teaching mathematics to culturally diverse students. The study was divided into two parts: Completion of the survey instrument, *The Powell Teaching Mathematics Index* (PTMI) and an intervention designed to involve teachers in implementing selected components of culturally responsive teaching into mathematics instruction. Volunteer teachers:

- Explored the applicability of culturally responsive teaching to their classrooms.
- Experimented with selected components of culturally responsive teaching in their own classrooms.
- Identified and addressed the "strengths" and "strains" of the implementation process.
- Expanded their knowledge and sensitivity when working with African American students.
- Identified student reactions to the implementation process.
- Made professional discoveries during the implementation process.

The Powell Teaching Mathematics Index (PTMI)

The demographic section of the PTMI was designed to provide information on the background and experiences of the participants. Seventy-eight percent (N=39) of teachers started and 68% (N=34) finished the survey. Unless otherwise noted, all data reported is based on the 68% (N=34) of those who finished the survey.

Table 4-1 presents the frequency distribution for all items in the demographic section in the PTMI. For the most part, the sample was quite homogeneous. About 74% (N=23) of the teachers attended high school in either a rural or suburban location and 67.6% of teachers attended college in a rural or suburban location as well. The vast majority of teachers were White (88.2%) and female (88.2%). The respondents, however, were not evenly distributed across grade levels. Most (47.1%) taught in middle school (Grades 6-8) with next most sizable group (32.4%) being teachers in the elementary grades (3-5). Similarly, the respondents differed in the number of years of teaching experience. The largest number of teachers (35.3%) had seven or more years experience in teaching. The next largest group was those who had 1-3 years of experience (26.5%). The pattern was somewhat reversed on the number of years experience the teachers had at their current grade level. Here the largest number of teachers (35.3%) had taught for 1-3 years at the current grade level and 20.6 percent had seven or more years experience at the current grade level. Most of the respondents (64.7%) taught classes of 21-25 students.

Table 4-1 Frequency Distributions for Demographic Section of PTMI

N=34

Variable	Frequency		Percent
Gender	Male	1	2.9
	Female	30	88.2
	Missing	3	8.8
Ethnicity	African American	4	11.8
	White	30	88.2
HS Location	Rural	14	41.2
	Suburban	11	32.4
	Urban	8	23.5
	Missing	1	2.9
College Location	Rural	6	17.6
	Suburban	17	50.0
	Urban	10	29.4
	Missing	1	2.9
Grade Level	Primary (K-2)	11	32.4
	Elementary (3-5)	7	20.6
	Middle School (6-8)	16	47.1
Overall Experience	0-1 Year	4	11.8
	1-3 Years	9	26.5
	3-5 Years	2	5.9
	5-7 Years	7	20.6
	7+Years	12	35.3
Current Grade Experience	0-1 Year	6	17.6
	1-3 Years	12	35.3
	3-5 Years	5	14.7
	5-7 Years	4	11.8
	7+Years	7	20.6
Class Size	10-15 students	2	5.9
	16-20 students	8	23.5

	21-25 students	22	64.7
	More than 25	2	5.9

The remainder of the PTMI was divided into five sections, four of which were common to all respondents and one of which was grade specific. Chapter three outlined the four sections common for all respondents were: culturally responsive teaching (CRT section), NCTM process standards, equity principle, and general efficacy. The last section (algebra efficacy) was grade specific: Grades K-2, 3-5 and 6-8 (the grade 6-8 section had one additional item as compared to the other two grade specific efficacy sections.) The total score on the part of the PTMI taken by all participants was 257. This score would reflect respondents selecting 5 "strongly agree" or 1 "strongly disagree" for negatively worded items on the four common sections on the PTMI.

Table 4-2 presents the descriptive statistics for total scores possible with and without the grade-specific questions on the PTMI (N=33). One respondent skipped the "efficacy" section on PTMI, so a total score could not be calculated. Examining first the total scores based on the items all teachers completed (CRT, Process Standards, Equity and General Efficacy), the mean was 209.5 with a standard deviation of 19.7. When the grade specific questions are factored in, scores for K-2 teachers ranged from 196 to 274, with a mean of 232.6 and a standard deviation of 19.5. Grade 3-5 teachers scored considerably lower with scores ranging from 195 to 263, with a mean of 233.4 and a standard deviation of 23.4. Scores for Grades 6-8 ranged from 223 to 304, with mean of 257.1 and a standard deviation of 20.2. The total score possible for Grade 6-8 teachers (6-8 Total Score=310) was five points more than the other two groups (K-2, 3-5 Total Score=305). The lowest score for Grade 6-8 (223) was higher than lowest scores for the

other two groups (196 and 195). Overall, Grade 6-8 teachers scored about one standard deviation higher than Grade K-2 teachers and Grade 3-4 teachers.

All sections of the PTMI were worded such that agreement with the items was desired. When mean scores are compared to the total score possible, the mean was 81.5% for the total score based on the items that all respondents completed and ranged from 76.2% (total score for K-2 teachers) to 82.9% (total score for 6-8 teachers). In general all the teachers reported "use" and "desire" to use CRT, NCTM process standards and Equity principle. Teachers also reported personal and teaching efficacy in mathematics in general and specifically in algebra. The standard deviation between the groups varied a little, with the standard deviation being 23.4 (+/- 7.7% of the total score) for Grade 3-5 teachers. This group also had the smallest number of teachers (N=7) completing the PTMI. A larger sample size would have probably reduced the standard deviation to a value comparable to the others.

Table 4-2 Descriptive Statistics for Total Scores on PTMI

	Total Score (No grade-specific questions) N=33	**Total Score K-2 (Grade specific questions) N=10**	**Total Score 3-5 (Grade specific questions) N=7**	**Total Score 6-8 (Grade specific questions) N=16**
Total Score Possible	257	305	305	310
Mean	209.5 (81.5%)	232.6 (72.2%)	233.4 (76.5%)	257.1 (82.9%)

Standard Deviation	19.7 (+/-7.7%)	19.5 (+/-6.4%)	23.4 (+/-7.7%)	20.2 (+/-6.5%)

Table 4-3 presents the number of items, total possible score, mean score, standard deviation and Cronbach Alpha coefficient for the PTMI subsections that all teachers completed. Except for "confidence in math" (efficacy) subsection, the number of respondents in each section was 34. Only 33 teachers completed "confidence in math" (efficacy) subsection. As shown in the table, nearly half of the items (42.6%) dealt with culturally responsive teaching (CRT). If you look at the mean score of each subsection as a fraction of the total score possible on that subsection, the high is 0.81 for CRT and the low is 0.71 for "use" of process standards in general. The standard deviation for the "desire" to use process standards with African American students (SD=7.1) was considerably larger than the other subsections with equivalent numbers of items, suggesting more variability among the teacher responses.

As also shown in Table 4-3, the Cronbach Alpha for the subsections of the PTMI ranges from a low of 0.43 (Equity) to a high of 0.94 ("desire" to use process standards in algebra with AA Students). The Cronbach Alpha coefficient provides a measure of internal consistency of the items included in each subsection. The reliability coefficient squared provides an estimate of the percentage of score variance that arises from true differences among the respondents. A Cronbach Alpha coefficient of 0.70 is typically considered acceptable for attitude inventories.

One subsection, "Attitudes Toward Math" (equity) had an exceptionally low Cronbach Alpha. The number of items on this subsection may have contributed to a

lower Cronbach Alpha coefficient. There was one negatively worded item in this subsection that was recoded, *"AA students are served well by implementing a "traditional" (facts and drills) mathematics program."* A high response to this item (5-agreement) would indicate that the respondent believes that a traditional curriculum is most effective for African American students, which is not a reflection of equity awareness.

The Cronbach Alpha for "use" of process standards in general is 0.61 as compared to Cronbach Alpha of 0.94 for "desire" to use process standards in algebra with AA students. Examining the use of "Process Standards in General" (M= 28.4, SD= 3.5) and desire to use "Process Standards in Algebra with AA" (M=31.5,SD=7.1) subsections suggests that respondents expressed stronger agreement with a "desire" to use process standards in algebra with African American students as compared to "presently" using process standards with all students. There was also, however, greater variability among scores in the "Process Standards in Algebra with AA" as the standard deviation was a little more than twice that of "Process Standards in General."

Table 4-3 Descriptive Statistics for PTMI Subsections

Section	Number of Items	Total Possible Score	Mean	Standard Deviation	Cronbach Alpha (Reliability)	Fraction of Mean Score
CRT "use" and "desire"	26 (42.6%)	130	105.7	10.3	0.89	0.81
Process Standards (General) "use"	8 (13.1%)	40	28.4	3.5	0.61	0.71
Process Standards in Algebra (AA students) "desire"	8 (13.1%)	40	31.5	7.1	0.94	0.79
Attitudes toward math (Equity) "use"	6 (10.0%)	30	28.9	2.3	0.43	0.76
Confidence in math (Efficacy) "confidence"	5 (9.0%)	25	19.5	3.0	0.72	0.78
Efficacy1 (K-2)	8 (13.1%)	40	34.1	4.0	0.84	0.71
Efficacy2 (3-5)	8 (13.1%)	40	30.0	4.7	0.86	0.69
Efficacy3 (6-8)	9 (14.6%)	45	37.5	7.2	0.97	0.94

Table 4-3 also presents the descriptive statistics for the algebra efficacy subsection completed by each of the three groups. There was a considerable difference between the mean scores for Grade 6-8 and Grade 3-5 and K-2 teachers. Taking into account one additional item on the Grade 6-8 section, the mean score (37.5) is higher than the mean score for Grade 3-5 (30.0). Conversely, there is a greater variance in scores for Grade 6-8 (SD=7.2) as compared to Grade 3-5 (SD=4.7) and Grade K-2 (SD=4.0). The Cronbach Alpha for "algebra efficacy" (Efficacy 3-Grades 6-8) is substantially higher than the Cronbach Alpha for the other two grade-level specific efficacy sections. This suggests the Grade 6-8 teachers saw these items as more internally consistent than the Grade K-2 and 3-5 saw the items on their efficacy subsections.

Item Statistics of The Powell Teaching Mathematics Index (PTMI)

Culturally Responsive Teaching Subsection

The culturally responsive teaching section of the PTMI was designed to assess in-service teachers' use ("Presently I…) and desire to use ("I desire to…") culturally responsive teaching methods in mathematics with African American students. The first 13 items assessed "use" of CRT and the remaining 13 items assessed "desire" to use CRT. Participants responded to each item based on a 5-point Likert scale, with 1 representing "disagree" and 5 representing "strongly agree". There were no negatively worded items on this subsection of the PTMI. Appendix I presents the frequency distributions for all items in this section. There were no respondents who indicated

strong disagreement with any item on the CRT section and very few respondents selected "disagree". There were, however, several participants who selected "uncertain" as a response to items.

Table 4-4 presents the item statistics for the CRT section of the PTMI. Mean scores of 3.00 reflect uncertainty or an equal number who "agree" or "disagree". Means of 4.0 or higher indicate strong agreement and means of 2.0 or lower indicate strong "disagreement". Results on the CRT "presently" use subsection show that respondents "strongly agreed" with *"I set high expectations for my AA students in mathematics"* (M=4.47) and *"I communicate my expectations to my AA students"* (M=4.50). Conversely, respondents reported "disagreement" with *" I provide examples of prominent AA mathematicians during the school year for my AA students*" (M=2.47). Finally, respondents reported "uncertainty" or an equal number reported "agreement" and "disagreement" on all other items in this section, with item means ranging from 3.06 to3.97. The standard deviation on the item scores on the "use" subsection ranged from 0.56 to 1.02. The greatest variance occurred with, *" I provide examples of prominent AA mathematicians during the school year for my AA students"* (SD=1.02) followed by *"I provide opportunities for AA students to share their problem-solving techniques with each other in small groups at least twice a week."* (SD=1.00) The lowest variance was observed with "I communicate my expectations to my AA students" (SD=0.56) followed by *"I use the mathematics curriculum in ways that assist AA students to make sense of the problems"* (SD=0.58). The standard deviation for the remaining items ranged from 0.69 to 0.99.

On the "desire" section, the average mean on all items was higher than the average mean on the "present use" items. The average standard deviation for the "desire" to use CRT section was 0.70, which was lower than the average standard deviation for the "present use" section (SD=0.78). The average mean difference of items on the "use" scale compared to the "desire" to use scale was 0.69, comparable to1.0 to 1.15 standard deviation on any given item. Respondents reported the "strongest agreement" with "*I set high expectations for my AA students in mathematics*" (M=4.74) followed by *"I communicate my expectations to my AA students"* (M=4.71). The largest differences between item means for the "use" and "desire" to use sections were "I provide examples of prominent AA mathematicians during the school year for my AA students" (1.62) and "I incorporate AA students' cultural experiences in the construction of mathematics lessons" (1.23). In general, teachers reported a strong "desire to" incorporate CRT in mathematics with AA students, as evidenced by item means for the remainder of the section ranging from 4.09 to 4.59.

Table 4-4 Item Statistics for CRT Subsection

"Use"	**Mean**	**Standard Deviation**
I employ culturally responsive teaching strategies in mathematics.	3.41	.78
I incorporate AA students cultural experience in the construction of mathematics lessons.	3.06	.74
I set high expectations for my AA students in mathematics.	4.47	.66
I communicate my expectations to my AA students.	4.50	.56
AA students often meet my academic expectations set for them in mathematics.	3.88	.91
I provide opportunities for AA students to share their problem-solving techniques with each other in small groups at least twice a week.	3.71	1.00
I collaborate with other subject area teachers (other subjects, such as art, music, physical education) to enhance the math concepts that I am teaching to my AA students.	3.62	.99
I see the need to incorporate the home/community realities into learning experiences in mathematics with AA students.	3.97	.76
I provide examples of prominent AA mathematicians during the school year for my AA students.	2.47	1.02
I allow my AA students to intelligently challenge others' responses in the mathematics classroom.	3.68	.69
I allow my AA students to intelligently challenge my responses in the mathematics classroom.	3.88	.69
I use the mathematics curriculum in ways that assists AA students to make sense of the problems.	3.97	.58
I present AA students with ideas of them pursuing future professions that involve a significant amount of mathematics (.ie., engineer, technician, scientist)	3.76	.82
Average Across Items	***3.72***	***.78***
"Desire"	**Mean**	**Standard Deviation**
I employ culturally responsive teaching strategies in mathematics.	4.29	.72
I incorporate AA students cultural experience in the construction of mathematics lessons.	4.29	.72
I set high expectations for my AA students in mathematics.	4.74	.45
I communicate my expectations to my AA students.	4.71	.46
AA students often meet my academic expectations set for them in mathematics.	4.59	.66
I provide opportunities for AA students to share their problem-	4.29	.87

solving techniques with each other in small groups at least twice a week.		
I collaborate with other subject area teachers (other subjects, such as art, music, physical education) to enhance the math concepts that I am teaching to my AA students.	4.26	.90
I see the need to incorporate the home/community realities into learning experiences in mathematics with AA students.	4.35	.60
I provide examples of prominent AA mathematicians during the school year for my AA students.	4.09	.71
I allow my AA students to intelligently challenge others' responses in the mathematics classroom.	4.35	.77
I allow my AA students to intelligently challenge my responses in the mathematics classroom.	4.41	.66
I use the mathematics curriculum in ways that assists AA students to make sense of the problems.	4.59	.66
I present AA students with ideas of them pursuing future professions that involve a significant amount of mathematics (i.e., engineer, technician, scientist)	4.38	.78
Average Across All Items	***4.41***	***.70***

The Process Standards Subsection

The items on the Process Standards subsection were adapted from NCTM' s Process Standard (NCTM, 2000a). This subsection of the PTMI was designed to assess teachers' present "use" of process standards in mathematics instruction in general. The second part of the process standards subsection assessed inservice teachers' "desire to use" the same process standards in teaching algebra to African American students.

Table 4-5 presents the item statistics for general "use" and "desire" to use process standards in algebra with AA students. The item means for the "use" in general subsection ranged 3.15 to 4.12. The strongest "agreement" was observed with *"I encourage students to communicate their mathematical thinking in a variety of ways*" (M=4.12) followed by *"I pose problems that allows students to apply a variety of strategies to solve math problems"* (M=4.03). Respondents were "uncertain" or an equal

number "agreed" or "disagreed" with *"My students are successful in developing mathematical arguments during math lessons"* (M=3.15), "*I find that most students are able to exhibit organization of their mathematical thinking"*(M=3.18) and *"I primarily use textbook examples in teaching mathematics concepts*" (M=3.24). Respondents "agreed" with the remaining items on the "use" process standards in general section, as evidenced by item means ranging from 3.50 to 4.03.

With regard to "desire" to use process standards in algebra with African American students, the largest item means were observed with *"I allow AA students to communicate their algebraic thinking in a variety of ways."* (M=4.15*), "I recognize the need to use examples from AA students lives in order to teach algebra concepts"* (M=4.12), "*I pose problems that allow AA students to apply a variety of strategies to solve math problems"* (M=4.09) and *"I allow AA students to find and solve mathematics problems that are related to algebraic concepts*."(M=4.06) Conversely, respondents reported strong "disagreement" with the negatively worded item *"I primarily use textbook examples in teaching mathematics concepts."*(M=2.76) Finally, respondents reported "uncertainty" or an equal number of respondents who "agreed" or "disagreed" with the remaining items, as evidenced by item means of 3.15 to 3.94.

The variance among responses on the "use" of process standards in general section revealed standard deviations from 0.53 to 0.96. The greatest variance was observed with, *"I primarily use textbook examples in teaching mathematics concepts."* (SD=0.96) followed by *"I find that most students are able to exhibit organization of their mathematical thinking."* (SD=0.94) The smallest variance was observed with *"I encourage students to communicate their mathematical thinking in a variety of ways."*

(SD=0.53) The standard deviation for the remaining items ranged from 0.68 to 0.90, suggesting moderate variance between scores.

In general, there was greater variance for the item means in the "desire" subsection. The largest standard deviations were: *"AA students are able to communicate their algebraic thinking in a variety of ways"* (SD=1.23), *"My AA students are usually successful in the discovery of solutions with algebraic concepts"* (SD=1.20), *"My AA students are successful in developing mathematical arguments during algebra lessons"* (SD=1.12) and *"When my AA students communicate their mathematical understandings during algebra lessons, it makes sense to me"* (SD=1.02). Moderate variance in responses on the remaining items was observed, as evidenced by standard deviations ranging from 0.82 to 0.97.

There was a slight difference in the wording for the items on the "desire" (most included algebra specifically and all included AA students) as compared to the items on the "use" in general section, however, items on both sections captures the same process standard (i.e. *"I pose problems that allows students to apply a variety of strategies to solve math problems*" and *"I pose problems that allow AA students to apply a variety of strategies to solve math problems*"). The average mean on each item on the "desire" to use process standards in algebra with AA students (M=3.94) is higher as compared to "use" of process standards in general (M=3.61). However, the average standard deviation for the "desire" to use process standards in algebra with AA students was significantly higher (SD=1.03) compared to the average standard deviation for the "use" in general section (SD=0.80). On average teachers reported a stronger "desire" of process standards in algebra with AA but there was a large degree of variance across respondents.

Table 4-5 Item Statistics of Process Standards Subsection of PTMI

"Use"	**Mean**	**Standard Deviation**
I pose problems that allows students to apply a variety of strategies to solve math problems	4.03	.68
I encourage students to find and solve mathematics problems that arise outside of the math classroom.	3.71	.90
My students are successful in developing mathematical arguments during math lessons.	3.15	.86
In general, my students are successful in the discovery of mathematics concepts.	3.50	.86
When my students communicate their mathematical understandings during math lessons, it usually makes sense to me.	3.94	.69
I encourage students to communicate their mathematical thinking in a variety of ways.	4.12	.53
I find that most students are able to exhibit organization of their mathematical thinking.	3.18	.94
I primarily use textbook examples in teaching mathematics concepts.	3.24	.96
Average Item Mean	***3.61***	***.80***
"Desire" (Algebra with AA Students)	**Mean**	**Standard Deviation**
I pose problems that allow AA students to apply a variety of strategies to solve math problems.	4.09	.97
I allow AA students to find and solve mathematics problems that are related to algebraic concepts.	4.06	.96
My AA students are successful in developing mathematical arguments during algebra lessons.	3.74	1.12
My AA students are usually successful in the discovery of and solutions of algebraic concepts.	3.76	1.20
When my AA students communicate their mathematical understandings during algebra lessons, it makes sense to me.	3.97	1.02
I allow AA students to communicate their algebraic thinking in a variety of ways.	4.15	.82
AA students are able to exhibit organization of their thinking during algebra related lessons.	3.65	1.23
I recognize the need to use examples from AA students lives in order to teach algebra concepts.	4.12	.91
Average Across Items	***3.94***	***1.03***

(AA=African American Students)

Attitudes/Perceptions (Equity) Subsection

The items on the "attitudes and perceptions" (equity) section were adapted from NCTM' s Equity Principle (NCTM, 2000a). The 6-item section was designed to assess teachers' "agreement" and/or "disagreement" with statements on equity. Table 4-6 presents the item statistics for this subsection. A low Cronbach Alpha of 0.43 (as presented in Table 4-3) suggested that the teachers saw some inconsistency in the areas probed by the questions.

Respondents reported strong "agreement" with *"All students can learn algebra"* (M=4.47)*, "All AA students must be presented with opportunities to learn algebraic concepts in order to prepare them for future experiences"*(M=4.41) and *"I provide adequate assistance in order to ensure that all my AA students meet high mathematics expectations."*(M=4.03). The remaining items suggested that respondents were "uncertain" or there were equal number who "agreed" or "disagreed" with the statements in this subsection.

The greatest variance among respondents was observed with the first item, *"AA students are served well by implementing a "traditional" (facts and drills) mathematics program"* with a standard deviation of 0.99 (M=3.62). This negatively worded item was recoded for analysis. The item with the lowest variance was, *"All students can learn algebra"* with a standard deviation of 0.56 (M=4.47). Variance for the other items in this section ranged from 0.61 to 0.81. Most teachers agreed that all students can learn algebra, but teachers seemed "uncertain" or an equal number of respondents "disagreed" or "agreed" that the traditional mathematics program would serve AA students well.

Table 4-6 Item Statistics for Attitudes/Perceptions (Equity) Subsection on PTMI

Statement *As you respond to each item, concentrate on your instructional attitudes/perceptions toward African American (AA) students in your mathematics classroom.*	**Mean**	**Standard Deviation**
AA students are served well by implementing a "traditional" (facts and drills) mathematics program.	3.62	.99
I provide adequate assistance in order to ensure that all my AA students meet high mathematics expectations.	4.03	.72
On average my AA students are successful in mathematics.	3.71	.80
All students can learn algebra.	4.47	.56
All AA students must be presented with opportunities to learn algebraic concepts in order to prepare them for future experiences.	4.41	.61
I find it necessary to make adjustments in the mathematics curriculum in order to serve of my AA students well.	3.65	.81
Average Across Items	***3.99***	***.75***

AA=African American

Confidence (Efficacy) Subsection

The items on the "confidence" section of the PTMI were adapted from Enoch & Riggs' (1990) Science Efficacy Scale and Bakari's (2000) Teaching African American Students Survey. It was designed to assess teachers' personal efficacy in mathematics (learning) and professionally (teaching) with teaching African American students. All participants responded to this subsection.

Table 4-7 presents the item statistics for the general efficacy section on the PTMI. Respondents expressed strong "agreement" with all items in this section, except for *"I find it challenging to motivate AA in the math classroom."*(M=2.97). This was a negatively worded item that was recoded for analysis. So "1" is the highest response with

"5" being the lowest response for this item. An item mean of 2.97 suggests that respondents reported ease (not difficult) with motivating their African American students. The largest variance in responses was observed with *"I am very good at learning mathematics"* (SD=1.06) followed by "*As a student, (when I was in elementary/middle school) I earned A's in math*" (SD=1.02). The lowest variance was observed with "*I have experienced success in teaching mathematics to AA students"* (SD=0.55), further supporting respondents' perceptions of being able to motivate AA students and thus experiencing success with teaching AA students.

Table 4-7 Item Statistics for General Efficacy Subsection on PTMI

Statement *As you respond to each item, concentrate on your instructional practices with African American students in your classroom.*	**Mean**	**Standard Deviation**
I am very good at learning mathematics.	4.06	1.06
I am very good at teaching mathematics.	4.00	.71
I have experienced success in teaching mathematics to AA students.	4.21	.55
I find it challenging to motivate AA in the math classroom.	2.97	.95
As a student, (when I was in elementary/middle school) I earned A's in math.	4.21	1.02
Average Across Items	***3.89***	***.86***

AA=African American

In addition to the general efficacy scale, grade-specific efficacy scales were included in the PTMI. Based on current teaching grade level, teachers were asked to respond to their level of comfort (or confidence) with the items indicated. All items from this section were adapted from NCTM' s content standards for algebra (NCTM, 2000a).

Table 4-3, mentioned earlier in this chapter, presents the subsection means and standard deviations.

Table 4-8 presents item statistics for Grade K-2 teachers. Respondents reported extreme "confidence" on all items except, "Use concrete, pictorial and verbal representations to develop an understanding of invented and conventional symbolic notations"(M=3.93). The largest item variances were "Analyze how both repeating and growth patterns are generalized" (SD=0.87) followed by "Use concrete, pictorial and verbal representations to develop an understanding of invented and conventional symbolic notations." (SD=0.83) Overall, there was little variance among respondents for most of the items in this subsection.

Table 4-8 Statistics for Grade K-2 Efficacy Subsection on PTMI

Statement *To what degree are you confident in teaching the following mathematical concepts?*	**Mean**	**Standard Deviation**
Sort, classify and order by size, number, and other properties.	4.57	.51
Recognize, describe and extend patterns such as sequences of sounds and shapes or simple numeric patterns and translate.	4.50	.52
Analyze how both repeating and growth patterns are generalized.	4.14	.87
Illustrate general principles and properties of operations, such as commutativity, using specific numbers.	4.07	.62
Use concrete, pictorial and verbal representations to develop an understanding of invented and conventional symbolic notations.	3.93	.83
Model situations that involve the addition and subtraction of whole numbers, using objects, pictures and symbols.	4.50	.52
Describe qualitative change, such as students growing taller.	4.29	.47
Describe quantitative change, such as a students' growing two inches taller.	4.07	.62
Average Item Mean	***4.25***	***.62***

Table 4-9 presents the item statistics for the Grade 3-5 algebra efficacy subsection. With the exception of **"***Represent and analyze patterns and functions, using words, tables and graphs."* (M=4.13) and *"Represent the idea of a variable as an unknown quantity using a letter as a symbol."* (M=4.13), respondents were "uncertain" or an equal number were "confident" or "unconfident" with the algebra concepts presented. There was also considerable item variance. The smallest variance was seen with *"Represent and analyze patterns and functions, using words, tables and graphs"* (SD=0.35) followed by *"Represent the idea of a variable as an unknown quantity using a letter as a symbol"* (SD=0.36). Combined with item means, this suggests that, as a group, respondents were the most "confident" with these specific algebra concepts.

Table 4-9 Item Statistics for Grade 3-5 Efficacy Subsection on PTMI

Statement *To what degree are you confident in teaching the following mathematical concepts?*	**Mean**	**Standard Deviation**
Describe, extend, and make generalizations about geometric and numeric patterns.	3.75	.71
Represent and analyze patterns and functions, using words, tables and graphs.	4.13	.35
Identify such properties as commutativity, associativity, and distributivity and use them to compute with whole numbers.	3.63	1.06
Represent the idea of a variable as an unknown quantity using a letter as a symbol.	4.13	.36
Express mathematical relationships using equations.	3.50	.93
Model problem situations with objects and use representations such as graphs tables and equations to draw conclusions.	3.88	1.00
Investigate how a change in a variable related to a change in a second variable.	3.25	.89
Identify and describe situations with constant or varying rates of change and compare them.	3.25	.89
Average Item Mean	***3.69***	***1.26***

Table 4-10 presents the item statistics for Grade 6-8 algebra efficacy subsection on the PTMI. Respondents reported extreme "confidence" with all algebra concepts. The greatest variance among respondents was seen with "Explore relationships between symbolic expressions and graphs of lines, paying attention to the meaning of intercepts and slope" (SD=1.01) followed by "Use symbolic algebra to represent situations and to solve problems, especially those that involve linear equations." (SD=1.00)

Table 4-10 Item Statistics for Grade 6-8 Efficacy Subsection on PTMI

Statement *To what degree are you confident in teaching the following mathematical concepts?*	**Mean**	**Standard Deviation**
Represent, analyze, and generalize a variety of patterns with tables, graphs, words and when possible, symbolic rules.	4.38	.81
Relate and compare different forms of representation for a relationship.	4.31	.80
Identify functions as linear or nonlinear and contrast their properties from tables, graphs or equations.	4.38	.81
Develop an initial conceptual understanding of different uses of variables.	4.19	.83
Explore relationships between symbolic expressions and graphs of lines, paying attention to the meaning of intercepts and slope.	4.13	1.01
Use symbolic algebra to represent situations and to solve problems, especially those that involve linear equations.	4.06	1.00
Recognize and generate equivalent forms for simple algebraic expressions and solve linear equations.	4.00	.97
Model and solve contextualized problems using various representations, such as graphs, tables and equations.	4.13	.81
Use graphs to analyze the nature of changes in quantities in linear relationships.	4.19	.99
Average Item Mean	***4.20***	***.89***

On average respondents reported a strong "desire" to use CRT in mathematics (M=4.41) and a "desire" to use process standards in algebra with AA students (M=3.94) as compared to their "use" of CRT (M=3.72) and process standards in general (M=3.61).

Teachers also reported some "agreement" with items on the Equity scale with most agreeing that, *"All students can learn algebra"* (M=4.47). In general teachers reported success in teaching AA students (M=4.21) and find ease with motivating their AA students (M=2.97) in the mathematics classroom. Finally, on average Grade K-2 teachers reported the highest algebra efficacy (M=4.25) with the lowest average variance between respondents (SD=0.62) followed by Grade 6-8 teachers (M=4.20, SD=0.89). Grades 3-5 teachers reported the lowest algebra efficacy (M=3.69) with the average largest variance among respondents (SD=1.26).

Correlations

Table 4-11 presents the intercorrelation matrix for the subsections of the PTMI that all respondents completed. Correlation coefficients describe the extent to which answers to one subsection may be related to answers on another subsection. The correlation coefficient squared describes proportion of variance held in common by the two subsections. The correlations coefficients ranged from r = 0.34 to 0.681 ($p \leq 0.01$ and 0.05). There were three statistically meaningful relationships that are discussed.

The first is the relationship between CRT and "desire" to use process standards in algebra with AA students which revealed a correlation coefficient of r=0.483** ($p \leq 0.01$). Twenty-three percent of the time teachers who reported, "use" or "desire" to use CRT reported "desire" to use process standards in algebra with AA students. There was a direct relationship between teachers who reported "use" and "desire" to use CRT and their "desire" to use process standards in algebra with AA students.

The second relationship was observed with "use" of process standards in general and "equity" as evidenced by a correlation coefficient of r=0.595**(p≤0.01). Thirty-five percent of the time, respondents who reported "use" of process standards in general also reported "agreement" with items on the "equity" scale.

Finally, the third relationship was observed with "use" of process standards in general and general "efficacy" A correlation coefficient of r=0.681** (p≤0.01) suggests that 46% (0.46) of the time teachers who reported "use" of process standards in general also reported high "efficacy" in general.

Table 4-11 Intercorrelations

	CRT Section	PS General	PS Algebra (AA)	Equity	Efficacy
CRT Section	1	.414*	.483**	.425*	.341
PS General	.414*	1	.355*	.595**	.681**
PS Algebra (AA)	.483**	.355*	1	.216	.230
Equity	.425*	.595**	.216	1	.489**
Efficacy	.341	.681**	.348*	.479**	1

*Correlations is significant at the 0.05 level (2-tailed)
**Correlations is significant at the 0.01 level (2-tailed)

Summary

Thirty-four teachers from four schools (2 elementary schools and 2 middle schools) in one district in the Midwest responded to the PTMI. The sample was primarily comprised of White (88.2%) females (88.2%) who attended high school and college in rural and suburban areas (74% and 67.6% respectively). Middle school teachers made up almost half of the sample (47.1%) with 35.3% of the teachers having had had seven or more years of experience.

Results from the PTMI revealed that most respondents expressed a "desire" to use CRT methods (M=4.41, SD=0.70) and "desire" to use process standards in algebra with AA students (M=3.94, SD=1.05). Most respondents "agreed" with the items on the "equity" subsection (M=3.99, SD=0.75) and teacher also reported general efficacy in math teaching and learning (M=3.89, SD=0.86). On the grade specific algebra subsections, results revealed Grade K-2 teachers to be the most efficacious in followed by Grade 6-8 teachers, while Grade 3-5 teachers reported the lowest algebra efficacy. Finally, bivariate correlations revealed statistically significant relationships between CRT and "desire" to use process standards in algebra ($r=0.483$, $p\leq0.01$), "equity" and "general efficacy" ($r=0.479$, $p\leq0.01$) and "use" of process standards in general and "efficacy" ($r=0.595$, $p\leq0.01$).

Some teachers reported "use" of CRT (M=3.72, SD=0.78), but most teachers reported a "desire" to use CRT in mathematics with African American students. This suggests that when provided with support and opportunities for implementation, teachers would in fact be willing to integrate CRT in mathematics instruction to support the learning of their AA students. Additionally, there was only a slight difference in the mean

across items on the process standard subsection (-0.33), however, the bivariate correlation revealed a relationship between the "use" of process standards in general and "equity" and with "efficacy". This suggests that the more teachers "use" process standards in mathematics instruction they increase their understanding of issues of "equity" and also increase their overall teaching and learning "efficacy" in mathematics.

CHAPTER 5 - Presentation of Data from PD Sessions

There were 13 teachers (38% of all respondents to the PTMI) who expressed interest in the professional development sessions. Due to scheduling conflicts 8 out these 13 teachers (62%) participated in the professional development sessions—four elementary and four middle school teachers. All reported data is based on the eight teachers who participated in the sessions.

Table 5-1 presents demographic information for the professional development participants. One hundred percent of the group was female and 88% were White (7 out of 8 teachers). Fifty percent (4 teachers) taught in a middle school, thirty-eight percent (3 teachers) taught grades 3-5 and thirteen percent (1) teacher taught in grades K-2. Equal numbers of teachers (3) had 1-3 years of teaching experience and seven or more years of teaching experience. One teacher had 5-7 years of teaching experience and another teacher had 0-1 years of teaching experience. With regard to the number of years experience teaching at the current grade level, only one of the most experienced teachers had a similar tenure at that grade level. The other two more experienced teachers had been at their current grade level 3-5 years. In general, the K-2 teacher had moderate teaching experience (5-7 years) and at been teaching at this level for 1-3 years. The group of Grades 3-5 teachers had the most teaching experience in general and at that grade level (7+) as well as the teacher who was least experienced (0-1 years in teaching and at that grade level). The group of middle-school teachers included one of the most experienced teachers (7+) who had also taught at the middle school level for 3-5 years. The other two middle school teachers were relatively new to teaching; one had 1-3 years of experience and the other was in the first year of middle school teaching.

Table 5-1 Demographic Information of PD Participants

Teacher	Race	Grade Level	Total Years Experience	Years of Experience Current Grade
Teacher #1 Cynthia	White	3-5	7+	7+
Teacher #2 Allison	African American	3-5	7+	3-5
Teacher #3 Susan	White	6-8	7+	3-5
Teacher #4 Jasmine	White	K-2	5-7	1-3
Teacher #5 Samantha	White	6-8	1-3	0-1
Teacher #6 Melissa	White	6-8	1-3	0-1
Teacher #7 Lori	White	6-8	1-3	1-3
Teacher #8 Julie	White	3-5	0-1	0-1

Table 5-2 presents the PD participants' total scores and mean scores for all subsections in the PTMI. The mean total score for the PD participant (208.1) was identical to that for the total sample. When the grade-specific efficacy items were factored into the total score, the PD participants had lower scores for Grades K-2 (222.3 compared to 236.9) and Grades 3-5 (230.0 compared to 207.3) and Grade 6-8 teachers scored slightly higher (255.4 compared to 232.5). In general, the PD participants were not significantly different from the whole sample group in their "use" and "desire" to use CRT, NCTM process standards and Equity principle and efficacy in general and in algebra.

Table 5-2 PTMI Scores for PD Group

	Total Scores W/O Efficacy	**Grade Level Algebra Efficacy**	**Total Scores With Efficacy**	**CRT Section**	**Gen. PS**	**PS with AA**	**Equity**	**Efficacy**
Total Possible Score	**257**	**K-5=40 6-8=45**	**K-2, 3-5=305 6=8=310**	**130**	**40**	**40**	**30**	**25**
Sample Mean (N=34)	M=208.1 SD=19.7	Grade K-2 M=34.1 (SD=3.5) Grade 3-5 M=29.5 (SD=4.6) Grade 6-8 M=37.8 (SD=7.2)	Grade K-2 M=236.9 (SD=19.5) Grade 3-5 M=230 (SD=23.4) Grade 6-8 M=255.4 (SD=20.2)	M=105.7	M= 28.4 (SD=3.5)	M=31.5 (SD=7.1)	M=22.7 (SD=2.3)	M=19.5 (SD=3.0) (N=33)
PD Mean (N=8)	M=208.1 SD=20.0	GradeK-2 M=36 Grade 3-5 M=27.3 (SD=27.0) Grade 6-8 M=37.0 (SD=20.1)	Grade K-2 M=222.3) (SD=23.0) Grade 3-5 M=207.3 (SD=27.0) Grade 6-8 M=232.5 (SD=18.5)	M= 106.5	M=27.8	M=33.4	M=22.3	M=18.3
Teacher #1 Cynthia (3-5)	219	32	251	112	26	40	22	17
Teacher #2 Allison (3-5)	177	20	197	94	22	24	21	14
Teacher #3 *Susan (6-8)	227	42	269	113	33	33	27	23
Teacher #4 Jasmine (K-2)	187	36	223	98	26	26	21	18
Teacher #5 *Samantha (6-8)	232	45	277	116	31	40	24	21
Teacher #6 *Melissa (6-8)	219	43	262	108	30	40	21	22
Teacher #7 *Lori (6-8)	212	18	230	110	23	40	23	14
Teacher #8 Julie (3-5)	194	30	224	101	31	24	21	17

Overview of Professional Development Sessions

This study was based on the integrated conceptual framework of culturally responsive teaching, NCTM' s Process Standards and NCTM' s Equity Principle shown in Figure 2-2. During the PD sessions all aspects of the integrated model were discussed. The purpose of the professional development sessions was to gain a deeper understanding of participants' "use" and "desire" to use CRT methods, NCTM Process Standards and NCTM Equity Principle and their instructional experiences with African American students, specifically in algebra. Furthermore, the sessions were designed for professional dialogue that led to the implementation of culturally responsive teaching methods over a one-month period in algebra with African American students.

Session Interactions

Teachers were very engaged during all four professional development sessions, as evidenced by consistent dialogue, laughter, question- posing, note-taking and steady eye contact. Although there were segments that required direct instruction, the researcher typically served as a facilitator, with the participants talking to one another in a group setting. Both elementary and middle school teachers participated equally and shared across grade levels throughout. The tone of the sessions was relaxed yet stimulating. There were moments of laughter and others that provoked deep thought and reflection. Several questions were presented to the group during the four-month data collection

period. These questions provided an overall picture of the tone of the sessions as well as provided a glimpse into the thoughts of the PD participants. The following paragraphs provide a summary of participant responses to those questions.

What influenced your decision to participate in the sessions?

Teachers decided to participate in the professional development sessions for various reasons, as summarized in Table 5-3. Four teachers wanted to learn strategies that would promote improvement in mathematics achievement for African American students. Another three teachers recognized that such strategies would not only benefit their African American students, but all students. Lastly, three teachers expressed basic curiosity and overall enthusiasm for what the professional development experience might yield.

Table 5-3 Rationale for Participating

Teacher	Rationale
Cynthia (#1)	• Have worked with few AA students in the past • Aware of the difference; but not on my radar • Unaware of different strategies • Decided to dive right in
Allison (#2)	• Curious • Interested in helping AA students do better on standardized tests • Want to be a better teacher for all students • Hoping to get better strategies
Susan (#3)	• Feel like we are leaving AA students behind • AA students underperforms other student groups • Very few AA students in advanced math courses • Growing up-few AA students in advanced classes • Desire for ways to motivate AA students toward higher success
Jasmine (#4)	• Desire to have something different • Want to get PhD someday; this is an opportunity to learn about the process; show support
Samantha (#5)	• Only a second year teacher • Lots still unknown • What will work with AA would probably work with other students
Melissa (#6)	• Shocked at the underperformance of AA students • Strong desire to find strategies that will help motivate students toward success
Lori (#7)	• Not aware of what I don't know • Hoping to gain some insight
Julie (#8)	• Like to learn what I don't know • However we can teach AA has got to work with other kids

All Students Can Learn Algebra

Teacher expectations, attitudes and perceptions play vital roles in students' academic achievement. NCTM' s Equity principle clearly states that mathematics is for all students. Furthermore, all students deserve to be provided opportunities to excel in

mathematics, no exceptions. As the researcher facilitated the discussion on equity, teachers were asked to share their perspectives with the statement "all students can learn algebra". All teachers expressed their agreement with this statement, however there were some varying views that were also expressed. Teachers presented various ideas about different methods for maximizing learning potential, which included assessment, pacing, structural design/order of algebra courses, and teacher presentation of the curriculum.

Several teachers shared their views on assessment as it related to student achievement in algebra. One teacher said, " I think they all can learn it. They may not be able to all present knowledge on a written test, but there are different ways. The limitation is that's the only way we assess…" Another teacher concurred by saying, "They know it, its theirs, they just may not be able to give it back to us the way we want it." Yet another teacher commented on the limitation of a singular form of assessment as evidence of knowledge, "It's that testing thing! They may be producing knowledge, but we don't see it because it does not look like what we are looking for." Two other teachers explained the rationale for their instructional choices related to building and district-level administrative pressures. They expressed feeling overwhelmed with having to administer formative assessments every couple of weeks. From their perspective, this requirement did not assist students in learning necessary skills. But in fact, created a sense of pressure; for students and teachers alike.

The appropriate timing of instructional decisions with algebra was another topic that surfaced. "They can all learn, maybe not at the same pace, but it is highly possible for all students to learn algebra." Teachers further discussed the critical nature of instructional decisions around algebra lessons in the classroom, but also the importance

of the order in which algebra courses are offered to students. The order in which algebra courses are offered generated another layer of discussion among the participants. Based on the discussion, there seemed to be a divide related to the structural design for mandatory algebra courses and the prerequisite skills associated with success in these courses. On one side of the divide, teachers recognized that many students who lack prerequisite skills might be set-up for inherent failure. Here is one teacher's perspective:

> They can do it, but if you can't multiply, divide…some of the basic computational facts…it makes learning algebra a lot harder. Many of them have not displayed competency in grades 4-7, then we are forcing them to learn algebra when they are not ready, where as if we would give them pre-algebra, where we spend a lot of time on adding integers; time for the foundational skills…I think…they would feel confident; the more confident, the more successful. [Sic]

On other hand, some teachers also recognized the importance of encouraging all students to take algebra courses. Several agreed that pre-algebra courses might provide a solid structure toward increased success for students, but one teacher pointed out that placing students on a particular track according to readiness is in fact "tracking" even if the specific term is not used. One teacher went further to say, "In every other subject that we do we demand background knowledge, and if the kids don't have it, we teach it to them. Ok, we get to algebra, if they don't have the background knowledge, why can't we teach it to them?"

In addition to the order and structural design of courses, participants also discussed the interpersonal components of instruction. Teachers expressed the idea that "who" is teaching, the "way" they are teaching, and the curriculum choices selected have

a direct impact on the degree to which students retain and reuse content knowledge. "They can learn it; maybe not all from the same teacher, or all from the same textbook, or the same classroom, doing the same projects…" but teachers expressed their belief that all students can and should learn algebra.

In summary, there seemed to be differing yet valid points of view related to the statement "all students can learn algebra". Both perspectives provide insight into how teachers see the complex needs of not only African American students, but also all students.

What are your overall experiences with African American students in math?

Responses ranged from interactions with parents, student perceptions, to success stories. One African American teacher discussed her personal experience as a mother of a middle school daughter. She noticed that her daughter was not achieving at the level of her other classes and she inquired. Her daughter seemed content with the "C" and explained that if she asked for assistance, she would be sent to the back of the room with the aide and "appear dumb". Mom expressed her disappointment with this and vowed to make an appointment to discuss the matter with the teacher. Her daughter was uneasy all evening, because she did not want to face the perceived ridicule attached to "needing help." This is an example of the pressures that many students face in the math classroom.

Another perspective was related to African American parents. On one hand, there are parents who demand high standards of their children and are advocates for academic success. Then there seemed to be parents who would rather tell you about their personal lives than help their child be successful in mathematics. One teacher shared that when she

encouraged her 1st grade Mom to listen to her son count, the Mom shared that she doesn't have the time to listen to him count. Two other teachers chimed in and shared their experiences with parents professing that they were not good in math, so they were not surprised that their child does not exhibit these qualities either.

Another teacher pointed out that she has observed students who have great potential to succeed in mathematics openly select not to. In one instance, a student admitted that doing his work and participating in class would give the appearance of being "smart" in front of his peers; and he would have no part in that.

While there are some challenges with encouraging African American students to be successful, two of the teachers pointed out their successes. One shared that her brightest student is an African American female. Another teacher recollected on an African American middle school girl who not only excelled in mathematics, but was popular and athletic. "You can be cool and still do your homework and get good grades". This particular student was a model for finding a balance between achievement and social acceptance among peers.

Overall, teachers expressed several factors that influence academic success with African American students in the math classroom. These factors include parental perspectives, student perceptions of success and the social environment. There seemed to be no single factor leading to academic success in mathematics for African American students.

Teacher Education/Professional Development on Cultural Awareness

During the third session, teachers began to share their experiences with courses/ professional development around cultural awareness in the instruction environment. Several teachers reported never having a course or professional development session that explained the importance of teachers' cultural awareness in the classroom environment. One teacher shared, " I had one class; we met once a week for 2 hours. It was the easiest class I ever took. I got an A, but I didn't learn anything [sic]." On the other hand, there was one teacher who felt that she entered the teaching profession culturally aware because of her undergraduate college course work. She discussed one course in particular. She shared that she had one of the "best" when it comes to multicultural education. She said, "It was hard, but I learned a lot."

One other teacher brought up the point that teacher education programs had their place, but she wondered about professional development in the local school district. She went on to share that she saw the need to have sessions that discussed these issues on a continual basis. One teacher chimed in and shared that she has been in the district for 3 years and she never attended a professional development session on different cultures. Another teacher shared this perspective, " This is my eighth year and I have been to the same exact presentation 5 times."

The discussion ended with yet another teacher making this point: "Until this point, I was trying to treat all my students equally…treat them all the same, You don't want to show biases and prejudice…with this class, I've learned no, you really can't do that. Because fair is not always equal."

Cases Studies

The following case studies provide a glimpse into the background, character, interactions and implementation decisions of each participant. Individual scores on the PTMI are also reported (See Table 5-2). Pseudonyms were used to protect the anonymity of the teachers.

Teacher #1- Cynthia

Cynthia is a White female with 7+ years of teaching experience and 7+ years of experience at her current grade level all in a predominantly rural community. She is a math tutor for students in grades 3-5, and has one month of experience in this position (this is a new position that began a month prior to the first professional development session). With limited exposure to culturally/racially diverse people, Cynthia thought she would benefit from the professional development sessions. Furthermore, she came into the sessions with a desire to acquire new strategies that would increase her awareness of working with diverse student populations.

As compared with the rest of the PD group, Cynthia's scores on the PTMI reported some “use” and “desire” to use CRT methods (112 out of 130 or 0.86), a strong “desire” to implement process standards with AA students (40 out of 40 or 1.00), and “agreement” with issues of equity (24 out of 30 or 0.80). Conversely, Cynthia was “uncertain” or “disagreed” that she “used” process standard in general (26 out of 40 or 0.65) and also reported low general “efficacy” (17 out of 25 or 0.68). Overall, Cynthia scored a total of 212 (possible total 230 or 0.92). When combined with algebra efficacy, her “level of comfort” with algebra concepts (32 out of 40 or 0.80). She had a final total score of 251 (total possible 305 or 0.82) on the PTMI. Cynthia scored higher on all

sections compared to her Grade 3-5 peers, suggesting she was the most supportive of "use" and "desire" to use CRT and her "desire" to use process standards in algebra with AA students and issues of equity. Although she seemed uncertain about her "use" of process standards in general and was uncomfortable with learning and teaching math in general, she was quite comfortable with algebra concepts.

Cynthia attended all four sessions. She was reflective and observant throughout. Although she was not as talkative as the others, her steady eye contact, forward posture, copious note taking and constant nodding provided evidence of attentiveness. Cynthia's written reflections from the sessions and reading assignments provided a window into her thought process. On her feedback/reflection from the first session, she said, "I found the first meeting very insightful." Based on her background from a rural community, she hadn't even thought about these issues. The reading assignment seemed to inspire agreement with the importance of movement, verbal interactions, and real-life relevance within the instructional environment and the positive influence of groups/teams as an avenue for academic success for all students, especially with African American students so "that gaps do not become permanent". Cynthia clearly agreed with the importance of schools providing academic rigor and support for all students. She says, "if implemented properly [referring to the academic rigor and structural support] this will ensure opportunities for every learner."

In her written reflection, Cynthia noted the academic realities for many minority students, when she says, "I do feel some students are not given a chance because they are written off as not being college bound or capable of understanding the concepts that [sic] algebra and geometry require. The inability of educators to change their learning

environment and instructional strategies to allow for culturally different learning styles of minority students is a hindrance."

NCTM (2000a) outlines best practices in mathematics instruction as a build-up from concrete to abstract representations. Instruction must always be connected to students' prior experiences; however Cynthia notes that the ability to create these instructional transitions is not always obvious for teachers. Somehow many are unaware of how to build effectively on students' experiences. Cynthia expressed the need to assist K-12 educators with awareness of the impact of cultural frames of reference during teacher preparation programs and district-wide professional development. This might be a way to address academic disparities with minority students. This professional instruction would also reduce and/or eliminate frustration and feelings of inadequacy among teachers.

Cynthia certainly stuck with her "dive right in" approach. Based on her written reflections and comments during the sessions, she began integrating culturally responsive teaching techniques into her mathematics by the end of the second session. Although she asked for clarity about her selected method at the end of the third session (marking the beginning of the official implementation phase), she had already conceptualized what was needed and had begun the implementation process.

Cynthia's enthusiasm for mathematics prompted her to display mathematical posters around her room. She relished students coming up with their own solutions to mathematical problems. As a math tutor, she had the privilege of working with small groups of students at one time and enjoys the questions and small group interaction. She delighted in having students work together and experience success in mathematics.

Unfortunately, Cynthia was not having much success with one group in particular; in fact they were the group she "least looked forward to".

During the implementation phase, Cynthia decided to focus on this small group of three African American students that she described as being very disconnected from each other, competitive, self-seeking and unsuccessful in completing academic tasks. Based on the information from the sessions, Cynthia thought the "comprehensive" method of culturally responsive teaching, which encourages students to develop trust, respect, empathy and responsibility for other students in their learning environment, would be effective. Since Cynthia believed that she must respond to the needs of students and "allow for these differences and embrace them", she intentionally created opportunities for collaboration and team building with this small group of students.

Even though students were focusing on up-coming state assessments, Cynthia made a concerted effort to highlight algebraic skills. Students were responsible for working on story problems, communicating a mathematical rule, working with an unknown variable, creating an equation toward a solution, as well as patterns (i.e., number growth patterns). Cynthia focused on incorporating real-life experiences and prior knowledge into constructed math lessons. As an incentive toward stronger collaboration and peer encouragement, Cynthia offered external rewards (i.e., Ring Pops, verbal praise) with the intention of weaning students of this by the end of the implementation phase. Finally, Cynthia introduced students to prominent African American mathematicians as a way to cultivate cultural pride.

In order to get students more invested in their learning, Cynthia brainstormed with students about possible real-world connections. These ideas were integrated into the

construction of all lessons. At the beginning of each session, Cynthia facilitated a 5-minute share-out with the group. They had an opportunity to share thoughts/events as guided by the teacher. Prior to the start of any lesson/problem each week, Cynthia revisited the expectations for group collaboration and stressed the importance of working together and "talking out a problem before solving it on their own." She also reminded them of the rewards attached to providing positive feedback to each other during the sessions. Finally, Cynthia modeled the solution to a simpler problem as a basis for direction.

Over the course of the month, Cynthia observed that students had made progress in building a stronger work relationship with each other. When one student appeared to not understand something, another student would eagerly volunteer to assist. She noted, "I see [saw] so much more patience with each other." Students seemed also to enjoy talking about mathematics beyond the math classroom, "it was apparent that math seemed more meaningful." When prominent African American mathematicians were introduced, she said, "I could see the smiles and their eyes lit up when they saw mathematicians that looked like them." Additionally, the need for the tangible rewards subsided. At the beginning of the month, the tangible reward seemed to be the motivating factor in the collaborative process; however, by the end of the month, this was not so much of a focus.

Cynthia reported that the "strength" of this implementation process was clearly evidenced in moving a disconnected group to a more cohesive team. She delighted in seeing the positive behavior and feedback coming from the students rather than from her. Cynthia also pointed out how instruction moved from being teacher-directed to a more

student-directed environment. Students also benefited from "really" getting to know one another and by the end of the month, Cynthia was assured that students had adopted an attitude of respect and support for one another. This was a group of students who were once the class that Cynthia "least looked forward to and now it is the one that [she enjoys] immensely."

Although there were several positive aspects of the implementation process, there were also areas of "strains." Cynthia felt that there were natural time constraints. Since she only met with students for 30 minutes twice a week, an absence, assembly and/or scheduling conflict really affected the instructional time. During week 3, students only met once and it was evident that this change affected the "consistency and momentum" toward the development of a cohesive group. On another note, by the end of week four, Cynthia reported a significant amount of time spent on mediating among peer explanations. In the past she would intervene and provide the answer, so facilitating the discussion toward group consensus was time consuming. Finally, the overall implementation process was very slow at the beginning, with very little "math" being done. However, by the end of the month, Cynthia reports the instructional gains as being well worth it.

In addition to time being an issue, control also surfaced as a "strain." In the past, simply stating the best way to find the solution worked with a student-directed learning approach, Cynthia found it challenging to relinquish control. "Giving the students more control over their learning wasn't easy. Many times I had to bite my tongue or step back because it was my natural instinct to try to control or take over…"

Cynthia reported that teachers should not "assume anything during the process." She mentioned her high expectations and the disappointment that arose when things did not always go as she had planned. She recognized how her personal behavior may have hindered the "flow and direction" that the students were assuming. However, when she let go of the control and "became more flexible," she acknowledged that her "best ideas" were in fact "not her best ideas." This meant that although she started each lesson with her goals in mind, she found that she had to let go and realize that students can in fact manage their learning. She actually became comfortable with this reality.

Cynthia reported that without a doubt, the culturally responsive "comprehensive" method has been added to her professional tool-kit. She reported that in actuality, this method has made her life easier, so much so that she integrated the techniques with other student groups as well. Cynthia concluded by saying, " I have been enlightened and don't feel like going back to the old ways."

Teacher #2-Allison

Allison is an African American female with 7+ years of experience in elementary education and 3-5 years of experience at the 3rd grade level. Allison reported that she was "curious" about what the professional development sessions would offer. She also shared her observation that many African American students underperformed on standardized tests. Both of these reasons were underpinned by Allison's interest in improving her teaching strategies for all of her students, not just her African American students.

Compared with the rest of the professional development group, Allison scored below the mean on all sections of the PTMI. She seemed "uncertain" in her "use" and

"desire" to use CRT methods (total score of 94 out of 130 or 0.72), general process standards (22 out of 40 or 0.55), process standards with AA students (24 out of 40 or 0.60) and utilization of "equity" in the mathematics classroom (19 out of 30 or 0.63). Results also showed that Allison expressed low "efficacy" in general (14 out of 25 or 0.56) and little to no "comfort" with algebra, for a total score 193 (possible total score of 305 or 0.63) on the PTMI. These scores placed her a full standard deviation below the sample mean and at the lower end among the PD participants. Being the only African American teacher, Allison reported the lowest "use" and "desire" to use CRT, NCTM process standards in general and in algebra with African American students as well as the lowest algebra efficacy. Allison may not have felt "safe" being a strong advocate for African American students and tended to select "uncertain" for the survey items.

Despite the scores on the PTMI, Allison was especially engaged during all four sessions. She was often the first one to respond to questions and was consistently enthusiastic. When Allison responded to questions or scenarios presented to the group, she tended to make references to her personal family and/or professional experiences to further illustrate her perspective. She also openly shared her professional challenges and discoveries related to culturally responsive teaching throughout the three-month period.

Allison shared her perspectives on incorporating students' cultural backgrounds and/or experiences into the construction of math lessons. She said, "I think even 3rd graders want to know 'am I going to use this?' Allison wanted her students to see the relevance in the mathematics they were learning. She developed a "mini society" within her classroom. In their mini society students were required to use mathematics in very concrete ways. Students had to pay rent/mortgages; they had to use earnings to pay for

lost homework; they were paid for attendance and received deductions for poor choices and even lost classroom jobs for unsatisfactory performance. Allison highlights the importance of math skills throughout all aspects of life and these experiences are consistent throughout the day, not just during the mathematics lessons. Allison also shared how at first she was the only teacher to adopt this style of teaching but now her colleagues at grades 3 and 5 have begun to implement the "mini society" paradigm into their classrooms as well.

In her written reflections, Allison noted how the sessions provided insight into the expressive behaviors of some African American students and this empowered her to see the significance of mathematics instruction from a new perspective. When she reflected on why some African American students have been unsuccessful in algebra, she says, "I think they have been unsuccessful because many of their parents don't understand it. I also think that algebra wasn't seen or used in practical ways." By the third session, Allison reported that she had been paying careful attention to the "empowering" and "validating" components of culturally responsive teaching. She wanted students to understand the importance of challenging themselves every day to do their very best. She reported that once she communicated this expectation, she already began to notice improvement. After searching her teacher's manual, she noticed all the algebra concepts that were embedded, so she was ready to go forward.

When it comes to teaching mathematics, Allison said, "I love math because there is just so much involvement." She believes that that various ways to solve problems along with the use of manipulatives makes mathematics so much more enjoyable as compared to her experiences as a student. Allison clearly believes that all students can

and will learn algebra with "adequate instruction." She sees the need for relevance to everyday life in mathematics. During the implementation phase, Allison wanted students to "feel free to try various strategies in problem solving." She set out to empower students to work together, to only compete against themselves and to take responsibility for their own learning with freedom and creativity. Because of Allison's desire for students to be risk-takers, during the implementation phase she focused on the "empowering" component of culturally responsive teaching. The "empowering" method establishes high expectations for students, encourages them to be risk takers as means for developing deeper confidence in their learning abilities. Allison planned to offer students a variety of problems, allow them to create and discuss their strategies, and provide rationales for strategies selected.

During the one-month implementation phase, Allison integrated the "empowering" component of CRT across 18 math lessons. Her class of 21 students included 7 African Americans. Allison's students were reviewing multiplication and division concepts including equal grouping, arrays and number facts. Students used individual dry erase boards to display solutions to number stories and then discussed strategies as a class. They also incorporated role-playing and scenarios that used actual students' names. By the third week, students were not only figuring out the best way to solve a problem, but were also discussing the efficiency of their methods. Allison would refer to students' strategies (i.e., Jason's strategy) and also decided to address students as "mathematicians" throughout the rest of the month. By the end of the month, she began to display students' work in various forms, including power point presentations and student made poster/projects using Excel charts.

Allison observed students taking more risks during the implementation phase. She reported how "students seemed more eager to learn." Her students also enjoyed acting out the problems and "really felt they had the freedom and the time…" to solve problems in their own way. Allison even noted how some students incorporated knowledge from other subject areas into their mathematics solutions.

The "strengths" of this implementation process for Allison was observed in the new level of confidence that her students showed in attempting difficult mathematics tasks and their shift from" having to do" the math to really "wanting" to do the math. Allison saw how the "empowering" component is not limited to math, but can be used in other subject areas as well. Another "strength" of this process, as Allison reported, is that her students, "really feel like mathematicians". She shared this on her final feedback form, "My students seem to take more risks. They are grasping the concepts that the only one they are competing against is themselves. I think they believe that it is better to try and fail than not have had the courage to try at all." Overall, Allison noted that her students were more excited about math and were able to see the practicalities of the subject matter and this motivated them to learn.

As Allison reflected on the professional "strengths" of the implementation phase, she recognized the need for her to talk less and listen more. She also noted how important it was to "empower" students and recognized the interconnectedness of all of the CRT components. Additionally, Allison had this observation, "even though the emphasis was on African American students, I have learned strategies that have helped all my students." Allison realized her role in students' academic success when she said, "I see

my students in a different light. They can achieve and there is a heavy emphasis on my perception and how I implement various plans and activities."

While Allison reported a general improvement in students' willingness to take risks, she clearly noted the time-consuming nature of students' new-found independence in problem solving. Allison reported the difficulty in providing individual attention to students the way she would have liked. She also observed students who needed to see a strategy before they would attempt to create their own "because they were still trying to figure out the concept." Finally, Allison reported the "strains" of the implementation process to include an increase in the classroom noise level (even beyond what was normal for her class) and the challenge of regaining control when students got excited about something.

During the implementation phase, Allison discovered that she "learned so many things" that she didn't know before. Even though she is an African American, she was enlightened to learn why many African Americans tend to talk really loudly and often offer responses in open settings whether or not they are solicited—which is evidence of culturally expressive behavior. Allison began with a desire to provide all of her students with the freedom to take risks and be responsible for their own learning. She discovered that this approach to teaching and learning is not just for African Americans but all children, because "all students want to be and should be empowered…" Allison posits that she will continue to use these methods for the rest of the school year and future years, "because it works."

Teacher #3-Susan

Susan is a White female with 7+ years of experience in education and 3-5 years of experience teaching algebra at the 8th grade level. The limited number of African American students in higher-level mathematics courses prompted her to participate in the professional development sessions. Even while growing up in an inner city, she recalled very few African Americans in upper level courses. Over the years, she has noticed many African American students who under perform on standardized tests. She said, " I feel like we are leaving our African American students behind…so I'd really like to see a way to get them up there—all of them and their test scores, too!"

Susan scored above the group mean on every subsection on the PTMI, except for "process standards with AA students" (33 out of 40 or 0.82). Susan reported, "use" and "desire" to use CRT methods (113 out of 130 or 0.87) and general process standards (33 out of 40 or 0.82). She scored the highest on the "equity" section (25 out of 30 or 0.83) and general "efficacy" section (23 out of 25 or 0.92). Overall, Susan had a total score of 227 (possible total of 265 or 0.86) combined with high algebra efficacy (42 out of 45 or 0.93) for a final total of 269 out of 310 (0.87) on the PTMI. This suggests that Susan was the most supportive of "use" and "desire" to use CRT, NCTM process standards in general and "desire" to use process standards in algebra with AA students. Susan scores also imply that she agreed with issues of equity in mathematics and was very comfortable with learning and teaching mathematics, especially algebra.

Susan was highly engaged and reflective during all four sessions. Through nods of agreement, verbal interjections and poignant written reflections, Susan seemed connected to the challenges that many African Americans face in mathematics. Susan tended to provide a balanced perspective that offered depth to the dialogue during the

sessions. For example, during the first session the topic of the most appropriate time for students to take algebra classes was raised. Another participant suggested that after 7th grade students should either go on to 8th grade math or algebra, based on readiness. Susan reminded the teacher that this decision based on a specific skill set is in fact tracking, just by another name. She went on to say, "In every other subject that we do, we demand background knowledge and if the kids don't have it we teach it to them. Ok, we get to algebra…if they don't have the background knowledge, why can't we teach it to them?"

Not only was Susan willing to express an opposite point of view, she also expressed openness to trying new ideas. When Susan learned of Allison's (Teacher #2) mini society, she reflected on the similar activities she had implemented with students. Susan shared how she given her students jobs, and had them balance a checkbook but not to the extent that Allison explained. Susan further inquired, "can I get a copy or outline of what you are doing…I'm thinking about doing that…"

When Susan reflected on how she teaches mathematics, she noted similarities between her method of instruction and that of Teacher #4. In addition to 10-15 minutes of direct instruction, Susan allows time for cooperative learning, reconvenes after group work and ends each lesson with some time for sharing mathematical discoveries and/or important information. Furthermore, Susan made this observation,

> If I assign a worksheet, more than 95% of the students complete it and turn it in. If I assign [work] out of the textbook, only 75% if the students will complete and turn it in This may stem from the students not wanting to appear smart (or "white") to their peers. Worksheets can be folded, put in pockets and hidden; textbooks cannot.

By the end of the second session, Susan decided to focus on the "comprehensive" component of culturally responsive teaching. She found that her students (African Americans in particular) really thrive when they get to compete. She also noticed that students are really good with teams and seem to work together well ("there are not a lot of people they won't work with"). She observed that students are "willing to work with others to get ahead instead of trying to do something on their own."

As an algebra teacher, Susan obviously enjoys teaching mathematics. She expressed her comfort with algebra and number sense, but relishes in the opportunity to teach probability. While she admits that it is the hardest topic to teach, she enjoys "setting up the experiments and letting the kids do it." Susan's reflections depict her thoughts about why so many African American students have been unsuccessful in mathematics. She recognized that traditional instruction fails to connect with African American students. She also noted that the African American students' lack of success could be the lack of role models, "they have not seen others like themselves being successful."

Because Susan wanted to create a classroom environment that would enable students to view themselves as successful in algebra, she focused on the "comprehensive" method of CRT. She noted the research that identifies algebra as the "gatekeeper" and understands the importance of success in algebra to opening access to a wide range of fields. During the implementation phase, she set out to cultivate opportunities for in-depth problem solving toward generalizing patterns through student collaboration, peer tutoring and hands-on projects.

The "comprehensive" method was implemented in 14 lessons during the one-month period. Instruction focused on solving equations, inequalities, slope intercept,

linear equations, and solutions in systems of linear equations. Susan provides instruction for 93 students, 28 of whom are African American. Unknowingly, Susan was already utilizing "comprehensive" techniques, so she "spent my [her] time fine-tuning the strategies that were already in place…"

During the month, the "comprehensive" component was integrated via students being encouraged to participate in classroom discussions at any time (except during Wednesday quizzes), both with their small groups and during whole group discussions. Students were assigned to long-term groups called "home groups" and remained in these groups for the entire month. However, participation was not restricted to students' "home groups", they were afforded lots of other opportunities for peer interaction. By the third week, students worked with "eyeball partners, shoulder partners, and partners from other groups within the room."

Even though there were individual assessments, during week 3 students participated in group-tests. They received extra credit on their quiz "if all members of their home group earned a C or above." While learning about linear equations, Susan referenced prior experiences from earlier in the school year. By week 4 Susan began to incorporate peer tutoring, which she noted, "comes naturally when working with others in group settings."

Susan's students were more excited and focused on days when she used the "comprehensive" strategies. This integration provided time for students to talk with peers and increased involvement in classroom discussions. Susan allowed students to "ask and answer questions freely without raising their hands." The most significant impact was observed with Susan's African American female students. She found that these students

were speaking up more in class and more willing to ask questions and clarify their thinking. Overall, Susan observed her students as being "more comfortable" in the math classroom. The quality of their conversations around mathematics deepened and a stronger conceptual understanding of the material emerged.

The flexible grouping and interactive activities not only led to "increased understanding" but also "higher test scores" for African American students as well as other student groups. Susan observed African American students' improvement on formative assessments. Of the 28 African American students who took the test at the end of the implementation month, only 2 students failed the test (less than 10 percent of her African American students) compared to the 10-12 students who had typically failed in the past.

In addition to an increase in test scores, there was also a stronger sense of community. She found that students were taking more risks with making their thinking public and displayed enthusiasm about completing projects like never before. Students were eager to tutor one another and there was a general sense "that they're all in this together." Students wanted to succeed. Prior to this implementation phase, Susan would have 1-2 students who would come before school for extra assistance. However, during the implementation, Susan noticed that she had 4-5 students every morning; 3 of the "regulars" were her African American students. She observed the same increase during the after-school program with African American students representing 50% of the population.

As Susan reflected on the "strains" to the implementation process, she noted the importance of classroom management. In the beginning, it took some time for students to

adjust to a new way of interacting with one another. They had to learn to refrain from interrupting while others (including the teacher) were speaking. Students struggled with discerning the appropriate times for "asking and answering questions." Overall, Susan observed her management had become less teacher-centered as a result of the project. She recognized that relinquishing some of her control actually benefited the learning experiences for her students, but also admitted that the shift was very challenging at some points.

Another "strain" that Susan recorded was the need to train students on appropriate tutoring techniques before engaging in interactive activities. Susan found that she had to constantly remind students to be kind when they were providing support or correcting someone's mistake. "No one wants to receive 'help' if they are made to feel bad." This is an area that requires instruction in order to implement peer tutoring effectively.

Finally, Susan noted the need to set responsible time limits. While she delighted in providing assistance to students, she spent all of her planning periods and even some lunches working with students. It was a sacrifice of her time, but Susan shared, "the gains in student achievement and willingness to ask questions many just be worth the 20 minute sacrifice every morning."

From a professional perspective, Susan "was thrilled that this focused solely on algebra." She realized that a few small changes in her routines and responses provided the platform for her students to blossom. She learned to step aside and allow her students to manage their own learning. Susan made two new adaptations for classroom discussions, she no longer required students to raise their hands in class and be called on before they talk and if a comment/question is aligned with the lesson (and is appropriate

and respectful) they would address it on the spot. Susan shared this closing comment "I have had a ball with this research…I will continue implementing this component in my classroom throughout the remainder of the year and in the years to come!"

Teacher #4- Jasmine

Jasmine is a White female with 5-7 years of teaching experience and 1-3 years of experience at the 1st grade level. Jasmine decided to participate in the professional development sessions because she thought that one day she'd like to pursue a doctorate degree. Participating in the sessions would provide some insight into the dissertation process. Even though Jasmine did not think that many algebra concepts were taught on the 1st grade level, she thought that she would participate anyway. By the end of the month, Jasmine had made an interesting discovery.

Compared to the rest of the PD group, Jasmine consistently scored below the mean on all subsections of the PTMI. She seemed to "disagree" or be "uncertain" on her "use" and "desire" to use CRT methods (98 out of 130 or 0.75) and general process standards (22 out of 40 or 0.55). She also reported "uncertainty" on her "desire" to use process standards with AA students (26 out of 40 or 0.65) and on "equity" (21 out of 30 or 0.70). Susan also scored just slightly below the mean on "efficacy" (18 out of 25 or 0.72) yet scored high with algebra efficacy (36 out of 40 or 0.90) for a final total score of 225 (possible total of 305 or 0.74) on the PTMI. Scores suggest that Jasmine was uncertain of her support of CRT, NCTM process standards in general and with AA in algebra, on issues of equity and in general efficacy. However, she expressed confidence with algebra.

During all four sessions, Jasmine expressed a solid willingness to change. She was honest and reflective throughout. Her written reflections were insightful. During the first session, she retold a brief account of one African American parent's rationale for not being able to support her student at home. Jasmine expressed her frustration with the apparent disconnection that surfaced. She wanted to help this student, but also realized that the mom needed some assistance as well. As a twenty-one year old mother of a first grader, Jasmine clearly noted this mom's lack of maturity necessary to adequately support the educational needs of her child.

At a different point during the sessions, Jasmine shared an incident that occurred in her building. She realized that as teachers sometimes discuss past interactions with students, they might also share negative experiences and make degrading comments. In one such instance, Jasmine recalled a colleague sharing "how dumb" a student was. Coincidently, Jasmine had that same student on her roster the following year. As she remembered the previous comment about the student's poor academic performance, Jasmine had to avoid stereotypical assumptions (and the previous teacher's perspectives) from clouding her view of that student. Before too long, Jasmine found that student to be a lot smarter than the previous teacher had believed.

As Jasmine continued to reflect on her interactions with students she recognized their exposure to typical adult challenges even as first graders. With a sigh and a disappointed shaking of her head, she said, "some of my first graders have had more trauma in their short lives than I have had in my entire life." Jasmine recognized that her sense of "reality" is often quite different from her students'.

Interestingly, throughout the four sessions, there were several instances where Jasmine exchanged ideas with the 8th grade participants. Through dialogue Jasmine found there were similarities in instructional choices at the elementary and secondary levels and realized topics such as "patterns" are not only prevalent in first grade but in eighth grade as well.

Despite her high algebra efficacy score (36 out of 40 or 0.90) Jasmine shared that math was never her strong point; as a result she finds teaching math challenging. As she reflected on her experiences with mathematics, she realized that because she failed algebra as a high school student, the stigma of "I am not good at math" was attached to her. Despite her experiences with algebra as a teacher, Jasmine notices the importance of elementary mathematics. For Jasmine, math teaching has not been restricted to one 45 minute class period but rather integrated throughout the day. Jasmine's initial beliefs about math instruction can be traced to her experiences while attending a Montessori school. She recalled using manipulatives and working through problems on her own without the teacher standing in front of the room. She has adopted this instructional style as well. She mentioned, " I know different people have different teaching styles, but I am big into using the manipulatives and whatever it takes for them to get it."

Jasmine values connections. As a means of connecting with her young students, she uses references, such as cartoon programs, to make concepts meaningful for her 1st graders. While she clearly desired to provide adequate instruction for all of her students, she struggled with the expressive behaviors of some of students, in particular her African American students. She found them to be very loud all the time. During the first session, Jasmine explained how she used a tally checklist as a discipline tool. She found that

despite her efforts to gain control of her boisterous class, her African American students were constantly being reprimanded for talking.

By the end of the first session, she had this to say: "I had no idea about African American students and their cultural differences…being loud, singing, moving, working in groups. This really made me step back and evaluate my teaching." Jasmine is originally from Maine and has had limited exposure to other races/cultures—some acquaintances "but very few close friends and no family." She reported that the professional development sessions had been an eye opener for her and suggested that every teacher be made aware of culturally responsive teaching.

After the first session, Jasmine abandoned her tally sheet and created a more productive structure for her talkative students. She sat down with her students and collectively decided on the most important times to be quiet (in the hall, during direct instruction and during announcements). She reported, "my kiddos have really changed…they are quieter during the times that it's important to be quiet, and overall, we (the students and I) are much happier!" Jasmine's willingness to adapt to the needs of her students was a consistent theme during the sessions and in her written reflections.

Jasmine thought that by providing more opportunities for students to lead projects, create math songs, and work as a group, that they in turn would learn to be risk-takers and have a more positive attitude about mathematics. Jasmine decided to focus on the "empowering" component of CRT during math instruction. Jasmine recognized that the majority of students in her class come from "single parent low income families." Because many of her students are below grade level and have verbalized their poor

efficacy in math, she wanted to create an environment of success for her students. She wanted them to know that they can be good at math.

Throughout 6 lessons over the course of the month, Jasmine's class of 24 students (10 of which are African American) set out to explore the world of algebraic reasoning. They focused on patterns, inequalities (greater than, less than, equal to), number sense and input/output machines.

Students created posters based on patterns, which were displayed around the room (i.e., number patterns, shape patterns, etc). They also developed their own "math tubs" by using the materials in the classroom. These tabletop containers are often used in elementary classrooms. They serve as instructional support across concept areas and can be used independently of the teacher. Students were required to provide instructions, appropriate manipulatives and some way to assess completion. Students worked together in groups, solved problems and worked out their ideas. Students also self-selected groups and made models of greater than, less than and equal to and took digital pictures of their models. Finally students worked on input/output tables in dyads. They each took turns making up a mathematical rule and collectively completed the table. They culminated this activity with student-developed t-charts in the computer lab. Final products were displayed around the classroom.

Jasmine reported that all of her students enjoyed these projects. She was surprised by her students' level of creativity. During the pattern activity, she recalled 3 African American students in particular. She noticed that they "really expanded on their ideas—more complex patterns; not just AB or ABC. They also used different materials instead of color or shape patterns." While executing the activities, Jasmine was reminded

just how much student students enjoy technology. Even though inequalities and input/output tables tend to be hard topics for 1st graders, they got it and they were equally excited to share their models on the Smart Board display and create t-charts on the computer.

Jasmine noted that some of the "strengths" were having smaller groups; this made it easier to monitor student progress. She expressed appreciation for the sessions prior to the implementation phase. They helped her to address issues, such as her need to have a quiet classroom all the time. These times of discussion and reflection encouraged her to examine her teaching techniques. As another "strength", Jasmine's students developed stronger collaborative skills. The enthusiasm from mathematics instruction spilled over into other subjects and the overall classroom atmosphere was more positive. She saw peer-to-peer teaching and a new sense of caring among students. Jasmine referred to her students as "mathematicians" and they loved it! While her African American students were "more at ease and enthusiastic about math" all of her students benefited from the implementation of the "empowering" component of CRT.

Jasmine reported the "strains" to include the extra time it took for students to work collectively with hands-on projects. While the outcomes were very positive, all of her lessons were more time consuming, requiring triple the amount of time she had allotted. Fitting all of this stuff into the instructional day was a bit overwhelming at times. Jasmine also observed that 1st graders are not skilled at being able to self-select their groups. During week three, students were given the freedom to form their own groups. Even though she tried to provide students with some directives, the groups were imbalanced—a super strong group and another with 3 Attention Deficit Disorder (ADD)

students together. In the future, she would set up the groups because she has a sense of which students function well together.

In addition to the time and structure, another area of "strain" was the need for appropriate assessments. Jasmine found that after students created projects, she did not have a way to assess the knowledge demonstrated in the project.

Although Jasmine noted some "strains" along the way, she had some great discoveries. She was amazed at how much algebra is actually taught in 1st grade. She noticed that she teaches it all the time. The integration process opened Jasmine's mind to a more interactive, hands-on approach to learning. Jasmine shared this thought, " I thought I was doing a good job recognizing the cultural differences in my class. But in reality, I wasn't. I wasn't doing a good job because I didn't know much about African American cultural background." When asked about the likelihood to continue with these methods, Jasmine said, "Yes! Yes! Yes! My kiddos (all races) love to be called mathematicians! One girl told me it makes her feel important—like she can do math now!"

In closing, Jasmine mentioned that her reason for participating in the PD sessions was to give her an opportunity to learn more about the doctoral research process. Well, midway through the professional development sessions, Jasmine disclosed that she was "empowered" to begin her doctoral program. She was preparing for enrollment in the first set of courses at a nearby university.

Teacher #5-Samantha

Samantha is a White female with 1-3 years of experience and less than one year of experience at the 6th grade level. Samantha decided to participate in the professional

development sessions because like Jasmine (Teacher #4), she hopes to pursue a doctoral degree within the next few years. Furthermore, as a second year teacher she realized that there are lots of things she doesn't know about teaching—whether about African American students or otherwise. She believed that anything that would work for one group would work for others as well. Samantha "loves mathematics". She shared that both her parents are good at math, so she doesn't recall ever struggling with the subject. She attributes her passion for the subject to her parents.

As compared to the rest of the PD group, Samantha scored above the mean on all but one subsection of the PTMI. Scores reflect Samantha's "use" and "desire" to use CRT methods (116 out of 130 or 0.89), "use" of general process standard (31 out of 40 or 0.78) and a strong "desire" to use "process standards with AA students" (40 out of 40 or 1.00). Samantha "agreed" with statements on "equity" (24 out of 30 or 0.80) and also reported "agreement" on general efficacy items (21 out of 25 or 0.84). A total score of 232 (out of 257 or 0.90) combined with very strong "algebra efficacy" (45 out of 45 or 1.00) yields a total score of 277 (out of 310 or 0.89), the highest for the entire PD group on the PTMI. Samantha's scores suggest that she is very supportive of CRT and has a strong "desire" to use process standards in algebra with AA students. Samantha supports "equity" in mathematics and is extremely confident with algebra concepts.

Samantha attended 3 ½ of the sessions (she left early during the first session). She was moderately engaged and seemed confident in her abilities as a teacher. She made several references to the reading assignments and readily shared what she knew about the instructional process. She expressed her ideas about the need for strong content knowledge at the secondary level as well as the ability to relate personally to students.

The assigned readings supported Samantha's perspective on the need for a solid mathematical base and mastery at the elementary level. She said, "if you get them then (at the elementary level), we can still have them once they come to us, but if they lose those years—they just don't care once they come to us because they've lost so much in those early years."

Samantha expressed her concern with students wanting answers provided for them as opposed to working it out independently of the teacher. She noted the need to adjust story problems in order to make them relevant to the lives of her students. For example, there was a problem that talked about dividing a township. Her students had no idea of what a township was, so she crossed out this title and replaced it with "a tray of rice crispy treats." The light bulb went on and students were able to relate and work on solutions.

As the sessions progressed, Samantha recalled instances when she encouraged positive interactions among students as well as other ways she might begin to foster achievement for African Americans and other student groups. During the third session, Samantha recounted a situation in which she jokingly decided to play "kiddy" music during math instruction. She thought her 6th students would be turned off by it and request that it be turned off. But to her surprise, the students found the music soothing and entertaining. They began to make a game out of it and tried to guess the movie to which each song was associated. Samantha saw how even 6th grade students enjoy singing songs and healthy competition. This characteristic does not fade away after elementary school. Highlighting this experience may have been the beginning of

Samantha's recognition of the importance of "teaching based on culture, not only content," even in the math classroom.

Since Samantha enjoys learning and teaching mathematics, she believes she can show students why she likes it and hopefully it will encourage them to enjoy it more themselves. Although she clearly loves the content, Samantha had some concerns with focusing on African American students when, in her opinion, she worked with such a small number of them. She seemed to experience a disconnection between what she had been taught in her teacher education program and what the professional development sessions may have been implying. She shared this idea, " I felt strange looking at one group after being told for so long that we shouldn't change teaching based on students' race."

Samantha believed that it was important to make mathematics relevant to students' experiences. She expressed her thoughts on the underperformance of African American students as being correlated to the students not seeing "the value of the material and why they need to learn it." Samantha viewed her role as one in which she could assist students in understanding why mathematics is important. Despite the intrinsic conflict that Samantha may have experienced, she agreed that knowing a little about students' cultural backgrounds and using this as a point of relevance might assist in the explanation of topics and concepts. Ultimately, she believed that strategies for African American students would work for all students.

Although Samantha was concerned with maintaining the normal flow of the instruction process, she thought that it was also important for students to feel valued in the classroom environment. As a result, Samantha selected the "validating" component of

CRT to implement with 87 students, 21 of whom are African American (or partially African American). The "validating" method affords students opportunities to see reflections of themselves in the curriculum. It acknowledges students' culture/race/ethnicity and includes these perspectives into the instructional environment. She implemented this component over 4 lessons (and 2 other short lessons). Because of the need to prepare for state assessments, these lessons were not introduced during the scheduled mathematics time, but rather during one 45minute period per week typically used for remediation. Samantha perceived this method to be the most "seamless" for her teaching style and would not "affect the routine students were used to." She thought that continuity was an important component for the successful implementation of the "validating" method.

Over the course of the month, students created their own word problems, worked on fractional computation, worked on a famous mathematician project, used the whiteboards for decimal computation and related problems to their individual interests and algebra concepts. As Samantha adopted the "validating" component of CRT, she thought that students would benefit from seeing famous mathematicians from their ethnic/racial backgrounds. In collaboration with the Language Arts teacher, she researched men and women mathematicians from various ethnic/racial backgrounds or as close to that background as she could find (i.e., Polish, African American) of each of her students and found a mathematician whose background matched the background of the student. This individual became the subject for research for students. Students were given some information on a famous mathematician from their cultural or gender group. The research extended into students finding out the origin of mathematical concepts such as

fractions and calculus. The intent was to present finished projects (power point presentations, brochures, etc) to the rest of the class. Samantha noted how this particular activity is really a research project that will extend beyond the one-month implementation phase.

Samantha's students also created personal word problems and exchanged them with one another. She noted that at first they struggled with writing the problems; but afterwards, students seemed to enjoy solving each other's problems. Similarly, students were enthusiastic about displaying answers on the white board for Samantha. She noted, "They like me to see their answers and their thoughts."

Finally, during the last week of the implementation phase, Samantha decided to have students create algebra word problems based on their personal interests. Students were solving equations with one unknown variable. They created problems based on areas such as baseball, football, swimming, running, shoes, skateboarding and lipstick. Samantha was unsure of the basis of the scenarios at some points, but as long as the math made sense and the scenario made sense to the students, she was fine with that.

Samantha noted a number of the "strengths" of the implementation process. One was an increase in student engagement. When students began the research on the famous mathematicians, she shared how "students were excited to see the mathematician that was from the same place as them." Another "strength" of the process was that students were afforded an opportunity to go deeper into the material. Additionally Samantha was able to integrate another content area—Language Arts. Samantha shared how the Language Arts teacher was a fairly new teacher as well, so this provided a layer of support for both of them.

Time management, especially when students were using the white boards was an area of "strain". Because Samantha has such a heterogeneous group of students ranging from gifted to special education it was especially challenging to negotiate the appropriate amount of wait-time. Another area of "strain" was the amount of time required to research the listing of ethnically/racially diverse famous mathematicians. While Samantha was excited to provide this opportunity for her students, she also recognized the huge time investment of the project. Finally, the gap in students' skills (i.e., writing) made it challenging to write the word problems efficiently. The skill gap may have interfered with the mathematical task of developing and solving problems.

Samantha continued to believe these strategies are good for all students. Samantha was initially uncomfortable with focusing on African American students exclusively. However, by the end of professional development sessions, she said, "No student has suffered because of my decision to participate in the professional development sessions. These strategies are good for African American students, special education students, Latino/a, students all students, all day long. Along the way Samantha learned a few things, and she ended by sharing, "My kids enjoyed it and I had fun."

Teacher #6-Melissa

Melissa is a White female with 1-3 years of teaching experience and less than one year of experience at the middle school level. She grew up on the East Coast. During her first year in the school district, she taught mathematics to 10^{th}, 11^{th} and 12^{th} grade students at the alternative high school. She decided to participate in the professional

development sessions because she recognizes that African American students are consistently underachieving. “There must be something that we can do to help these kids…so I figured that I’d give it a try.”

Compared to the rest of the PD group, Melissa scored above the mean of every section of the PTMI. She reported “use” and “desire”” to use CRT methods (108 out of 130 or 0.83) and general process standards (30 out of 40 or 0.75) as well as a strong “desire” to use “process standards with AA students” (40 out of 40 or 1.00). Melissa reported some “uncertainty” on the “equity” section (23 out of 30 or 0.77) yet a strong general efficacy (22 out of 25 or 0.88). Melissa’s total score of 223 (possible total 265 or 0.84) combined with high level of algebra efficacy (43 out of 45) gave her a final total score of 266 out of 310 (0.86) on the PTMI. Melissa’s scores suggest that she is “uses” and has a “desire” to use CRT in mathematics with AA students. Melissa also supports the ”use” of process standards in general and has a strong “desire” to use process standards in algebra with AA students. Melissa was quite confident in her ability to learn and teach mathematics, especially in algebra.

Melissa was highly engaged during all four sessions. She often shared personal stories/experiences that enhanced the depth of the dialogue. She was reflective, transparent, and possessed a good sense of humor. Melissa asked several clarifying questions about the content and the process of culturally responsive teaching. She exhibited a teachable demeanor while still holding true to her convictions.

While engaged with the other participants, Melissa shared several stories about her previous encounters that led to insights about some African American students’ perspectives. In one instance she recalled a conversation with a male student who

explained why he was not turning in his assignments. He said, "I can't turn it in in front of the rest of the kids." Melissa began to understand then that for some African American students, especially males, there is sometimes a stigma attached to high performance in school. Researchers have referred to this response as the "acting white" theory (Thompson, 2004). This was an eye-opening experience for Melissa.

The rich exchange of ideas prompted Melissa to reflect on her personal experiences in school as a middle school/high school student. She recalled how mathematics courses were offered. Students were not forced to take algebra by a certain grade…they only did so if they possessed the skills to be successful. If they were not ready, they would take pre-algebra in 8th grade, then algebra in 9th grade. She recognized the sensitive nature of assigning students to certain classes as having a resemblance to "tracking." But Melissa seemed unsettled on the manner in which curricular choices were decided. Melissa made this observation:

> Even if they [the students] don't pass algebra at 9th grade, we put them in 10th grade Geometry anyway…so I ended up with 10th, 11th and 12th graders in Geometry who hadn't passed either semester of algebra. By the end of 10th grade many students have no math credit because they have now failed Geometry also. Now that is "structural inequality".

Melissa recognized the additional instructional supports provided by that the district (i.e., computer-based tutorial programs) to meet the needs of students but still disagrees with the structure that is in place. Although Melissa is not able to make vast curricular adjustments, she has begun to embrace the freedom in adjusting mathematics instruction to relate to her students. For example, she began to present a problem that

discussed students taking a bike tour. After inquiring, she realized that many of her students didn't own bikes, let alone had ridden one. After this experience, she began to recognize the need to revise scenarios in order to relate to the students' experiences. The sessions provided a venue to discuss these areas of instructional disconnect. Overall, during the four sessions, Melissa displayed a willingness to adjust instruction to meet the needs of her students. She exhibited a "trying to understand" demeanor that led her to the actual implementation phase.

The written reflection at the end of the first session provided a glimpse into Melissa's thought process. She wrote, " I will always ask myself, does my example or approach to the topic have any relevance to my students?" Melissa displayed concern for relevance. In order to provide relevance, she would have to get to know her students and they would have to trust her. She wanted them to know that she appreciated who they are and had a desire for them to experience academic success.

Melissa considered the "validating" component of CRT to be a good foundation for relationship building. As she provided opportunities for students to see themselves in the learning environment, this might be translated into the academic success that she longed to see. During the one-month implementation phase, Melissa worked with four different classes, two 7th grades and two 8th grades. In all four classes the students were placed there because of their underperformance on formative assessments and/or teacher recommendation. Unfortunately, students lost an elective course and were not thrilled to be in Melissa's class. She noted that the students who needed the most improvement were the least motivated.

Melissa really wanted to focus on one particular class, which consisted of 9 boys--5 African American, 2 Hispanic, 1 Vietnamese and 1 Caucasian student. However, she decided to implement the "validating" component with all four classes, while paying close attention to the impact on her target class. This new class started at the beginning of the implementation phase. So, Melissa and these students were not acquainted prior to the first day of class.

During the month, Melissa set the tone for learning and focused on creating an environment that was comfortable, collaborative and confident. During the first week, students spent time getting to know one another. They decorated a paper t-shirt with personal facts. Students were paired up with the intention of exchanging information. As a class they brainstormed names for their class. They voted and selected the most popular name.

During the second week, Melissa's intention was to build a sense of collaboration and teamwork despite the diversity of the group. She took class photos and mounted it on colored paper on the wall. Melissa reported that no one from either 8th grade class volunteered to write their class name on the poster, but there were volunteers from both 7th grade classes who recorded their class names.

Week three coincided with the 2009 Presidential Inauguration. Melissa thought that highlighting current African Americans might evoke a sense of pride and confidence among the students. Students read about their own superintendent (who is an African American male from an all African American town in Oklahoma) in the New York Times newspaper article, discussed a prominent educator, Stedman Graham (longtime friend of

Oprah Winfrey and recent keynote speaker for an event in their neighborhood) and watched Barack Obama being sworn in as the 44th president of the United States.

Finally during week four, students researched prominent mathematicians and scientists based on a list that Melissa developed. This two-day project consisted of students reading about self-selected individuals (from a list provided by Melissa) and creating a display with photos and pertinent facts. Melissa found biographies/photos from each cultural background represented in her classes. "I tried to have someone for each student to relate to." She found males and females from African American, Hispanic, Vietnamese and Samoan backgrounds. Students shared their final products and their work was displayed in the class.

In addition to the above activities, Melissa integrated student interests into mathematics instruction with topics such as:

- "Football Fever" (AFC, NFC Championship game scores-- prime number review and factor review, Superbowl—roman numeral, probability, prime vs. composite, ration/percent and rate and unit rate)
- Percent Problem Tic-Tac-Toe (student-created problems)
- Rate-Unit Rate Tic-Tac-Toe (student-created problems)
- Basketball Competition (total number correct=total number of shots taken; calculate shooting percentage)
- Darts (similar to basketball)
- Video Clips

Melissa utilized the "validating" component of CRT to incorporate cultural connections and everyday interests of her 7th and 8th grade students into the mathematics classroom.

The discussion around current prominent African American men was a noted "strength" of the implementation process. Melissa said, "I saw pride in some faces." As students watched the inauguration, talked about their superintendent and Stedman Graham's visit, Melissa recalled that this was "easy to do!" Students were clearly able to identify and the occurrence seemed to evoke the pride and confidence that Melissa had set as a goal.

Another "strength" that Melissa reported was that students seemed to enjoy decorating their t-shirts during the first week. Unfortunately students were not comfortable enough to exchange information as anticipated. In contrast, during week two, many students were "thrilled to be in a photo" and insisted that Melissa hurry up with the printing and classroom posting. This was another noted "strength" during the implementation process.

One final "strength" was observed during week four with the research of the prominent mathematicians and scientists. Melissa reported that "students started to see that not everyone prominent is an 'old white guy'." Students saw reflections of themselves in the ethnically/racially diverse men and women. Student typically observed White men being in prominent positions, but this experience opened a window for something new and personal.

Melissa reported that the time required to research the prominent mathematicians and scientists was definitely a "strain". This process took a lot of time beyond what is

usually allotted. Another area of "strain" was observed during the very beginning. Students were not excited to be losing an elective course and having to take another math class with a new teacher. They seemed quite suspicious of Melissa at first. When it came to taking the group photo, some students had to be persuaded to join; a few did even offer a smile. Melissa also noted that no one invited her to be in the team photo. She wondered to what extent they saw her as part of the team.

One other "strain" that Melissa reported was based on her meta-cognitive process. As she reflected on students studying prominent individuals and watching a historical event unfold, she wondered to what extent these interactions might really affect the level of achievement for her African American students. "Does it inspire the students to work?" is a question that remains to be answered.

By the end of the professional development sessions, Melissa agreed that students who are not successful in algebra and geometry courses would have limited opportunities and success in higher education. She contended that, "success in algebra depends on the proficiency with basic math skills, so maybe the focus needs to shift back to 3rd and 5th grade math."

Melissa set out to cultivate a culturally accepting and "validating" environment. She desired that her students recognize that she believed that they could be successful and know that she was accepting of who they were. She understood that the cultural mismatch between teachers and students could interfere in the quality of learning. Furthermore, she wanted her students to trust that she had their best interests at heart regardless of cultural differences. She was not certain that the process was completed during the one month implementation period. She ended her reflection with this, " I

believe my African American students see that I am an 'old white woman' but trust me and know that I want to them be successful." This was her objective and her discovery.

Teacher #7-Lori

Lori is a White female with 1-3 years of experience as a 7th grade special education teacher and a math lab instructor. She is from a small town and grew up with little to no ethnic diversity around her. When asked why she decided to participate in the professional development sessions, she said, "I am not aware of what I don't know." She realized that there might be some important information that could be applied to her interactions with students. She hoped that the sessions would provide some professional insight.

Compared with the rest of the PD group, Lori scored above the mean on all but two subsections on the PTMI. She reported some "use" and "desire" to use CRT methods (110 out of 130 or 0.85), and a strong "desire" to use "process standards with AA students" (40 out of 40 or 1.00). Lori reported some "uncertainty" on general process standards (23 out of 40 or 0.58) and items on the "equity" section (23 out of 30 or 0.77). Additionally, Lori scored moderately on general "efficacy" (14 out of 25 or 0.77) and low on algebra efficacy (18 out of 45 or 0.40) for a final total score of 230 out of 310 (0.74) on the PTMI. Scores suggest that Lori is supportive of CRT and has a strong "desire" to use process standards in algebra with AA students, despite her "uncertain" "use" of process standards in general. Lori moderately agreed with issues of "equity", was somewhat comfortable with teaching and learning math, however, she was quite uncomfortable with teaching algebra concepts.

Lori was very engaged during all four sessions. She demonstrated a sense of reflection and willingness throughout. During the course of the sessions, she made several references to books she had read or pertinent comments she had heard from college courses. Lori found the first session helpful in that it clarified some typical behaviors of African American students.

During a discussion about the expressive behaviors among many African American students, Lori made reference to an article that she heard a guest speaker reference in a multicultural college course. The article is called, Those Loud Black Girls: (Black) Women, Silence and Gender "Passing" in the Academy by Signithia Fordham (1993). The speaker pointed out some of the cultural differences between African American and White middle class homes. One difference is in the use of volume. Many African Americans tend to use loud voices in and outside of closed environments. This is connected to the need to be heard. Lori found this information quite helpful in her interactions with students. This information helped her to understand the boisterous style of AA girls as not being disrespectful necessarily but rather as a cultural trait.

Lori reported that the reading assignment further illustrated how culture impacts students' learning process and how student performance is influenced by their personal feelings and teacher's expectations. As Lori reflected on this, she said, "I often forget to consider that all of my students have very different backgrounds than I do." Lori began to understand these differences could lead to empowering changes or create roadblocks for her students.

As Lori continued to engage in the professional dialogue, she was encouraged to know that CRT strategies are based on "good teaching" and will work with all students.

In the beginning, Lori started thinking of the positive impact of an "empowering" and "validating" learning environment, especially in algebra. She saw this as a need for African American students because most don't see other African American individuals being successful in this area. Lori believes in the power of modeling instruction. As a special education teacher, she understands the need for variance in the instructional environment. In her math classroom, students are searching for and discovering connections and interacting with related materials.

Interestingly, Lori is a not a trained math teacher, but provides supportive instruction to a group of special education students. She admits that she "hated math" because she did not feel like she was good at it, as evidenced by her moderate to low efficacy score ("efficacy" 14 out of 25 or 0.77 and "algebra efficacy" 18 out of 45 or 0.40). But she learned to love it and now, "its my [her] favorite thing to teach because I [she] get [gets] excited by that fact that I [she] can do it…I can really do this!" Lori's struggle in understanding mathematics makes her able to relate to her students better. She realizes that they struggle sometimes, so she is able to support them with empathy and compassion.

After additional reflection, Lori concluded that the "comprehensive" component of CRT would be most applicable to her students. It seemed to Lori that this component was a "logical place to start because it is like the backbone of everything else you do." She saw the "comprehensive" method as the structure for lesson plans and assessments. Lori developed four lessons for 19 students, 5 of whom were African American. Over the course of the month, students focused on working in teams, working as a community of learners, involving prior knowledge and aiming to see the relevance of what they learned.

Mathematically, students focused on geometric concepts (surface area of a cube, volume of rectangular prisms), number concepts (multiply and divide fractions) and probability (solving proportions, finding unit rates, simplifying ratios).

Since Lori wanted to students to focus on working as a community of learners, during week one's activity students were divided into teams of two. In each pair there was an "expert". The "expert" was responsible for explaining some aspect of the lesson to his/her partner. When the teams came back together, each member would win a prize if both were able to explain the concept accurately.

During week two of the implementation, Lori decided to create problems that were related to students' real-life situations. Students developed a list of items that might be included in a package to a deployed loved one. Using their knowledge of surface area and volume, students were responsible for figuring which items would fit into particular boxes (given the volume) and how much paper would be needed to wrap the boxes (surface area).

Week three of the implementation phase offered students an opportunity to multiply and divide fractions and then displayed their responses on white boards. Lori would provide a number sentence or word problem, students would record their answer on the board and hold it up for Lori's viewing. Week four provided a new twist to the implementation of the "comprehensive" component of CRT. Students worked in pairs again, but this time utilized the computer. Students played an on-line game of jeopardy; the winner got a prize.

Students who were the "experts" during the first activity felt a sense of pride. Lori observed an increase in effort and enthusiasm. In her opinion, "they were motivated by

being taught by a peer and not knowing who would be called on and the prospect of a prize." Lori reported three "strengths" of this activity. One was that the students had a break from hearing her talk. Another was that the "expert" students were able to learn the concept at a deeper level and finally, each student was held responsible for his/her learning.

Students generally responded well to the packing activity. Most students displayed excitement about a pretend list to send to a deployed parent. Lori reported that the girls were more enthusiastic than the boys. She also reported that her African American students were the least excited. Because Lori surveyed the students, she knew that her African American students could relate to a having a deployed parent, but nonetheless, they were not engaged in this activity. However, the "strength" of this activity was that is provided a real-life example for applying surface area and volume concepts. Additionally, the activity afforded students the freedom to solve the problem in different ways. They used what worked for them. Many of them came up with solutions that Lori had not thought of.

Holding up the white board fostered high engagement and a little healthy competition. Lori reported that her African American students were very enthusiastic about trying the problems. She found that these same students wanted to assist with passing out materials and even came up with their own problems for the class. Lori noted that a "strength" was the use of different materials. Paper and pencil work can get a little dull. Also, Lori found that because they had to hold their answers up, the students started racing. This enabled a quick and efficient assessment.

The jeopardy game around proportions and unit rates on the computer also livened up the math classroom. Lori noted that all students embraced a change in the normal routine. They asked lots of questions and offered help to one another. Lori found it quite easy to circulate about the room to listen to conversations and ask clarifying questions. Students seemed to take pride in helping one another—operated as a team, rather than a competition. This exchange helped both students—the one providing the instruction and the one listening.

Overall, Lori felt that students were more engaged in the lessons based on the "comprehensive" component of CRT and as the weeks progressed "they seemed to enjoy coming to math lab…. " They referred to the days with the CRT method as the "fun" days. Students were given opportunities to get up and talk with a partner as opposed to sitting taking notes. Lori remembered one student, in particular, who displayed "awesome leadership skills" in Socratic circle in Language Arts. Those same skills surfaced when he realized he understood the math. Another student had an "ah-ha" moment and realized he also understood the math.

Lori noted professional "strengths" as gaining a deeper understanding of the mathematical concepts. She also appreciated that she was able to hear and see what students could really do. During the month, her African American students, in particular, showed her that they really do understand the concepts she has been teaching.

Lori reported four "strains" with the implementation process. The first was observed during week one. Even though she kept the groups small, Lori would have liked to circulate more and have the time to listen to students' conversations. The second "strain" was observed during the packing activity. Even though Lori created a situation

that she believed her African American students would be able to relate to, she was surprised that they didn't. "It is difficult to know what [sic] kids will have a personal connection with." Lori considered the fact that such a project may have been an "emotional and sensitive subject, so maybe they didn't want to relate or connect to those painful memories."

The third "strain" was observed the day after students used the white boards to multiply and divide fractions. Most students struggled with displaying their understanding of this concept. Lori's African American students "reverted to not writing anything without me [her] spoon feeding them." The other issue with the white boards is that there is no record of students' work. "I couldn't pull out their success from the day before and say, 'see, you know how to do it'."

The fourth "strain" was a technical difficulty observed during the on-line jeopardy game. There were instances when the students would respond correctly but the computer would mark the problem incorrect. This is an area that Lori believes she should have reviewed before she integrated the activity into classroom work.

Lori expressed that "culturally responsive teaching is just good teaching" for all students. She admitted that it required time, patience, hard work and consistency; but it was worth it. The implementation of the "comprehensive" component really produced "good results and made math lab more enjoyable for me too."

Lori participated in the professional development sessions to gain some important information that could be applied to her interactions with students and hoped that the sessions would provide some professional insight. Lori considered the likelihood that she would continue to implement the "comprehensive" method. She said, "It is very likely

that I will continue to use…these methods. Why would I discontinue use of something that is helping my kids learn and helping me see that they're learning?"

Teacher #8-Julie

Julie is a White female and a recent college graduate, in her first year as a 3rd grade teacher. Growing up in metropolitan area, she was accustomed to being around many people from many different backgrounds. In her opinion, she found it shocking to be in a community with a limited amount of diversity. As a new teacher, she felt confident that she was meeting the needs of her students, however; she knew that there were things that she did not know. She thought that attending the professional development sessions would provide some insight into strategies that would be applicable to all of her students. She said, "Whatever we can learn to teach African American students has got to work with other kids."

As compared to the rest of the PD group, Julie scored above the mean on some subsections and below the mean on the other subsections on the PTMI. Julie reported some "use" and "desire" to use CRT methods (101 out of 130 or 0.78) and general process standards (31 out of 40 or 0.78), yet seemed to "disagree" or be "uncertain" about the use of "process standards with AA" (24 out of 40 or 0.60). She seemed "uncertain" on issues of "equity" (21 out of 30 or 0.70) and reported low general efficacy (17 out of 25 or 0.68). Julie's total score of 194 (out of 257 or 0.75) combined with moderate "algebra efficacy" (30 out of 40 or 0.75) yielded a final total score of 224 out of 305 (0.73) on the PTMI. Scores suggest that Julie is moderately supportive of the "use" and "desire" to use CRT in mathematics. She supports the "use" of process standards in general but seemed to lack the "desire" to use process standards in algebra with AA

students. A moderate score suggests some uncertainty with issues of equity and general efficacy, however, Julie did seem confident in her ability to effectively teach algebra concepts.

Julie was somewhat engaged during the professional development sessions. She attended 3 out of the 4 sessions. She was often observed taking notes while actively listening to the dialogue among her peers. When Julie reflected on how she incorporates students' cultural backgrounds into the construction of math lessons, she shared her strategy of using Popsicle sticks to call on students randomly because she had observed that they wouldn't readily volunteer. She thought that this method provided time for students to process their answers. "I'll let them know that I'm going to call on them next, so they can get ready." Julie recognized the importance of students verbally communicating their mathematical understandings and she saw her role as a critical part of this process.

In addition to verbal communication, Julie shared how incorporating information from television shows provides a sense of connection for students. As a mom of a 4th and 5th grader, she is knowledgeable of the current cartoons, so she uses this information as a frame of reference when appropriate to explain mathematical concepts. She observed that this could sometimes increase student engagement.

Along the same line, when Julie reflected on how she teaches mathematics, she said, "I think that loudest time of the day is during math—they're talking and moving." While some of her colleagues take some issue with the noisy classroom, Julie does not. "My family and I are loud. We're like the loudest family in the restaurant. We're so loud that my class being loud does not bother me. "

Unfortunately many teachers have often perceived some student behaviors (such as being loud) as having a negative influence in the classroom. The group discussed the idea of recognizing these behaviors as "strengths" rather than annoyances. Julie chimed in on the dialogue, recognizing that in addition to being able to articulate their thoughts, several students possess great flexibility. Julie has observed that many students live very transient lives and are subject to the adult decisions around them. With these conditions they are still expected to perform as students who don't have these realities—and some are resilient and flexible enough to do so. Teachers' recognition of their students' "flexibility" can be an asset to any learning environment.

Julie utilized her written reflections to share her thoughts about the sessions and the assigned readings. She reported that she found the first session to be "eye opening" in that it provided a new way of looking at the behaviors and interactions with her African American students. She also shared her hesitation with working on algebra concepts. After reflecting on the reading, she began to realize that algebra concepts are taught as early as kindergarten. She had not realized that 3rd grade students were developing skills that would continue to expand as students progressed to higher grades.

She attributed her openness and appreciation to cultural diversity to the instruction during her teacher education program. She shared how fortunate she was to have had "fantastic teachers" and her personal experiences that provide a "good idea of cultural diversity." By the end of the second session (although she did not attend the session, she received the handouts and readings) Julie became quite interested in the "empowering" component of CRT. She expressed a desire for students to be more self-directed in their learning. She said, " I want them to feel respectful of their learning and

understand that they have a say and an input into their education." Julie believed that if she made small changes in the instructional environment, her students would develop a new sense of confidence in their abilities as math students.

Julie did not report the specific math skills that she taught during the implementation phase. However, she did report her implementation of the "empowering" component of CRT across four lessons with a class of 19 students, 10 of which are African American. During the implementation phase, Julie began to include positive messages and a greeting on the board each morning. During mathematics instruction, Julie would greet her students by saying, "Good Morning Math Geniuses!". At other points during the month, Julie displayed posters with encouraging statements as a means to "empower" students to do their best, such as "When you fail to plan, you plan to fail." She also had a display of books and music for students to review. This is what she shared, "I always make sure to have "math" literature available from the library to support whatever math lesson I am teaching."

During week three, Julie focused on setting high expectations. She reported that she had been trying to do this all year. While working on "parenthetical equations", she made special efforts to encourage students and reiterated her belief that they could understand this once perceived challenging concept. Julie ended the implementation phase with students working at their own pace and self-grading their progress on state assessment preparation guides.

Although Julie thought that addressing her students, as "Math Geniuses" would be "empowering" to them, she reported that some students liked it but the majority of her students did not. She also reported that traditionally her students have not been receptive

to her "being too silly or just plain goofy". They appeared to be "too cool" for that. Nevertheless, Julie thought that thinking about how teachers refer to students as a "strength" in the implementation process. She suggested that perhaps changing the word to scientist or something like that would in fact be "empowering" for students.

Julie reported another "strength" of the process to be the cross curricular connections. Using math literature was a great integration and "it helps the kids to see and be able to touch real examples of math." As Julie reflected on the week of setting high expectations, she saw this in and of itself as a "strength" of the process. Students responded to Julie's encouragement by saying, "you always say that". She believed that it is important to set high expectations for students all year long.

One final "strength" that Julie reported was the impact of having students self-pace and self-grade their work. She noted that this process validates students in a non-threatening way. Students can self-check without anyone knowing if they missed a question. It also encourages them to try problems they might not normally attempt. Overall, Julie believed that giving her students an opportunity to take responsibility for their own learning was a huge "strength" in the implementation process.

Julie reported her greatest "strains" to be time and the focus on assessment. As a new teacher, she has been faced with time management issues from the start. Finding the time to implement the "empowering" component seemed to require additional time that she could not find. One of Julie's time commitments was preparing for standardized tests. She observed that with educators stressing the importance of focusing on testing exclusively, she struggles to find the time to incorporate innovative activities into the

classroom as much as she would like. Julie reported that the focus on assessments "took away a lot of the spontaneity and freedom of choice for curriculum."

Julie also reported other "strains", such as the need to monitor students for honesty during the self-checking process and the availability of math literature books when you need them. She concluded the implementation with the "strain" of wondering about the next steps for student who seemed to try so hard, yet still fail to live up to teacher expectations?

Despite the challenges, at the end of her final reflection, she wrote," I really enjoyed everything we did and I plan on implementing everything that I can." She asserted that her eyes were open to issues she had never been taught or considered. Julie believed that her students enjoyed the lessons during the implementation process and she pronounced that she would continue to "empower" her students toward high mathematics achievement.

Summary of Professional Development Sessions

Participating teachers self-selected one CRT method that they believed would best match their achievement goals for African American students in their mathematics classroom. During the final session, participants shared their implementation of the selected method. Table 5-4 presents the selected CRT method, the extracted process standards that were utilized, the mathematical content, the number of lessons and components of the NCTM' s Equity Principle that were explored during the

implementation phase for each participant. Additionally, information regarding years of teaching experience and current grade experience is also presented.

Results indicate that teachers incorporated CRT methods across 4-18 math lessons over the one-month period. Three teachers selected the "comprehensive" method (1 elementary teacher, 2 middle school teachers), three selected the "empowering" method (3 elementary teachers) and two chose the "validating" method (2 middle school teachers). Fifty percent of the teachers reported the implementation of algebra concepts, 38% reported the integration with number concepts or skills related to algebraic reasoning and 13% reported integration with geometry concepts. All but one teacher (Teacher #8) reported direct use of process standards in mathematics during the implementation month. Additionally, all teachers reported some component of the Equity Principle during the implementation phase.

In some cases, results from the PTMI did not necessarily reflect the actual implementation of CRT, NCTM process standards and comfort with equity and algebra. For example Teacher #2 (Allison) scored below the group mean on all subsections of the PTMI, however, during the PD sessions and implementation phase she reported strong support for CRT methods and issues of equity in mathematics. Likewise, Teacher #5 (Samantha) scored the highest on all subsections in the PTMI as compared to her Grade 6-8 peers. However, during the PD sessions and implementation phase she reported some "uncertainty" with implementing CRT in her mathematics classroom.

On the other hand there were cases in which the results from the PTMI did reflect the interactions in the PD sessions and the results from the implementation phase. Teacher #7 reported her lack of confidence in mathematics on the PTMI and supported

this position during the sessions. Despite her apparent lack of confidence in this area, she created opportunities for her students to increase their mathematics achievement and she increased her mathematical understanding as well. Similarly, Teacher #2 (Susan) scored high on algebra efficacy scale, general efficacy, issues of equity and had a "desire" to use process standards in algebra with AA students. Since Teacher #2 teaches algebra exclusively, she had the advantage of finding ways to implement CRT directly into algebra daily. Her enthusiasm for the implementation was evident in her written reflections and verbal interactions. Teacher #8 (Julie) scored moderately on the PTMI and seemed "uncertain" about her "desire" to implement process standards in algebra with AA students. Although Julie contributed to the PD discussions, she also appeared uncertain on how to implement CRT into her daily instruction. As a new teacher, there is a need to manage a number of classroom concerns. Although she was willing and enthusiastic about this professional opportunity, she may have been overwhelmed at times.

In closing, the combination of the PTMI and the PD sessions provided a glimpse into what teachers think about the cultural influences on mathematics instruction and their "desire" to include these realities into the construction of algebra lessons with particular attention to AA students. Both approaches assisted in the understanding of the "strengths" and the "strains" of the implementation process of CRT, NCTM process standards and Equity principle.

Table 5-4 Implementation of CRT, Process Standards and Equity Principle

	Teacher #1 Cynthia	**Teacher #2 Allison**	**Teacher #3 Susan**	**Teacher #4 Jasmine**
Total Experience (Curr. Grade Experience)	7+years (7+) Grade 3	7+ years (3-5) Grade 3	7+ years (3-5) Grade 8	5-7 (1-3) Grade 1
Number of Lessons	7	18	14	6
Math Content	-Unknown variables -Writing equations -Number patterns	-Multiplication -Division concepts/equal grouping -Arrays -Number Facts	-Solving equations/Inequalities -Slope intercepts -Linear equations -Systems of equations	-Number & shape patterns -Inequalities (< , >,=) -Input/Output Machines
Selected CRT Method	Comprehensive	Empowering	Comprehensive	Empowering
Use of Process Standards	Connections -Real-life experiences -Learning about famous AA Communication Sharing mathematical rules	Connections -Real-life experiences -Role playing -Using student names in problems Representation Math understanding displayed in Excel charts, power point presentations and posters	Reasoning and Proof -Generalizing patterns Communication -Group discussions (small &whole) -Peer tutoring Representation Hands on projects	Communication -Sharing mathematical rules -Collective work in small groups Representation -Pattern posters -Greater, less than models
Equity Principle	"I must allow for differences and embrace them"	"I want students to feel free to try various strategies in problem solving."	Want to create an environment where students see themselves as successful in algebra	Want to create an environment for success in math

	Teacher #5 Samantha	Teacher #6 Melissa	Teacher #7 Lori	Teacher #8 Julie
Total Experience (Curr. Grade Experience)	1-3 (0-1) Grade 6	1-3 (0-1) Grade 7-8	1-3 (1-3) Grade 8	0-1 (0-1) Grade 3
Number of Lessons	4	Worked with 4 classes	4	4
Math Content	-Fractional Computation	-Prime and composite numbers -Probability -Unit ratio/percent	-Geometry concepts (surface area, volume or rectangular prisms) -Number concepts (multiply and divide fractions) -Probability (solving proportions, finding unit rates, simplifying ratios)	Parenthetical equations
Selected CRT Method	Validating	Validating	Comprehensive	Empowering
Use of Process Standards	Connections -Famous mathematician project -Student-created story problems based on interest	Connections -Famous mathematicians project -Math lessons related to student interests (i.e. football, basketball, darts, tic-tac-toe, video clips)	Connections -Building on prior knowledge	Connections -Incorporating math literature into lessons
Equity Principle	Believes that it is important to make math relevant to student experiences	" I always ask myself, does my example or approach to the topic have any relevance to my students?"	Believes in the power of modeling	"I want them to feel respectful of their learning and understand that they have a say and input [sic] into their education."

CHAPTER 6 - Summary, Conclusions and Recommendations

Literature discusses the importance of cultural connections in the learning environment (Ferguson, 2001; Gay, 2000; Kunjufu, 1986; Ladson-Billings, 1995a; 1995b) Lee, 2002; Lowen, 1995; Thompson, 2004, 2002) especially in mathematics (Hilliard, 1992, 1989; Stiff and Harvey, 1998; Tate, 1995). However, there is limited empirical research on the actual exploration and implementation of culturally responsive teaching in the mathematics classroom. It was important that teachers explore and experience the implementation of interventions such as culturally responsive teaching as a means to explain, argue and/or validate how attention to cultural differences might increase mathematics achievement (Banks, 2006; Gay, 2000; Ladson-Billings, 1994; Robins et al., 2002).

This study provided a context for in-service teachers to implement culturally responsive teaching methods in algebra with African American students (Hilliard, 1995; Tate, 1995; Thompson, 2004). Because many African American students underachieve in mathematics and algebra serves as a gatekeeper for access to future academic experiences, this study focused specifically on algebra content with African American students in elementary and middle school classrooms (Moody, 2003, 2000; Moses & Cobb, 2001).

Summary of Research Questions

Three research questions provided direction for both the design and analysis of data collected in this study. The following section provides a summarized response for each question.

Question #1-CRT, Process Standards and Equity

To what degree do in-service teachers self-report the actual "use" and "desire" to use culturally responsive teaching components, NCTM process standards and the Equity principle in teaching mathematics to African American students?

Culturally Responsive Teaching

The concept of culturally responsive teaching (Gay, 2000) seems to be a new construct to most teachers. *The Powell Teaching Mathematics Index* (PTMI) was designed to assess the degree to which in-service teachers actually use these methods in the mathematics classroom. The researcher considered the fact that many teachers may not have been aware of culturally responsive teaching as pedagogical construct, so a "desire" section was incorporated. Results indicated several instances in which a considerable number of respondents selected "uncertain" on the "use" section of the PTMI. This suggested their unawareness of these instructional methods in the mathematics classroom (See Appendix M). However, there was a pattern of these

participants making a more definitive decision on the "desire" section, as evidenced by the increase of "agree" and "strongly agree" responses for the same item.

For example, on the first item *"I employ culturally responsive teaching strategies in mathematics."* 32.4% of the respondents selected "uncertain" but on the "desire" section for that same item only 5.9% of respondents selected "uncertain" with 91.2% indicating a "desire" to employ CRT methods in mathematics. The same pattern is seen with *"I incorporate AA cultural experiences in the construction of mathematics lessons."* where 55.9% reported "uncertain" on the use item while 91.2% selected "agree" and "strongly agree" "uncertain" on the "desire" item. Another example is *"I provide examples of prominent AA mathematicians during the school year for my AA students."* Where 61.8% selected "uncertain" on the "use" item and 85.3 % reported a strong "desire" to incorporate this into mathematics instruction. The one instance in which this pattern did not occur was with *"I set high expectations for my AA students."* Only 2.9% "disagreed" and no one responded "uncertain" on this item. The one person who did report disagreement with this statement later reported a "desire" to do so for a total of 100% "desire" for this item.

In general, teachers reported "use" of CRT as it related to: setting high expectations, communication of expectations, AA meeting those expectations, providing time for problem solving in small groups, use of curriculum with AA students, and opportunities for AA students to intelligently challenge teachers and peers. These are areas in which teachers seemed to be most familiar, so it was likely that they reported "use" of these components. However, teachers may not have realized the connection of these items in the culturally responsive teaching design. Although a summary of CRT

was included at the beginning of that section, teachers may not have paid attention to it or even understood how the ideas related to the mathematics classroom.

Teachers reported "desire" on CRT items related to: employing CRT into mathematics, incorporating AA cultural experiences into math lessons, incorporating home/community realities into math learning experiences, provision of prominent AA mathematicians and presenting ideas of AA pursuing future professions that involve significant amounts of math (i.e. engineer, technician, scientist). These areas are not typically related to mathematics achievement. Nevertheless, respondents reported a "desire" to implement these components into math instruction.

The professional development participants (N=8) reflected the sample group (N=34) in that their responses on the PTMI were similar to the sample. Discussions during the PD sessions revealed that teachers were not aware of the cultural impacts that are present in learning environments. The irony is that many of the PD participants reported, "use" of CRT methods on the PTMI and yet were unable to provide examples of how they integrated such methods. PD participants later reported that they found the information from the PD sessions enlightening because they were neither aware of the need for cultural connections nor aware of how to address these in the math classroom.

Process Standards

Teachers' "use" of general process standards varied. Generally teachers reported some degree of "use" of the process standards in the math classroom. Most "disagreed" with the negatively worded item, *"I primarily use textbook examples in teaching mathematics concepts",* reflected by an item mean score of 3.24, which suggests that

teachers may be incorporating other resources into mathematics instruction as instead of strictly relying on the math textbook.

While teachers reported "use" of process standards, they also reported a strong "desire" to implement these same standards in mathematics with African American students. The strongest agreement was with the item, *" I pose problems that allow AA students to apply a variety of strategies to solve algebra problems"* (M=4.09)*, "I allow AA students to find and solve problems that are related to algebraic concepts"* (M=4.15) *and "I recognize the need to use examples from AA students' lives to teach algebra concepts."* (M=4.12) This may suggest that teachers are aware of African American students' need to solve problems using a variety of strategies related to their personal lives in order to achieve academic success in algebra.

One half of PD participants reported "use" of process standards and the other half were "uncertain" about their "use". Seventy-five percent of those who reported "use" of process standards also reported a strong "desire" to implement process standards with their African American students (40 out of 40). The PD sessions provided an opportunity to discuss further the incorporation of process standards. Although many reported incorporating these into math lessons, teachers were unable to identify NCTM' s five process standards. One teacher shared that she had a vague memory of the standards from her teacher education program but could not recall them, while a few others tried to guess the standards—with no success. As a way to inform teachers, the researcher conducted a brief lesson on the process standards (and content standards) and their usefulness in math instruction. Teachers still seemed unsure of the differences between the specific process

standards, but intuitively understood some degree of their importance in mathematics instruction.

Equity

In general, teachers' attitudes/perceptions toward African American students were positive. They reported strong "agreement" on most items and there was little variance among scores. Teachers reported (N=34) the strongest agreement on *"All students can learn algebra"*(M=4.47) and *"All AA students must be presented with opportunities to learn algebraic concepts in order to prepare them for future experiences."* (M=4.41) Conversely, teachers disagreed that *"AA students are served well by implementing a "traditional" (facts and drills) mathematics program."* (M=3.62) This suggests that teachers had some awareness of the importance of engagement (i.e., hands-on lessons, projected, cooperative learning) during mathematics instruction.

The PD group's responses (N=8) on the equity section of the PTMI mirrored that of the sample group (N=34), with scores ranging from 19 to 25 (out of 30). Once again, the PD sessions provided deeper insight into issues of equity in mathematics. Participants shared varying views on *"AA students can learn algebra."* While all teachers agreed that all students have the capacity to learn algebra, they differed in their perspectives about how courses should be structured and the prerequisite skills needed for maximum achievement—especially with the pressure of standardized testing. Another teacher voiced her caution with "tracking" students based on certain prerequisite skills. She said, " …if they don't have the background knowledge, why can't we teach it to them?" Yet

another teacher commented, “Because we are not teaching the standards and they won’t pass the state test.”

Middle school teachers had more to share on the topic than their elementary peers. In fact, a couple of participants stated that if computational skills were adequately taught at the elementary level, students would be more prepared at the middle school level. This comment seemed to generate a sense of blame that was uncomfortable. In order to divert attention from the apparent discomfort, one elementary teacher shared on her experiences with algebra. “I failed algebra, but I was still forced to take it again. I was told ‘if you want to go to college, you have to’. It was a struggle for me because I was [thinking that] I’m not good at math…I really was.” This discussion about students’ ability to learn algebra left teachers with some uncertainty about the most effective ways to present algebra. Which students are best prepared to learn algebra? When should they learn it? What courses best prepare students for this content?

Question #2-General Efficacy and Algebra Efficacy

In general, to what degree do in-service teachers self-report personal efficacy in teaching and learning mathematics? In algebra? With African American students?

In general, teachers (N=34) reported a considerable degree of “efficacy” in teaching and learning mathematics. *“ I am very good at learning mathematics”* had a mean of 4.06 and *“As a student, (when I was in elementary/middle school) O earned A’ s in math”* had a mean of 4.21 *“I am very good at teaching mathematics”* had a mean of 4.00. Additionally, teachers reported having *“success in teach mathematics to African American students”* (M=4.21), and did not *“find it challenging to motivate AA in the*

math classroom" (M=2.97). On average most teachers reported confidence in learning and teaching mathematics with African American students.

An examination of "efficacy" across grade levels shows that Grade 3-5 teachers were more likely to select "uncertain" for the algebra efficacy statements as compared to Grade K-2 and Grade 6-8 teachers. Likewise, Grade 6-8 teachers were more likely to select "confident" or "extremely confident" as compared to both groups. This suggests that Grade 6-8 teachers were the most confident in their ability to teach algebra concepts and Grade 3-5 were the least confident in their ability to teach algebra concepts.

Total scores from PD participants revealed 38% of the group reporting "confidence" in teaching and learning mathematics and 62% revealed some "uncertainty" with general efficacy. However, discussion comments confirmed that only 25% (2 out of 8) of teachers reported low confidence in mathematics. For example, one teacher (grade 3-5) said, "I love it because there's just so much involvement." Another (Grade 3-5) shared, " I love math and I enjoy teaching it!" Several others shared their positive experiences with math as a student and consequently have a passion for the topic. There were some alternate perspectives shared as well. One K-2 teacher admitted, "Math is not my strong point" while one 6-8 teacher confessed, "I always hated math because I did not feel I was good at it, probably because of the way it was presented to me."

Although a couple of teachers reported their discomfort with mathematics, the total scores for PD participants revealed 75% of teachers reported "confidence" in algebra. The 25% of teachers whose score revealed low algebra efficacy were teachers in grades 3-5 and 6-8. While the middle school teachers score might be considered an anomaly (Total score 18 out of 40) the elementary teacher's (3-5) score (Total score of 20

out of 40) supports the earlier finding—Grade 3-5 teachers reported the lowest "algebra efficacy" as compared to their K-2 and 6-8 peers.

Question #3-"Strengths" and "Strains" of Implementation Process

What do in-service teachers report about the process of implementing (the strengths and strains) culturally responsive teaching methods in algebra with African American students?

The professional development sessions afforded participants an opportunity to explore the implementation of culturally responsive teaching in algebra, with special attention on their African American students. Table 6-1 presents teachers' reported ideas on the "strengths" and the "strains" of the implementation process across the CRT components. Teachers selected the "validating", "empowering" or "comprehensive", methods of culturally responsive teaching. No one selected the "multidimensional", "transformative" or "emancipatory" methods.

The two teachers who implemented the "validating" component reported "strengths" to include increase in student engagement and the impact of prominent mathematicians from ethnically/racially diverse backgrounds. Teachers reported students' excitement when invited to research someone from their cultural/racial backgrounds. Both teachers reported that they were not certain if this would have a positive influence on overall mathematics achievement, but agreed that the assignment did support the cultural realities for diverse students. The main "strains" for this method was reported as

"time"—negotiating an appropriate amount of "wait time" when students are using white boards and the time it takes to research the prominent mathematicians.

The three teachers who implemented the "empowering" methods reported "strengths" to include students taking more risks, students being more excited about math, a new level of confidence in attempting challenging tasks, enthusiasm for math spilling over to other subjects (cross-curricula connections), recognition that "empowering" is not just limited to math. Reported "strains" with this method also included time—the nature of problem solving process and hands-on projects requiring more time as well as overall time management (just needing more time than allotted).

Finally, the three teachers who implemented the "comprehensive" methods reported "strengths" to include an increase in student engagement, stronger sense of community, deeper mathematics discussions, an increase in student questions, willingness to help one another (peer-tutoring) and students reported the "comprehensive" days as "the fun days". Conversely, teachers reported time as a "strain" —natural time constraints of class period, the need to set time boundaries (students staying during planning and lunch periods) and more time needed to circulate to student groups. Other "strains" included the transition from a teacher-directed classroom to a student-directed classroom, classroom management and the need to be aware of potentially sensitive topics. .

Overall, the degree to which teachers implemented the CRT methods into math instruction varied greatly. Some teachers conceptualized ways to naturally incorporate the CRT method into their pedagogical practices, while others viewed the implementation as an "add-on" to what they already had to do.

Table 6-1 Reported Strengths and Strains of Implementation Process

Teacher	"Strengths"	"Strains"
Cynthia Teacher #1 Grade 3 "Comprehensive" • 7+ years of experience • 7+ years at current grade level	• Students made progress in building a stronger work relationship • Students seemed to enjoy talking about mathematics beyond the classroom • Students perceived math as more meaningful • Seeing prominent African Americans evoked smiles and sense of pride • Moving a disconnected group to a more cohesive whole • Transition from teacher-directed to student-directed learning • Students benefited from getting to know one another better • Students adopted an attitude of respect and support Professional Strength: Cynthia ended up enjoying the class more than she did before	• Natural time constraints (only met with students twice for 30 min.) • Control—"giving students more control over their learning wasn't easy. Many times I had to bite my tongue or step back because it was my natural instinct to try to control or take over…"
Allison Teacher #2 Grade 3 "Empowering" • 7+ years of experience • 3-5 years at current grade level	• Students taking more risks • Students seemed more eager to learn • Students "really felt they had the freedom and the time…" • Some students incorporated knowledge from other areas into math solutions • New level of confidence in attempting difficult math tasks • "Empowering" is not limited to math, but can be used in other subjects • Students really feel like "mathematicians" • Students were more excited about math • Saw the practicalities of the subject Professional Strength: Allison recognized the need to talk less and listen more to her students She also noted the connectedness between the CRT methods	• Time consuming nature of independence with problem solving • Difficulty in providing individual attention to students • Some students need to see an example before they will search for their own strategy • Increase in classroom noise level • Challenge regaining control once students got excited about something
Susan	• Students more excited and focused	• Classroom management—

Teacher #3 Grade 8 "Comprehensive" • 7+ years of experience • 3-5 years at current grade level	on "comprehensive" days • Time for peer conversations • Increased involvement in classroom discussions • Greatest impact with AA females—speaking up more, more willing to ask questions and clarify thinking • Students "more comfortable" in the math classroom • Quality of math conversations deepened • Stronger conceptual understanding of material • Flexible grouping and interactive activities—increased understanding and higher test scores • Stronger sense of community • Students taking more risks, making thinking public • Displayed enthusiasm about completing project • Eager to tutor one another • General sense, "That they're all in this together." • Increase in number of AA students coming in for morning and after school support	students had to learn to refrain from interrupting others • Challenging to shift from teacher-centered management to student-centered management • The need to train students on appropriate tutoring techniques before interactive activities • Need to set responsible time limits (spent all planning periods and some lunches working with students)
Jasmine Teacher #4 Grade 1 "Empowering" • 5-7 years of experience • 1-3 years at current grade level	• All students enjoyed the projects • Surprised by student level of creativity • Smaller groups made it easier to monitor student progress • Enthusiasm from math spilled over to other subjects • Positive classroom atmosphere • Peer-to-peer teaching • Students loved being called "mathematicians" • AA students "more at ease and enthusiastic about math"	• Time-consuming nature of hands-on projects • 1st graders are not skilled to self-select groups • Need for appropriate assessments—no way to assess demonstrated knowledge with projects
Samantha Teacher #5 Grade 6 "Validating" • 1-3 years of experience • 0-1 year at current grade	• Increased student engagement • "Students were excited to see the mathematician that was from the same place as they." • Students were afforded an opportunity to go deeper into the material • Collaborated with the Language Arts teacher	• Time management—negotiating the appropriate amount of wait time when students are responding using white boards • Amount of time to research list of ethnically diverse mathematicians • Gap in student skills—gaps

level		in writing made it challenging to write story problems
Melissa Teacher #6 Grade 7-8 "Validating" • 1-3 experience • 0-1 year at current grade level	• Discussion around prominent AA men—"I saw pride in some faces." • Students seemed to enjoy decorating T-Shirts • Some students were "thrilled to be in a class photo" • Research on prominent mathematicians and scientists—"students started to see that not everyone prominent is an 'old white guy'"	• Time requires to research prominent mathematicians and scientists • Students seemed suspicious of Melissa (not excited to be in an extra math class) • Some students did not want to be in the class photo—no one invited Melissa to join the group • Wondered to what extend these interactions might really affect the level of achievement for her AA students
Lori Teacher #7 Grade 7 "Comprehensive" • 1-3 years of experience • 1-3 years at current grade level	• Motivated by peer-teaching • Taking a break from hearing Lori talk • Providing real-life examples • Use of different materials—other than paper and pencil • Increase in student questions and willingness to help one another • Easy to circulate room and respond to student questions • Students took pride in helping one another—operated as a team, rather than a competition • Increased student engagement • Students referred to "comprehensive" days as "the fun days" • One student had "ah-ha" moments and realized he understood math <u>Professional Strength</u> Gained a deeper understanding of the mathematical concepts; appreciated being able to hear and see what students can do; noticed her AA showed her they really understood the math concepts she was teaching	• Would have appreciated more time to circulate and respond to students' questions • The need for awareness of emotionally sensitive topics (i.e.-package to deployed parent) • Use of white boards provides no record of students' work • Technical difficulty with on-line game
Julie Teacher #8 Grade 3 "Empowering"	• Thinking about how teachers address students (i.e. Math Geniuses) • Cross-curricula connections (i.e. literature)	• Time—time management, integration requires more time than allotted • Focus on assessments—"took away a lot of spontaneity and freedom of

• 0-1 year of experience • 0-1 at current grade level	• Benefit of students self-pacing and self-grading	choice from curriculum" • The need to monitor students for honesty during self-checking process

Interpretations

PTMI

The *Powell Teaching Mathematics Index* (PTMI) did provide some insight into what teachers perceive about their "use" and "desire" to use culturally responsive teaching methods, NCTM' s Process Standards and NCTM' s Equity Principle in mathematics. Information about teachers' practice was restricted to the responses they provided on the PTMI. Administering one instrument makes it challenging to know the validity of responses as related to teachers' perceptions. Additionally, using an on-line portal presented challenges as well. A few teachers reported being unable to access the survey as anticipated and thereby were unable to complete survey. This hindrance may have decreased the number of teachers who actually responded to the survey/

PTMI results revealed Grade K-2 teachers as the most efficacious in algebra (average item M=4.25) followed by Grade 6-8 teachers (average item M=4.20) among the three groups. In early elementary grades, there is a strong emphasis on patterns, classification and modeling number situations with objects, pictures and symbols and primary instruction for middle school teachers centers on algebra or related concepts, so it makes sense that these two teacher groups would report the highest confidence in teaching these concepts. During the PD session the one K-2 teacher discovered the similarity between the grade K-2 and 6-8 algebra concepts.

Grade 3- teachers were the least efficacious in algebra. In these grades, mathematics instruction has a strong emphasis on number skills, which are valuable in developing algebra skills. Unfortunately 3-5 teachers did not recognize the relationship between what they are teaching and algebra or that they are only focusing on two algebra concepts "*Represent and analyze patterns and functions, using words, tables and graphs"* (M=4.13) and *"represent the ideas of a variable as an unknown quantity using a letter or a symbol"* (M=4.13). The other items on the "algebra efficacy" subsection (as reported in Chapter 4) include algebra concepts such as*: "express mathematical relationships using equations", "investigate how a change in one variable relates to a change in a second variable"* and *"identify and describe situations with constant or varying rates of change and compare them."* Providing instruction on these algebra concepts would not only prepare grade 3-5 students for more advanced work in algebra, but also assist teachers in seeing the relationship between what is taught in grades 3-5 and what is taught in grades 6-8. Results on the PTMI suggest that additional support is needed to assist Grade 3-5 teachers in understanding these instructional relationships.

The attitudes/perceptions (equity) section only contained six items and had a Cronbach Alpha of 0.43. The first item "*AA are served well by implementing a 'traditional' (facts and drills) mathematics program"* was negatively worded and was recoded for analysis purposes. A bivariate correlation revealed a relationship between "equity" and general "efficacy" ($p=0.479$, $p \leq 0.01$), suggesting that the equity subsection and general efficacy subsection share 23% of the variance on the PTMI. This suggests that 23% of the time as teachers reported agreement with issues of "equity" they also reported confidence on the "efficacy" subsection.

Professional Development Sessions

The inclusion of professional development sessions proved beneficial. It was helpful to have teachers' responses to a survey, but having an opportunity to engage a group of professionals in meaningful dialogue was invigorating. PD participants were in awe of all that they did not know, despite the completion of the PTMI and their reported "use" of CRT methods. One teacher shared how she wished she could re-take the survey, now that she had a better understanding of the topic.

Teacher #5 reported a desire to learn more about the implementation of CRT methods, she asked, "Are there any books to tell us how to incorporate CRT methods correctly?" While most would agree that having a book could be helpful, it is also important that teachers see themselves as self-directed risk-takers in the instructional environment. It is important that teachers feel "empowered" and "validated" within "comprehensive" learning environments so that they might adequately create such experiences for students—African American or otherwise. Unfortunately, teachers often don't feel the freedom to try new ways of approaching teaching. If they are so bold to attempt new constructs they are usually fearful of negative feedback. Teacher #2 shared her fears,

> …But I do get a little intimidated, especially if someone is coming to evaluate me—are they going to walk in and say, 'she's crazy…this child is doing this, there's a group here and they're singing, there's a group there and they're dancing, someone else is listening to music, this group is on the notebook…' Are they

> going to say, 'what going on in this room?' You got a newsletter team, a camera team. You got all these different groups doing their job….I realize that the way I have my class, [sic] that's why it's so noisy because I give them freedom. I know that the first thing I must do is build their confidence, they have to be built up and encouraged to come to school…but I'm afraid that someone will come in and say 'she's a terrible teacher because they're so loud.

This gives us a glimpse into the beliefs and instructional practices of this particular teacher. Perhaps some may view her style as unorganized, but it appeared is that students are engaged in various learning tasks in this environment. Interestingly, this same teacher scored the lowest on every subsection of the PTMI, yet seemed to have the most conceptualized view of culturally responsive teaching practices. As noted in the above vignette, she already actualized her belief system for students. Her construction of a "mini-society" exemplifies her desire to create authentic experiences so that students will maximize academic achievement.

According to Gay (2000), culturally responsive teaching methods were not presented in a hierarchical fashion. However, after examining the manner in which teachers interpreted the components, the researcher began to wonder whether teachers see the components as hierarchical. Figure 1 presents the hierarchy of the culturally responsive teaching methods, with the simpler methods on the bottom and the most complex method at the top.

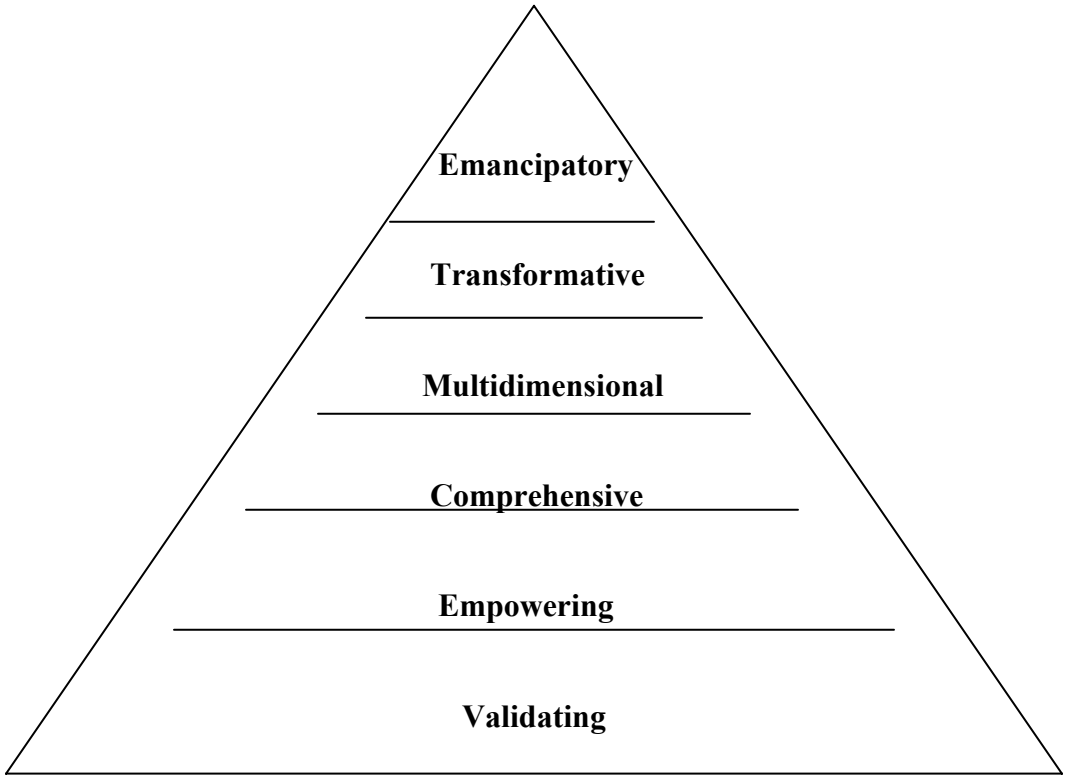
As teachers explored the CRT methods, there was a relationship between total years experience and the selected method. Experienced teachers (5 or more years) selected the "empowering" or "comprehensive" methods. There were two exceptions in

which a teacher with 0-1 year experience selected "empowering" and one teacher with 1-3 years of experience selected the "comprehensive" method. Both of the teachers who selected the "validating" method had 0-1 year of experience.

Not only was there a pattern with the selected CRT method, there was an observed relationship between experience and the degree to which teachers identified "strengths" and "strains" during the implementation process. Experienced teachers tended to highlight a significant number of "strengths" and their "strains" focused on pedagogical perspectives that were reflective and/or based on natural circumstances that were out of their control. For example, Teacher #1, who reported a "strain" as-"natural time constraints, only met with students twice a week for 30 minutes" Teacher #3's reported "strain" was that it was "challenging to shift from teacher-centered to a student-centered management." Overall, experienced teachers took ownership of instructional choices and were more reflective about those choices during the implementation process. These teachers applauded the process and vowed to continue to incorporate these methods for the rest of the school year and in years to come.

Less experienced teachers tended to minimize "strengths" (only stating a few) and the "strains" tended to place blame or focus on student deficiencies. One example is Teacher #5's reported "strain"—"gaps in students' writing skills made it challenging to write story problems." Another example is Teacher #8's reported "strain"—"Focus on assessments took away a lot of spontaneity and freedom of choice…"Teachers in this group questioned the degree to which these methods would positively influence African American student' mathematics achievement.

Figure 6-1 Hierarchy of Culturally Responsive Teaching Methods



Underlying Conditions for Implementing CRT

Culturally responsive teaching is an abstract construct and implementation can be challenging to manage. After observing the methods that teachers did and did not select, there seemed to be three conditions for effective implementation. These conditions are not necessarily supported by the collected data exclusively, but rather provided a rationale for why teachers may have selected some CRT methods and not others.

Examination of the professional dialogue around CRT and the implementation of such methods prompted an awareness of two significant areas: belief systems of students'

abilities and instructional choices. The data from this research study demonstrated that when teachers discussed their mathematics instructional practices, they inherently shared their personal beliefs in students' abilities as underlying their choices. Sometimes these perspectives were positive and sometimes there weren't. Nevertheless, the two conditions were discussed in conjunction with each other.

The last condition, transference, emerged from what teachers did not do. Teachers did not select from the three highest components in the hierarchy: "multidimensional", "emancipatory" and "transformative." It is unclear as to why the "multidimensional" method was not selected. This component requires teachers to collaborate with other subject areas (or include other academic components in the instruction environment), so perhaps teachers viewed this method as going on beyond the time span that the implementation phase allowed. After careful consideration, the researcher realized that the last two methods (transformative and emancipatory) are quite abstract in design. They require teachers to possess a deep understanding of the instructional process as well as the ability to envision the ways that acquired knowledge can be applied to contexts beyond the classroom. The following sections provide a summary of the three underlying conditions for the effective implementation of culturally responsive teaching in mathematics.

Belief Systems of Students' Abilities/Value

Belief systems are foundational to effective mathematics instruction, especially for African American students. Since many African American students lag the achievement of their White counterparts, it is important that they have teachers who possess positive beliefs regarding their academic success. Beliefs are based on what

teachers perceive about students' learning ability. Furthermore, teachers with positive belief systems set high expectations for all students and usually recognize and value the strengths of their students. Ultimately, these teachers are responsive to the needs of culturally and linguistically diverse students and are not afraid to assess and confront their biases.

All the CRT methods that are best aligned with highlighting teacher belief systems about students' abilities/value, but the "validating" and "empowering" methods afford teachers a starting point for examining such beliefs. These are the first two methods in the CRT Hierarchy. The collected data supported the fact that teachers who selected these methods are often paying close attention to what they believe regarding student achievement. Teachers utilizing the "validating" and "empowering" methods are considering closely the needs of their students, setting high expectations and recognizing the strengths of their students. They readily seek to address personal bias that might impede effective instruction. Teachers concentrate on how they can effectively address students' needs and are sensitive to the images presented in the learning environment. Finally, they create opportunities to communicate their expectations.

Instructional Choices

Instructional choices are the deliberate decisions that teachers make in the classroom based on belief systems. When positive belief systems are operative, teachers accept responsibility for managing effective instruction. Teachers provide assistance to help students meet their high expectations and they are willing and able to support different learning styles and cultural perspectives in the learning environment. Teachers

carefully select learning opportunities and accommodate students' learning effectively and sensitively. Ultimately, there is a strong direct relationship between teacher beliefs and instructional choices in the mathematics classroom.

From the researcher's perspective, the CRT methods that best encourage instructional choices for culturally/ethnically diverse students are "comprehensive" and "multidimensional". Since none of the PD participants selected the "multidimensional method, observations are based on teachers implementation of the "comprehensive" method. In this research study, teachers who implemented the comprehensive methods were aware of their belief systems, and were concentrating on the selection of learning opportunities for their students. Teachers assigned students to work collaboratively and they developed team goals. With the "multidimensional" method teachers may also collaborate with other subject teachers as a means to enhance the quality of instruction. Ultimately, teachers reported that they began to play a less prominent role in the learning environment and students took a more active role in managing their learning. Teachers who implemented the "comprehensive" method were also incorporating aspects of the "empowering" and "validating" methods. It was important for teachers to continue to empower and validate students while supporting their cultural differences in the learning environment.

Transference

The collected data does not support this condition for the implementation of CRT because none of the teachers selected the "transformative" or "emancipatory" methods. Nevertheless, transference would be the next condition for the teachers as they make a

concerted decision to implement CRT. From the researcher's perspective, transference refers to the degree to which learning experiences extend beyond the math classroom. Students not only make use of community resources but also identify ways to apply mathematics knowledge in real and practical ways. Teachers create learning opportunities that address authentic issues rather than ones that are simply simulated within the classroom environment. With the "tranformative" and "emancipatory" methods operative, students see themselves as proactive members of the local/global community. Students take a more active role in their learning and are even encouraged to participate in societal causes (i.e. AIDS Awareness, Cancer Research). Ultimately, transference affords students opportunities to deliberately apply learned mathematical knowledge as a means to address local/global issues and students see themselves as contributors to the broader community.

Teachers who incorporate these methods have a strong conceptual understanding of quality mathematics instruction and are efficacious in their ability to take mathematics learning beyond the classroom. Mathematics learning is translated into real-life applications. Students see themselves as possessors of knowledge and they seldom rely on the teachers for answers—because they see themselves as scholars. Students search for their own voices, develop social consciousness and intellectually critique societal ills. Students operate in high levels of efficacy and the teacher serves as the facilitator/overseer of the process.

In summary, teachers who recognize, appreciate and celebrate the differences between students are fostering an environment of trust and respect (validating). As teachers set high expectations for all students they also provide supports for them to reach

these expectations. They actively attend to their students' learning styles and build on social and academic strengths as a vehicle toward increased academic achievement (empowering). Validated and empowered students now begin to see themselves as contributors to the learning community. Through meaningfully constructed learning opportunities across disciplines (multidimensional) they are invited to work collaboratively with others and nurture their intellectual, social and emotional perspectives (comprehensive). Students become motivated to manage their learning and find their own voices in order to critique/challenge social ills in their school community and the local/global community (transformative). As self-actualized scholars, students apply instructional skills learned in the classroom, see themselves as manufacturers of knowledge and ultimately view themselves as change-agents who proactively interact with their local/global community (emancipatory).

Data Supported Conditions for Implementation of CRT

Effective implementation of culturally responsive teaching in mathematics is based on teachers' belief systems and instructional choices that have the ultimate potential to be transferred (applied) to the real-life situations in the local/global community. Analysis of teachers' beliefs from the PD sessions revealed that they have the desire for students to experience success in mathematics. Many shared thoughts such as, " I want students to feel free to try various strategies in problem solving". Other ideas about their belief system included believing in the power of instructional modeling, and wanting students to feel valued in the classroom. Teachers also reported belief systems

based on the Equity Principle. These include, setting high expectations, addressing students as "mathematicians" and recognizing that many AA students work well in groups and enjoy collaborative activities.

Table 6-2 presents teachers' instructional choices during the implementation phase based on their beliefs and underpinned by the Equity Principle. Several teachers provided opportunities for students to see themselves reflected in the classroom environment, utilized real-life experiences and prior knowledge when performing mathematical tasks and facilitated hands-on projects. These choices were designed to teach mathematical concepts in a culturally responsive manner.

While all teachers expressed equitable belief systems, some were more successful than others in creating effective instructional environments. Some teachers were unable to see the connection between equity and culturally responsive teaching and its relevance in mathematics for AA students. These select few tended to view their choices as add-ons or intrusions to their regular instruction, rather than a professional growth opportunity that might lead to an increase in student achievement.

For example, Teacher #5, a second year pedagogue, expressed her concern for disrupting the normal instructional flow of her class, so she implemented the "validating" methods over four mini lessons during an extra class period. She also expressed her concern for focusing on AA students, since she had so few in her classes. She was uncomfortable with this idea because it seemed to clash with perspectives she had heard in her teacher education program. Teacher #5 reported that she wanted students to feel valued and believed that it was important to make mathematics relevant to their experiences (belief system). However, when she was invited to put her beliefs into

practice, maintaining the normal flow of the instructional day superseded the opportunity to integrate the two.

Conversely, Teacher #1, a twenty-seven year veteran, expressed her value for students coming up with their own solutions. As she began to understand the cultural realities that are present in the math classroom, she said, "I must allow for differences and embrace them." Even though she only saw her students twice a week for 30 minutes each day, she intentionally implemented the "comprehensive" method and sought to create opportunities for student collaboration while encouraging students to be responsible for each other's learning. She modeled solutions, provided external rewards for encouragement (later weaned off) and made a concerted effort to focus on algebra instruction. Her beliefs dictated her instructional choices.

Unyielding equitable belief systems in mathematics dictate instructional choices that lead to transference into the world outside of the classroom. Instructional transference involves a deeper understanding of mathematics instruction and affords students freedom from the conventional constraints of the classroom. The teachers in this study examined and articulated their belief systems, which led to instructional choices. They are were not yet ready for "transference" but with continued attention on beliefs and how these dictate their choices in the classroom, they can certainly be well on their way.

Table 6-2 PD Participants' Conditions for Implementation of CRT

	Underlying Conditions for Implementation of CRT	
Teacher	**Belief System**	**Instructional Choices**
Teacher #1-Cynthia "Comprehensive" PS=Connections and Communication	• Enthusiasm for math • Value for students coming up with solutions • "I must allow for difference and embrace them."	• Made a concerted effort to focus on algebra instruction • Incorporated real-life experiences • Provided external rewards • Students working together in groups (responsible for each others' learning) • Strong collaborative approach • Modeled solution to simpler problem
Teacher #2-Allision "Empowering" PS=Connections, Problem Solving, and Representation	• Believes that all students can and will learn algebra with "adequate instruction" • Making learning relevant to students' lives • "I want students to feel free to try various strategies in problem solving." • Students as "risk-takers"	• Using math in concrete ways (mini-society) • Relevance to everyday life • Role-playing and scenarios • Using students' names in problems • Displayed student work • Varied instructional practices
Teacher #3-Susan "Comprehensive" PS=Problem Solving and Representation	• "AA students thrive when they get to compete—they enjoy working together as a team" • Want to create an environment where students see themselves as successful in algebra.	• Allowed time for cooperative learning • Students encouraged to participate in classroom discussions at any time (small and whole group) • Peer-tutoring • Hands-on projects
Teacher #4-Jasmine "Empowering" PS=Representation and Communication	• Addressing students as "mathematicians" • Developing risk-takers • Want students to possess a more positive attitude about math • Create an environment for success in math	• Varied learning opportunities • Student self-selected instructional groups • Created math songs • Student-created projects
Teacher #5-Samantha "Validating" PS=Connections and Representation	• Want students to feel valued in classroom • Believed it was important to make mathematics relevant to students' experiences	• Famous Mathematicians Project • Student-created word problems based on personal interests • Present finished projects, via power point, brochures

Teacher #6-Melissa "Validating" PS=Connections	• Want student to know that she appreciated who they are • Has a desire for students to be successful • "I always ask myself, does my example or approach to the topic have any relevance to my students? • Importance of making cultural connections	• Provided opportunities for students to see themselves in the learning environment • Built a sense of collaboration and team work • Students researched famous AA mathematicians • Created activities related to student interests (football, basketball, darts, tic-tac-toe, video clips)
Teacher # 7-Lori "Comprehensive" PS=Connections and Representations	• Believes in modeling • Responds to needs of students • Careful selection of learning opportunities	• Involving prior knowledge • Create problems that activate students' prior knowledge (i.e., using math to send a package to a deployed loved one) • Use of computer to display understanding to math concepts • Varied assessment • Focused on team work • Students working as a community of learners
Teacher #8-Julie "Empowering" PS=Connections	• Addressing students as "Math Geniuses" • Positive messages/greeting on board • High expectations • "I want them to feel respectful of their learning and understand that they have a say and input [sic] into their education."	• Incorporating literature into lesson

PS=Process Standard

Limitations of the Study

There were initially four limitations identified for this study, but additional items were added at the end of the research study.

1. The actual data collection, data analysis and data interpretation process was directed by the researcher who at times functioned as a participant observer. The data collection process included administering the PTMI and conducting the professional development sessions, of which the researcher was a participant. It was a challenge to remain objective while collecting and analyzing the data. Videotaping of the sessions along with repeated reviewing of the sessions in collecting and analyzing the data helped minimize the impact of this element of the study design.
2. Information about teachers' practice was restricted to the responses they provided on the PTMI. Administering one instrument makes it challenging to know the validity of responses as related to teachers' perceptions. Moreover, work with the PD teachers suggested that the PTMI results overstate teachers' actual use of CRT, NCTM process standards and Equity principle.
3. The sample is derived from one school district and four schools within the same district in the Midwest; findings from the PTMI and the professional development sessions' are not necessarily generalizable to populations in areas of the country that are more ethnically diverse.
4. *The Powell Teaching Mathematics Index* (PTMI) was constructed specifically for this study. Checks for validity and reliability were limited to the responses from the expert panel and feedback from the pilot study sample. Cronbach's Alpha

suggested that the instrument was reasonably reliable, with r values ranging from 0.64 to 0.94. The "equity" subsection was clearly not reliable and needs to be revised in subsequent use.

5. An African American researcher asking predominantly White teachers about their experiences with African American students may have generated some discomfort during the professional development sessions. By the researcher facilitated the processional development sessions and developing relationships with participants, this served to reduce any discomfort by the participant. Additionally, teachers were aware of the research study and volunteered for the PD sessions, so it is assumed that they were honest/comfortable in sharing perspectives on implementing culturally responsive teaching with African American students.

Recommendations

1. Teacher Education Programs
    a. Teacher education programs have a significant impact on the quality of teachers that are produced. In light of the changing demographics in school districts across the United States, it is important that colleges/universities take a closer look at the degree to which they are preparing teachers. It is suggested that such programs include instruction on culturally responsive teaching. This might provide earlier opportunities for pre-service teachers to explore this model and encourage later effective implementation with diverse student populations.

b. It is also important that colleges/universities consider the cultural responsiveness of their instruction. Does the structural design of courses respond to the needs of pre-service teachers from diverse backgrounds? Are professors understanding and confronting their own biases? Are they providing adequate assistance to help students meet expectations? In order for pre-service teachers to gain a clearer picture of culturally responsive teachers, they must have concrete experiences. It is important that culturally responsive teaching is modeled for them in actual classroom environment. Without such models, culturally responsive teaching will have no true significance.

c. Math methods courses should explore the cultural implications in mathematics instruction. The notion of math being "culture free" is no longer acceptable in today's mathematics classrooms. Colleges/universities would be a prime place to cultivate these connections with teachers (undergraduate/graduate programs) and encourage them to strongly consider culturally responsive teaching, NCTM' s Process Standards and NCTM' s Equity Principle as the basis of solid mathematics instruction.

d. Results on the algebra efficacy section of the PTMI indicate the need for additional support for Grade 3-5 teachers. Assisting teachers in their understanding and importance of algebra skills that are taught in grades 3-5 may increase their overall teaching efficacy.

2. Local School Districts

a. Professional development in local school districts plays a significant role in the professional maturity of its teachers. It is advantageous for districts to provide on-going workshops around issues of diversity and cultural awareness and appreciation. A teacher in the PD session reported taking the same workshop five times over the past eight years, while another reported being in the district for three years and never participating in a workshop on race/culture. This should not be the case. Instead varied professional opportunities should be a norm rather than an exception.
b. Conducting periodic assessment of attitudes/perceptions toward diverse student populations would provide necessary information for the adequate provision of professional development opportunities.

3. Teacher Networks
    a. Teachers who have participated in professional development on culturally responsive teaching provides an opportunity continue to grow in knowledge of CRT and would serve as a support for others who want to implement these methods in their classrooms. It would be beneficial for teachers to continue to meet and discuss the implementation of CRT methods as it relates to the math classroom and across other disciplines (i.e., social studies, reading, science, etc.) Gellert (2008) discussed the importance of teachers revisiting their professional development experiences as a means toward sustained change. He explained that if continual effort toward systemic change does not occur, teachers would return to their former ways of doing.

b. Findings from the PD sessions revealed some teachers' lack of reflection. Critical Pedagogy (Wink, 2005) provides a structure for meaningful reflection on teaching practices. Teachers might gather and read this as a way to assist in reflection process.

c. Since a couple of teachers researched a host of prominent mathematicians and scientists from ethnically/racially diverse backgrounds, it would be helpful to develop a website for quick retrieval. Teachers might also post their CRT integration as a way to inform teachers of the impact on mathematics achievement for African American elementary and middle school students.

4. Include additional items on the Attitude/Perceptions (Equity) section of The Powell Teaching Mathematics Index (PTMI) to increase its reliability.

Suggestions for Future Research

Further research in the implementation of culturally responsive teaching is needed to ensure that educators are aware of the cultural implications in the mathematics learning environment. Suggestions for future research might be:

Conduct a follow-up study with African American students who are successful in algebra. Inquire about the keys to their success. Compare their perspectives on teacher attitudes to those in this study.

1. Interview professional development participants about 6-12 months after the initial study to see if they are continuing with the implemented method.

2. Replicate this study with a group of teachers in a school district comparable to the one in this study and look for similarities and differences.
3. Replicate this study in an urban school district and look for similarities and differences as compared to this study.
4. Replicate this study with collegiate level math educators across a number of colleges/universities across the United States.

Conclusion

Culturally responsive teaching is a new construct for many teachers. General practitioners are often unaware of empirical frameworks and tend to find such information lofty and disjointed from their normal practice. This research study was designed to bring the two worlds together—theory and practice, in an effort to inform practitioners of the wealth of resources available and in turn inform research of the needs of practitioners.

It is no secret that many African American students lag in the academic performance of their White counterparts. Yet, when teachers were invited to focus their attention on ways to improve the mathematics instruction of these students, many were uncomfortable. They preferred to embrace culturally responsive teaching as being good for all students. While I agree that culturally responsive teaching provide a foundation for good teaching, I also believe that CRT invites teachers to consider the cultural realities, frames of reference and points of view of ethnically and racially diverse students.

For far too long students have been clumped together and considered all the same without acknowledgement of the true cultural expressions that are present. One teacher confirmed this when she said, "Until this point, I was trying to treat all my students equally…treat them all the same, You don't want to show biases and prejudice…with this class, I've learned no, you really can't do that. Because fair is not always equal."

Failure to recognize and respond to such differences minimizes the influence of culture and may undermine the mathematics achievement of African Americans and other students of color. The truth is, it is not "taboo" to address culture because true learning is not "culture free". Students bring who they are into classrooms everyday and teachers bring themselves as well. However, because over 80% of teachers in the US are White and middle class (Tab, 2007), their cultural norms often supersede the cultural perspectives of minority students. Failure to recognize this reality, perpetuates superior ideologies, oppresses minority perspectives and ultimately undermines the Constitutional decision of Brown v Board of Education (1954). Asking students to divorce themselves from their cultural realities is a modernized form of instructional segregation that cannot be tolerated.

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Appendix A - Expert Panel Questions

- How well do you think the items on this instrument are aligned to the research questions presented?
- How do you rate the clarity of the stated directions?
- How do you rate the clarity of each of the statements?
- Which items would you add? Why?
- Which items that you think should be eliminated? Why?

Appendix B - Appendix G-Pilot Study Questions

- How do you rate the clarity of the stated directions?
- How do you rate the clarity of each of the statements?
- How did the definitions in the boxes assist you in your response to the statements?
- What items/thoughts would you add? Why?
- What items that you think should be eliminated? Why?

Appendix C - Discussion Questions for PD Sessions

The following questions were used in the development of the professional development sessions

What are your overall experiences with African American students in the math classroom?

Culturally Responsive Teaching

Discussion Prompts

- I employ **culturally responsive teaching** strategies in mathematics.
- I incorporate what I know about students' cultural experiences in the construction of mathematics lessons (foundation of culturally responsive teaching).
- I set high expectations for my students in mathematics (all methods).
- I provide daily opportunities for African American students to share their problem-solving techniques with each other in small groups (empowering).
- I use a variety of instructional strategies in mathematics (multidimensional).
- Building bridges between the home/community environment and learning experiences in mathematics is evident in my instructional practices (validating).
- I provide examples of prominent African American mathematicians for my students (validating)
- I encourage my students to create their own meaning of the math tasks presented to them (emancipatory).
- I encourage students to generate mathematical problems that address social concerns in their community (i.e.: crime, healthcare, etc) (transformative)

Process Standards

- What are your thoughts about the utilization of NCTM' s process standards in the math classroom?
- Which processes do you promote with students the most? The least? Why?

Equity in Mathematics

What are your thoughts in response to this statement: *All students can learn algebra.*

Efficacy Mathematics Instruction

General

What are your feelings related to teaching mathematics in general?

- Do you feel comfortable with the subject matter?
- With which areas do you feel most comfortable?

Algebra

What are your feelings related to teaching algebra concepts?

- Do you find it easy to construct engaging lessons in algebra?
- Do you find that you are able to utilize manipulatives and other concrete experiences for students in algebra?

African American Students

What are your thoughts related to algebra instruction with your African American students?

- Have you given any thought to how your students perform in this area of mathematics?
- As compared to another concept in mathematics, how would you rate your students performance with this particular area of mathematics?
- As compared to your White (or other ethnic groups) how do your African American students perform on class work, tests, other assignments?

Appendix D - Outline of Professional Development Sessions

Session One Agenda
(Each section was presented on Power Point Slides)

A. Getting Started:
    i. Name Tags
    ii. Videotaping Protocol
    iii. Signed Consent Forms
    iv. Expectations
        1. Nov. 20th, Dec. 4th, Jan. 8th, Feb. 12th
B. Researcher as Facilitator
C. Description of Study
    i. 2 Part Data Collection Process
        1. The Powell Teaching Mathematics Index
        2. 4-Part Professional Development Sessions
D. Components of Part 2
    i. Culturally Responsive Teaching
    ii. NCTM Process Standards
    iii. NCTM Equity Principle
    iv. Teaching Efficacy
        1. General
        2. Algebra
        3. African American students
E. Session Protocol
    i. Professional Dialogue
        1. Perspectives across grade levels
    ii. Readings/discussion
        1. Short articles/journal reflections
    iii. Student demographics
    iv. African American students
F. Why?

i. What influenced your decision to participate in these professional development sessions?
ii. What do your hope to gain from this experience?

G. What do you see? (Picture of an African American boy about 6-7yrs. old)

H. Why algebra?
   i. Gatekeeper (Cobb and Strong, 2000)
   ii. A Civil Right (Moses, 2001)
   iii. NCTM Focus

I. Background Research
   i. Geneva Gay (2000)
   ii. Ladson-Billings (1994, 1995)
   iii. Robert Moses (2001-Algebra Project)
      1. Strong and Cobb (2000)
      2. Noddings (2000)
      3. Lott (2000)
      4. Allen (2000)

J. Research Question
   i. What do in-service teachers report about the process of implementing (the strengths and strains) culturally responsive teaching methods in algebra with African American students?

K. Purpose of Study
   i. Invitation for practicing teachers to explore and experience theoretical frameworks in the actual classroom setting.
   ii. Identify/address the "strengths" and "strains" during the implementation process.
   iii. Address cultural discontinuity and structural inequality for culturally diverse students during mathematics instruction (especially in algebra).
   iv. Expand teachers' knowledge and sensitivity to working with African American students.

L. Equity in Mathematics

i. What are your thoughts about this statement: All students can learn algebra.
ii. What are your overall experiences with African American students during mathematics instruction?
iii. To what degree do you incorporate what you know about students' cultural backgrounds/experiences into the construction of mathematics lessons?

M. Culture
i. Multidimensional and ever changing
ii. Dynamic, complex, interactive
iii. Stabilizing force
iv. Expressive behaviors
v. Mitigated by variables

N. What's the relationship?

Mitigating Variables	Expressive Behaviors
Affiliation	Thinking
Gender	Relating
Age	Speaking
Social Class	Writing
Education	Performing
Individuality	Producing
Residence	Learning
Immigration	Teaching

(Adapted from Gay, 2000, p.11)

O. The Achievement Dilemma
i. Test scores and grades are symptoms, not causes of achievement (Gay, 2000)
ii. Student/Family Structure (Parents-are-at-fault)
1. Pressure-and-lure-of-street-life

2. Acting white

iii. School's Influence

1. Structural inequality
2. Cultural discontinuity
3. 4th grade syndrome
4. Tracking/low expectations

P. Impact of Culturally Responsive Teaching

i. Provides an instructional paradigm
ii. Unleashes high levels of learning
iii. Expands teacher pedagogical tool-kit

Q. What is culturally responsive teaching?

(Not in any order of importance.)

i. Empowering
ii. Validating
iii. Comprehensive
iv. Transformative
v. Multidimensional
vi. Emancipatory

R. Culturally Responsive Teaching

i. It teaches to and through the strengths of these students.
ii. It is culturally validating and affirming

S. What is culturally responsive teaching?

i. Tapping into the "strengths" and "cultural" expressions of African American students—for SUCCESS!
ii. The power of caring and setting high expectations
iii. Communicating expectations to students

T. Culturally Responsive Teaching

i. In order to make learning encounters more relevant and effective for ethnically/culturally diverse students, it is important to use:

1. Cultural knowledge
2. Prior experiences

3. Frames of reference
4. Performance styles (Gay, 2000)

ii. Teacher Expectations
1. Students tend to excel when they know they are "expected" to do well in instructional interactions. (Students will live up to or down to the expectations set for them.)
2. What are some "expressive" behaviors that you might identify as "strengths"?

U. Performance Styles
i. Participatory-Interaction (engaging speaker through vocalization or motion as speaking)
ii. Call and Response (Listeners giving encouragement to speaker, commentary, compliments as they are speaking)
iii. Passive-Receptive (Sit, listen, respond only when a direct question is asked)

V. Does CRT work with all subjects?
i. CRT can be applied to any subject area because it is a pedagogical teaching method. So that means <u>student success</u> in:
1. Math
2. Science
3. Writing
4. Etc…

W. Describe your mathematics instructional practices.

X. Based on what we have discussed today, what are your thoughts and/or questions?

Y. Closing
i. Next Session: Thursday, December 4, 2008
ii. Article reading
1. NCTM' s Closing the Achievement Gap: A position of the National Council of Teachers of Mathematics (April, 2005)
2. Algebra Position Paper

Session Two Agenda
(Each section was presented on Power Point Slides)

A. Session #1 Reflection
    i. How did the reading assignment further inform your understanding of the importance of algebra instruction for African American students?
    ii. What are your initial thoughts to culturally responsive teaching?
B. Teaching Mathematics
    i. How do you feel about teaching mathematics in general? (Which areas do you feel most comfortable?)
C. Teaching Algebra
    i. How do you feel about teaching algebra concepts? (Elementary)
    ii. Which aspect of algebra do you feel most comfortable? Least comfortable? (Middle School)
    iii. Do you find it easy to construct engaging lessons in algebra?
    iv. Do you find that you are able to incorporate manipulatives and other concrete experiences for students in this area?
D. African American students
    i. As compared to other concepts in mathematics, how would you rate your students' performance in algebra (algebraic reasoning)? (1-poor and 5-great)
    ii. As compared to your White students (or other ethnic groups) how do your African American students perform on class work, tests, other assignments?
E. How do you teach mathematics?
    i. What are your thoughts about the utilization of NCTM' s process standards during mathematics?
    ii. Which process do you use with students the most? The least? Why?
F. Culturally Responsive Teaching

i. To what degree do you employ culturally responsive teaching strategies in mathematics?
    1. I use a variety of instructional strategies in mathematics
    2. I set high expectations for my students in mathematics.
    3. I provide daily opportunities for African American students to share their problem-solving techniques with each other in small groups.
    4. I provide examples of prominent African American mathematicians for students.

ii. Which one will work during your math lessons?
    1. Empowering
    2. Validating
    3. Transformative
    4. Comprehensive
    5. Emancipatory
    6. Multidimensional

iii. It uses a variety of instructional strategies that are connected to different learning styles.

iv. It teaches students to know and praise their own and each other's cultural heritages.

G. Instructional strategies

i. What are some different instructional strategies?
    1. What are students doing?
    2. What are you doing?
    3. How does the environment look and feel?

ii. Culturally Responsive Teaching: An Example (Short Video Clip with Deborah Ball-Dr. Ball is teaching a group of African American 5th graders a song about the measurement components; clip switches to Dr. Ball engaging a group of teachers with her methods)

H. CRT is Validating (I Matter…)

i. It acknowledges the legitimacy of the cultural heritages of different ethnic groups, both as traditions that affect students' dispositions, attitudes and approaches to learning.
ii. Makes content worthy to be taught in the formal curriculum
iii. I Need You to Help me See Myself (Clip from Disney's Ice Age, scene: Mammoth finding another mammoth)
iv. Black Mathematicians
    1. Kelly Miller (1887, first Black mathematics graduate student)
    2. Charles Reason (1818-1893)
    3. Katherine Adebola Okikiolu (Nigerian Mathematician)
    4. Nathaniel Dean (PhD-1987, Mathematics, Vanderbilt University, Professor and Chair of Mathematics, Texas Southern University)

I. CRT is Comprehensive
    i. Students develop intellectual, social, emotional and political learning by using cultural references to impart knowledge skills and attitudes.
    ii. What does this mean?
    iii. How might it look in a math classroom?
        1. During algebra lessons (real-world applications)
    iv. Looking at an algebra lesson—Tiling a Patio (Grades 3-5) (Navigating through Algebra, NCTM, 2001)

J. CRT is Empowering (I Can Do It)
    i. Students have to believe they can succeed!
    ii. In what ways can you empower students to be successful?
        1. Recognizing success and affirming it
        2. Providing opportunities/exposure to new ideas…ways of doing
        3. Environment reflects you unspoken beliefs and assumptions.

4. The power of symbolizing (read clip-Gay, 2000, p.39)
5. What are the unspoken signs in your classroom?

Assessing your environment—Classroom Environment Survey (Midwest Equity Assistance Center, KSU, College of Education)

K. Based on what we have discussed today, what might be some evidence of culturally responsiveness in a classroom?
   i. A tech-rich classroom has evidence of technology
   ii. A print-rich classroom has evidence of literature
   iii. What is the evidence of a culturally responsive environment?

L. Closing
   i. Next Session: Thurs, Jan. 8, 2009
   ii. Article reading: Dialogues in Algebra/Algebra in the Middle School
   iii. Journal Entry
   iv. Come with questions, thoughts, barriers and suggestions
   v. Email and phone number provided

<u>Session Three Agenda</u>
(Each section was presented on Power Point Slides)

A. Purpose
   a. Review all the CRT components
   b. CRT instructional integration
   c. Game Board of Change
   d. Implementation Ideas (lesson review)
   e. Reporting Protocol

B. Review
   a. Highlight from the readings

i. How did the readings further inform your awareness of algebra instruction?

b. What are your thoughts about how you can begin to implement CRT methods?

C. NCTM' s Current Position

a. Position paper (December 2008)

b. President's message

D. CRT Components (review)

a. Validating

b. Empowering

c. Comprehensive

E. Other Components

a. Multidimensional (Various Options/Approaches)

i. Involves various aspects of learning environment

1. Curriculum (varied tools for teaching)
2. Content (across content areas)
3. Instructional techniques (varied practices)
4. Performance assessments (differentiated assessments)

ii. Examining a topic/concept from many perspectives

iii. Collaborating with other subject specialists-incorporating different ethnic styles (i.e. music, dance, poetry, paintings, political actions)

iv. Tapping into wide variety of cultural knowledge, experiences, contributions, and perspectives.

b. Transformative (Butterfly)

i. Recognizing students' strengths and accomplishments and capitalizing on them through the instructional process (i.e. storytelling for some African American students)

ii. Helping "students to develop the knowledge, skills, and values needed to become social critics who can make reflective decisions and implement their decisions in effective personal, social,

political and economic action" (Banks, 1991, p. 131 as cited in Gay, 2000)

iii. Confronting the cultural control of society and speaking out against them

iv. Developing social consciousness, intellectual critiques, and political and personal efficacy (confidence) in students (i.e. AIDS Awareness)

v. Combating prejudice, racism, and other forms of oppression

c. Emancipatory (Lifting the veil of authority)

i. Liberating

1. It released the intellect of students from mainstream forms of knowledge and ways of doing (i.e. Black history as it pertains to present day society)
2. This freedom allows students to focus on tasks more closely and concentrate on learning

ii. Lifts the Veil of Authority

1. Students see themselves as scholars
2. Encourages and enables students to find their own voices regarding cultural perspectives
3. Helps students to become active participants in shaping their own learning.

d. Instructional Integration

i. Take some time to review all 6 components. Think about which one speaks most profoundly to you. (Do you envision yourself integrating this particular component into your instructional practices?)

e. Game Board of Change

f. How might it look?

i. Collectively, let's brainstorm about how to integrate CRT components into the mathematics classroom. (CRT methods on

posters around the room. Teachers circulated with markers and recorded their ideas)

g. How will these looks for you?
    i. What is your integration plan?
    ii. Look at the lessons that are coming up and consider how you will integrate your selected component.
    iii. Use your Game Board of Change to help you focus.
h. Implementation Phase
    i. One month (Jan. 9th-Feb.12th)
    ii. Select one CRT component to integrate into all algebra (or those which develop algebraic reasoning) lessons.
    iii. Keep notes about the experience (implementation guide)
    iv. Be prepared to share these experiences with the group on Feb. 12th
i. Journal Entries
    i. It is important that you log your reactions and/or experiences
    ii. You can submit student work samples as applicable
    iii. Focus on your African American students
j. Final session
    i. Feb 12th, 4-7pm
    ii. Each will share feedback from implementation month
    iii. About 10 minutes each (allow time for Q&A)
    iv. Available for questions/concerns that arise.

Session Four
(Each section was presented on Power Point Slides)

A. Introduction (read a short poem)
B. Research Question
    a. What do in-service teachers report about the process of implementing (the strengths and strains) culturally responsive teaching mathematics methods in algebra with African American students?
C. Purpose of the Study

a. Invitation for practicing teachers to explore and experience theoretical frameworks in the actual classroom setting.
b. Identify/address the "strengths" and "strains" during the implementation process.
c. Address cultural discontinuity and structural inequality for culturally diverse students during mathematics instruction (especially in algebra).
d. Expand teachers' knowledge and sensitivity to working with African American students.

D. Share Out Protocol (each person shared for 10-15 minutes)
    a. Name, school, grade level
    b. Total number of African American students/Total Number of Students
    c. Selected CRT Method/ Number of Lesson
    d. Discuss "strengths" and "strains"
    e. Student responses
    f. Personal responses

E. Recapping
    a. What do you see? (Picture of an African American boy, about 6-7 yrs old)

F. Impact of Culturally Responsive Teaching
    a. Provides an instructional paradigm
    b. Unleashed high levels of learning potential for ethnically diverse students
    c. Expands teacher pedagogical tool-kit

G. What are you taking?
    a. As you reflect on your participation, what are some final thoughts/ideas that you are taking with you?

H. What happens next?
    a. Compile and analyze data
    b. Construct Chapters 4 and 5
    c. Set defense date
    d. Defend research
    e. Share findings with PD group
    f. Graduate…(you are all invited)

I. Before you leave
    a. Please turn in:
        i. Reflection journal
        ii. Share out guide
J. Thank you for your time and effort!

Appendix E - Journal Writing Prompts

Session 1-Journal Writing Prompts

Please hand this form in at our next session.
You can submit your response via email, if you'd prefer: powell@ksu.edu
Be sure to include your name, school and grade.

Which element of "algebra" are you currently teaching your students?

To what degree did the information from the first session provide insight on the topic of culturally responsive teaching in algebra with African American students?

How did the reading assignment further inform your understanding of the importance of algebra instruction? With African American students?

Session 2 -Journal Writing Prompts

Please hand this form in at our next session.
You can submit your response via email, if you'd prefer: powell@ksu.edu
Be sure to include your name, school and grade.

What is your overall reaction to the information presented during this session?

In what ways are you thinking about how to apply the culturally responsive teaching methods during your mathematics lessons in general? And specifically in algebra?

How did the reading assignment further inform your understanding of the importance of algebra instruction for African American students?

In your opinion, why have African American students traditionally been so unsuccessful in algebra courses? How might YOUR classroom environment/instructional practices address some of these issues?

Appendix F - Implementation Phase

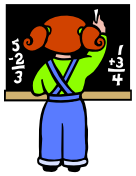
Implementation Phase

Name_____

Grade _____

School_____

Gameboard of Change



1. As you are considering your **IDEAL CLASSROOM**, think about the components of culturally responsive teaching that we have explored. Which component is being utilized? What are students? What are you doing? What are you saying? How does your environment look? As you reflect on what you want your classroom to reflect, write these characteristics down in the star (use additional paper as you need to).

2. Now that you have a picture of what you want, consider what you have in your classroom **RIGHT NOW**. What practices do you have in place that you can build off of? What materials do you use? How do students interact with you and each other in the classroom? To what degree do you consider the cultural backgrounds of your African American students in the classroom environment?

3. While keeping your goal in mind and considering your present circumstances, how will you **GET TO** your IDEAL CLASSROOM? How will you need to adjust? Which component of CRT are you striving to implement? What is the essence of that component (as you understand it)? What steps can you take toward your goal? Now…keep in mind that this is a work in progress. You may not get to your ideal classroom state, but you are well on you way to making the changes that will get you to where you would like to be.

The game board of change is a mind mapping model that is useful in outlining goals and steps toward accomplishing these goals. It can be adapted for many other purposes.

Gameboard of Change

1.Consider the characteristics of your ideal culturally responsive classroom environment—record these in the **STAR.**

2. Think about what you have NOW in your classroom—record this in the **SCROLL.**

3. Decide the things you need to do to get to your ideal state---record these in the **MIDDLE.**

Right Now!

What do you have in place in your classroom right now?

What will it take for you to get to your ideal state?

Getting There...

How would your ideal culturally responsive classroom look?

Ideal Classroom

CRT Integration Plan

CRT Method Selected_____

Rationale_____

_____

_____

Focus Lessons_____

_____

_____

_____

_____

During the implementation phase, I plan to:

_____

_____

_____

_____

I will evaluate the effectiveness of this integration by:

_____

_____

_____

Week 1

Lesson Focus:

How did you integrate the selected CRT component into lessons this week?

How did students respond to this integration as compared to others lessons that you have taught?

What are the “strengths” of this implementation process?

What are the “strains” of this implementation process?

Week 2

Lesson Focus:

How did you integrate the selected CRT component into lessons this week?

How did students respond to this integration as compared to others lessons that you have taught?

What are the “strengths” of this implementation process?

What are the “strains” of this implementation process?

Week 3

Lesson Focus:

How did you integrate the selected CRT component into lessons this week?

How did students respond to this integration as compared to others lessons that you have taught?

What are the “strengths” of this implementation process?

What are the “strains” of this implementation process?

Week 4

Lesson Focus:

How did you integrate the selected CRT component into lessons this week?

How did students respond to this integration as compared to others lessons that you have taught?

What are the “strengths” of this implementation process?

What are the “strains” of this implementation process?

Final Feedback

How did the integration of CRT impact mathematics instruction with your African American students?

What is your overall reaction to the focus on algebra?

What were the overall **"strengths"** of the implementation process?

What were the overall **"strains"** of the implementation process?

What discoveries did you have along this journey?

What is the likelihood that you will continue to implement these methods?

During the rest of the school year? In future years?

Appendix G - Final Share Out Guide

Share-Out Guide

Final Session

February 12, 2009

Name_____

School_____ Grade Level_____

Total Number of Students_____

Total Number of African American Students_____

Total Number of Lessons that included CRT component_____

Which CRT component did you select to implement?_____

Why?_____

_____

Summarize the "strengths" of implementing this CRT component (What worked well during the implementation phase?)

_____

_____

Summarize the "strains" of implementing this CRT component (What challenges did you face during the implementation phase?)

_____

_____

Summarize your overall impression of students' responses to this implementation.

_____

_____

Summarize your overall personal response to this implementation.

_____

_____

Appendix H - Frequency of Total Scores on PTMI

H1-Total Score Without Grade Specific Efficacy Scale
N=33

Score	Frequency
166	1
175	1
183	1
187	1
189	1
190	1
194	1
195	1
197	1
199	2
201	1
203	1
204	1
205	1
207	1
209	1
210	2
214	1
216	1
221	2
228	1
229	4
227	2
229	1
231	1
232	1
235	1
259	1

H2- Total Score Distribution for Grades K-2 (With Efficacy Scale) N=10

Total Score	Frequency
196	1
219	1
225	1
231	1
234	1
235	3
242	1
274	1

H3- Total Score Distribution for Grades 3-5 (With Efficacy Scale) N=7

Total Score	Frequency
195	1
215	1
224	1
239	1
249	2
263	1

H4-Total Score Distribution for Grades 6-8 (With Efficacy Scale) N=16

Total Score	Frequency
223	1
228	1
237	1
239	1
246	1
248	1
252	1
260	1
264	2
265	1
265	1
266	1
269	1
271	1

Appendix I -Frequency Distribution of CRT Items

N=34

"I employ culturally responsive teaching strategies in mathematics"		
USE		**DESIRE**
Response	*Frequency/Percentage*	*Frequency/Percentage*
Disagree	5 (14.7)	1 (2.9)
Uncertain	11 (32.4)	2 (5.9)
Agree	17 (50.0)	17 (50.0)
Strongly Agree	1 (2.9)	14 (41.2)

"I incorporate AA cultural experiences in the construction of mathematics lessons."		
USE		**DESIRE**
Response	*Frequency/Percentage*	*Frequency/Percentage*
Disagree	7 (20.6)	1 (2.9)
Uncertain	19 (55.9)	2 (5.9)
Agree	7 (20.6)	17 (50.0)
Strongly Agree	1 (2.9)	14 (41.2)

"I set high expectations for my AA students."		
USE		**DESIRE**
Response	*Frequency/Percentage*	*Frequency/Percentage*
Disagree	1 (2.9)	0
Uncertain	0	0
Agree	15 (44.1)	9 (26.5)
Strongly Agree	18 (52.9)	25 (73.5)

"I communicate my expectations to my AA students"		
USE		**DESIRE**
Response	*Frequency/Percentage*	*Frequency/Percentage*
Disagree	0	0
Uncertain	1 (2.9)	0
Agree	15 (44.1)	10 (29.4)
Strongly Agree	18 (52.9)	24 (70.6)

"AA students often meet my academic expectations set for them in mathematics."		
USE		**DESIRE**
Response	*Frequency/Percentage*	*Frequency/Percentage*
Disagree	5 (14.7)	1 (2.9)
Uncertain	1 (2.9)	0
Agree	21 (61.8)	11 (32.4)
Strongly Agree	7 (20.6)	22 (64.7)

"I provide opportunities for AA students to share their problem-solving techniques with each other in small group at least twice a week."		
USE		**DESIRE**
Response	*Frequency/Percentage*	*Frequency/Percentage*
Disagree	6 (17.6)	3 (8.8)
Uncertain	5 (14.7)	0
Agree	16 (47.1)	15 (44.1)
Strongly Agree	7 (20.6)	16 (47.1)

"I collaborate with other subject area teachers (or subjects, such as science, art, music, physical education) to enhance the math concepts that I am teaching to my AA students."		
USE		**DESIRE**
Response	*Frequency/Percentage*	*Frequency/Percentage*
Disagree	7 (20.6)	3 (8.8)
Uncertain	4 (11.8)	1 (2.9)
Agree	18 (52.9)	14 (41.2)
Strongly Agree	5 (14.7)	6 (47.1)

"I see the need to incorporate the home/community realities into learning experiences in mathematics with AA students."		
USE		**DESIRE**
Response	*Frequency/Percentage*	*Frequency/Percentage*
Disagree	1 (2.9)	2 (5.9)
Uncertain	7 (20.6)	0
Agree	18 (52.9)	18 (52.9)
Strongly Agree	8 (23.5)	14 (41.2)

"I provide examples of prominent AA mathematicians during the school year for my AA students."		
USE		**DESIRE**
Response	*Frequency/Percentage*	*Frequency/Percentage*
Disagree	3 (8.8)	1 (2.9)
Uncertain	21 (61.8)	4 (11.8)
Agree	2 (5.9)	20 (58.8)
Strongly Agree	7 (20.6)	9 (26.5)

"I allow my students to intelligently challenge others' responses in the mathematics classroom."		
USE		**DESIRE**
Response	*Frequency/Percentage*	*Frequency/Percentage*
Disagree	6 (17.6)	2 (5.9)
Uncertain	4 (11.8)	0
Agree	19 (55.9)	16 (47.1)
Strongly Agree	5 (14.7)	16 (47.1)

"I allow my AA students to intelligently challenge my responses in the mathematics lesson."		
USE		**DESIRE**
Response	*Frequency/Percentage*	*Frequency/Percentage*
Disagree	2 (5.9)	1 (2.9)
Uncertain	4 (11.8)	0
Agree	24 (70.6)	17 (50.0)
Strongly Agree	4 (11.8)	16 (47.1)

"I use the mathematics curriculum in ways that assists AA students to make sense of the problems."		
USE		**DESIRE**
Response	*Frequency/Percentage*	*Frequency/Percentage*
Disagree	1 (2.9)	1 (2.9)
Uncertain	3 (8.8)	0
Agree	26 (76.5)	11 (32.4)
Strongly Agree	4 (11.8)	22 (64.7)

"I present AA students with ideas of them pursuing future professions that involve a significant amount of mathematics (i.e.: engineer, technician, scientist)."		
USE		**DESIRE**
Response	*Frequency/Percentage*	*Frequency/Percentage*
Disagree	3 (8.8)	2 (5.9)
Uncertain	7 (20.6)	0
Agree	19 (55.9)	15 (44.1)
Strongly Agree	5 (14.7)	17 (50.0)

Appendix J-Frequency Distribution for Process Standards

J1-General Process Standards
N=34

Score	Frequency
22	1
23	2
24	2
25	1
26	6
27	2
28	3
29	3
30	6
31	2
32	2
33	3
28	1

J2=Process Standards with African American Students
N=34

Score	**Frequency**
14	1
16	1
24	3
25	1
26	3
28	3
29	1
30	1
31	2
32	6
33	1
37	1
40	10

Appendix K-Frequency Distribution for Equity and Efficacy

K1-Equity

N=34

Score	**Frequency**
21	6
22	6
23	4
24	7
25	2
26	2
27	5
28	1
29	1

K2=Efficacy
N=33

Score	Frequency
14	2
15	2
16	3
17	3
18	4
20	4
21	4
22	6
23	3
24	2

Appendix L-Consent Forms

KANSAS STATE UNIVERSITY
INFORMED CONSENT
(Part 1)

October 6, 2008

You are invited to participate in a study that explores teaching practices in mathematics with African American students. The study is divided into two parts.

Part 1 involves a 50-item online questionnaire, *The Powell Teaching Mathematics Index* (PTMI) that examines practicing teachers' knowledge regarding the concept, known as "culturally responsive teaching" as well as their willingness to incorporate these strategies into algebra instruction. It also addresses practicing teachers' comfort level in mathematics in general and in the specific area of algebra. ***It will take approximately 20 minutes to complete the survey.***

*****(Participants may respond to the question at the end of the questionnaire (PTMI) to indicate interest in volunteering for Part 2 of the research study.)

The data collected will be kept strictly confidential. Actual names will be kept separate all recorded responses. Following the collection of data, your individual identity (code) will be removed from all records. This will protect the anonymity/confidentiality of your responses. The records of this study will be maintained for five years. The possible risk factors from your participation are no greater than normal daily activity. However, you cannot expect to be compensated for any discomfort or injury because of your participation in the research described here.

Please sign and date the following statements:

- I understand this project is research, and that my participation is completely voluntary. I also understand that if I decide to participate in this study, I may withdraw my consent at any time, and stop participating at any time without explanation, penalty, or loss of benefits, or academic standing to which I may otherwise be entitled.
- I verify that my signature below indicates that I have read this consent form, and willingly agree to participate in this study under the terms described, and that my signature acknowledges that I have received a signed and dated copy of this consent form.
- If I have questions about the rationale or the method of study, I understand that I may contact researcher, Tiffany Powell (785) 727-8073 or the Major Professor, Dr. Jacqueline Spears at (785) 532-5530
- If I have questions about the rights of subjects in this study or about the manner in which the study is conducted, I may contact: Rick Scheidt, Chair, Committee on Research Involving Human Subjects, 203 Fairchild Hall, Kansas State University, Manhattan, KS, 66506, (785) 532-3224

Participant Name: _____

Researcher: _____Date:_____

Participant Signature: _____Date:_____

Witness to Signature: (Project Staff)_____Date:_____

KANSAS STATE UNIVERSITY

INFORMED CONSENT

(Part 2)

October 6, 2008

You are invited to participate in Part 2 of the study on practicing teachers' knowledge and willingness to implement culturally responsive teaching in the algebra classroom with African American students. This will involve a 4-part professional development session with a small group of individuals. ***Each session will last for 3 hours.*** (You can earn PDC points for participation.)

The first three sessions will provide additional learning experiences on the concept of culturally responsive teaching in mathematics in general and then specifically in algebra with teachers of grades 3-8. During the third session, you will select one culturally responsive teaching method to implement over a month-period. At the end of the one-month period, during the fourth session, participants you will report the strengths and strains to this implementation process.

It is understood that you would participate in the three phases of this section:

- attend all four professional development sessions
- participate in the implementation project
- be available for follow-up interviews at the end of the professional development sessions (if necessary).

At the end of the data collection process, you will be invited to a "closeout" gathering. You will receive a small compensatory "thank you" for your participation in each phase of this section. There you will also learn about preliminary findings from the research project. Please note that all sessions will be video taped exclusively for research purposes associated with this project. The researcher will be the only person to hear or view tapes.

Please sign and date the following statements:

- I understand this project is research, and that my participation is completely voluntary. I also understand that if I decide to participate in this study, I may withdraw my consent at any time, and stop participating at any time without explanation, penalty, or loss of benefits, or academic standing to which I may otherwise be entitled.
- I verify that my signature below indicates that I have read this consent form, and willingly agree to participate in this study under the terms described, and that my signature acknowledges that I have received a signed and dated copy of this consent form.
- If I have questions about the rationale or the method of study, I understand that I may contact researcher, Tiffany Powell (785) 727-8073 or the Major Professor, Dr. Jacqueline Spears at (785) 532-5530
- If I have questions about the rights of subjects in this study or about the manner in which the study is conducted, I can contact: Rick Scheidt, Chair, Committee on Research Involving Human Subjects, 203 Fairchild Hall, Kansas State University, Manhattan, KS, 66506, (785) 532-3224

Participant Name: _____

Researcher: _____Date:_____

Participant Signature: _____Date:_____

Witness to Signature: (Project Staff)_____Date:_____

Appendix M-The Powell Teaching Mathematics Index (PTMI)

AXIO SURVEY

The Powell Teaching Mathematics Index

Survey Description

The ***Powell Teaching Mathematics Index (PTMI)*** examines practicing teachers' knowledge and "use" of a concept, known as ***Culturally Responsive Teaching*** as well as their "willingness" to incorporate such strategies into algebra instruction with African American students. It also examines practicing teachers' comfort level in mathematics in general and in the specific area of algebra.

The data collected will be kept strictly confidential. Actual names will be kept separate from all responses and will be removed from all records. The records of this study will be maintained for five years. The possible risk factors from your participation are no greater than normal daily activity. However, you cannot expect to be compensated for any discomfort or injury because of your participation in the research described here.

Opening Instructions

Please respond to each statement as honestly as possible. It is really important that you respond to ALL statements.

Part 4 of the survey is grade level specific. Please respond to the section for your **current** teaching grade. If you teach more than one grade level (ie: Math support personnel or Special Education teacher), please respond to sections for **all grade levels** that you teach/work with.

It should take approximately 20 minutes to complete the survey

Part 5 descibes the extension to this study. If you are interested in learning more about participating in the next phase of this research project, please indicate your **interest** at the very end, by responsinf to the statements.

Page 1

This section asks for general information such as race, gender, years of experience, etc. Please respond to each statement in this section.

Question 1 ***required***

1. What is your gender?
   - ○ Male
   - ○ Female

Question 2 ***required***

2. How do you racially identify yourself? (Please check all that apply.)
   - ☐ (1) Black/African American
   - ☐ (2) White/Caucasian
   - ☐ (3) Asian/Pacific Islander
   - ☐ (4) Hispanic/Latino/a
   - ☐ (5) Native American
   - ☐ Other:

Question 3 ** *required* **

3. Describe the location of the high school that you attended.

- (1) Rural
- (2) Suburban
- (3) Urban

Question 4 ** *required* **

To the best of your recollection, what was the racial composition of the students in your **high school you attended** (while you were there)? Please mark the appropriate response for each racial category listed as you remember it.

1 - 0% | 2 - Less than 10% | 3 - 11%-30% | 4 - 31%-50%
5 - More than 50%

	1	2	3	4	5
4.1 Black/African American	○	○	○	○	○
4.2 Hispanic/Latino/a	○	○	○	○	○
4.3 White/Caucasian	○	○	○	○	○
4.4 Asian/Pacific Islander	○	○	○	○	○
4.5 Native American	○	○	○	○	○
4.6 Bi/Multi-racial	○	○	○	○	○

Question 5 ** *required* **

Describe the **location** of the **college/university** that you attended.

- Rural
- Suburban
- Urban

Question 6 ** *required* **

To the best of your recollection, what was the **racial composition** of the students in your **college/university** (while you were there)? Please mark the appropriate response for each racial category listed as you remember it.

1 - 0% | 2 - Less than 10% | 3 - 11%-30% | 4 - 31%-50%
5 - More than 50%

	1	2	3	4	5
6.1 Black/African American	○	○	○	○	○
6.2 Hispanic/Latino/a	○	○	○	○	○
6.3 White/Caucasian	○	○	○	○	○
6.4 Asian/Pacific Islander	○	○	○	○	○
6.5 Native American	○	○	○	○	○
6.6 Bi/Multi-racial	○	○	○	○	○

Question 7 ** *required* **

Up to now, how many **years** have you been (or were you) a classroom teacher?

- 0-1 (less than 1 full year)
- 1-3 (less than 3 full years)
- 3-5 (less than 5 full years)
- 5-7 (less than 7 full years)
- 7+ (more than 7 years)

Question 8 ** *required* **

Which grade level do **currently** you teach/work with?

- ☐ Primary (PreK-2)
- ☐ Elementary (3-5)
- ☐ Middle School(6-8)

Question 9 ** *required* **

How many **years** have you been **teaching** at your **current** grade level?

- ○ 0-1 (less than 1 full year)
- ○ 1-3 (less than 3 full years)
- ○ 3-5 (less than 5 full years)
- ○ 5-7 (less than 7 full years)
- ○ 7+ (more than 7 years)

Question 10 ** *required* **

What is your **class size** (how many students do you teach during one class setting)?

- ○ Less than 10
- ○ 10-15
- ○ 16-20
- ○ 21-25
- ○ More than 25

Question 11 ** *required* **

Think about the students you currently teach. What is the **racial composition** of the students in your classroom? Please mark the appropriate response for each racial category listed to the best of your recollection.

1 - 0% | 2 - Less than 10% | 3 - 11%-30% | 4 - 31%-50%
5 - More than 50%

	1	2	3	4	5
11.1 Black/African American	○	○	○	○	○
11.2 White/Caucasian	○	○	○	○	○
11.3 Asian/Pacific Islander	○	○	○	○	○
11.4 Hispanic/Latino/a	○	○	○	○	○
11.5 Native American	○	○	○	○	○
11.6 Bi/Multi-racial	○	○	○	○	○

Page 2

Definition

Culturally Responsive Teaching can be defined as using the cultural knowledge, prior experiences, frames of reference and performance styles of ethnically diverse students to make learning encounters more relevant to and effective for them. (Gay, 2000)

Culturally Responsive Teaching builds on student knowledge/skills and relates school lessons to real-life situations. It also includes school wide and community celebrations, festivals and holidays.

Culturally Responsive Teaching is built on teacher-student relationships in the "culturally relevant" classroom that are fluid and humanely equitable. Furthermore this instructional style seeks to cultivate relationships beyond the boundaries of the classroom, involve practices that are careful to demonstrate sensitivity to the cultural needs with each of their students and are characterized by practices that encourage a community of learners. (Barr and Parrett, 2004)

As you respond to each section, specifically concentrate on your instructional practices with **African American students in your classroom now**.(You will see **"AA"** used for African American students.)

Question 12 *** required ***

Indicate the degree to which you **"presently" agree** with each statement. (AA represents "African American" students)

1 - Strongly disagree | 2 - Disagree | 3 - Uncertain
4 - Agree | 5 - Strongly Agree

	1	2	3	4	5
12.1 I employ culturally responsive teaching strategies in mathematics.	○	○	○	○	○
12.2 I incorporate AA students cultural experiences in the construction of mathematics lessons.	○	○	○	○	○
12.3 I set high expectations for my AA students in mathematics.	○	○	○	○	○
12.4 I communicate my expectations to my AA students.	○	○	○	○	○
12.5 AA students often meet my academic expectations set for them in mathematics.	○	○	○	○	○
12.6 I provide opportunities for AA students to share their problem-solving techniques with each other in small groups at least twice a week.	○	○	○	○	○
12.7 I collaborate with other subject area teachers (or other subjects, such as science, art, music, physical education) to enhance the math concepts that I am teaching to my AA students.	○	○	○	○	○
12.8 I see the need to incorporate the home/community realities into learning experiences in mathematics with AA students.	○	○	○	○	○
12.9 I provide examples of prominent AA mathematicians during the school year for my AA students.	○	○	○	○	○
12.10 I allow my AA students to intelligently challenge others' responses in the mathematics classroom.	○	○	○	○	○
12.11 I allow my AA students to intellectually challenge my responses in the math classroom.	○	○	○	○	○
12.12 I use the mathematics curriculum in ways that assists AA students to make sense of the problems.	○	○	○	○	○
12.13 I present AA students with ideas of them pursuing future professions that involve a significant amount of mathematics (ie: engineer, technician, scientist)	○	○	○	○	○

Question 13 *** required ***

Indicate the degree to which you **"desire to"** agree with each statement.

1 - Strongly disagree | 2 - Disagree | 3 - Uncertain
4 - Agree | 5 - Strongly Agree

	1	2	3	4	5
13.1 I employ culturally responsive teaching strategies in mathematics.	○	○	○	○	○
13.2 I incorporate AA students cultural experiences in the construction of mathematics lessons.	○	○	○	○	○
13.3 I set high expectations for my AA students in mathematics.	○	○	○	○	○
13.4 I communicate my expectations to my AA students.	○	○	○	○	○
13.5 AA students often meet my academic expectations set for them in mathematics.	○	○	○	○	○
13.6 I provide opportunities for AA students to share their problem-solving techniques with each other in small groups at least twice a week.	○	○	○	○	○
13.7 I collaborate with other subject area teachers (or other subjects, such as science, art, music, physical education) to enhance the math concepts that I am teaching to my AA students.	○	○	○	○	○
13.8 I see the need to incorporate the home/community realities into learning experiences in mathematics with AA students.	○	○	○	○	○
13.9 I provide examples of prominent AA mathematicians during the school year for my AA students.	○	○	○	○	○
13.10 I allow my AA students to intelligently challenge others responses in the mathematics classroom.	○	○	○	○	○
13.11 I allow my AA students to intellectually challenge my responses in the math classroom.	○	○	○	○	○
13.12 I use the mathematics curriculum in ways that assists AA students to make sense of the problems.	○	○	○	○	○
13.13 I present AA students with ideas of them pursuing future professions that involve a significant amount of mathematics (ie: engineer, technician, scientist.)	○	○	○	○	○

Page 3

The **Process Standards** for mathematics education informs the "how" in mathematics education. These instructional methods speak to the "manner" in which mathematics is delivered in the classroom setting. These instructional procedures should be used in an integrated approach for the effective teaching and learning of school mathematics.

Question 14 *** required ***

Think about **all** the students in your classroom. Indicate the degree to which you **"presently"** agree with each statement.

(As you respond to each item, concentrate on your general instructional practices with all students.)

1 - Strongly disagree | 2 - Disagree | 3 - Uncertain
4 - Agree | 5 - Strongly Agree

	1	2	3	4	5

14.1 I pose problems that allow students to apply a variety of strategies to solve math problems.	○	○	○	○	○
14.2 I encourage students to find and solve mathematics problems that arise outside of the math classroom.	○	○	○	○	○
14.3 My students are successful in developing mathematical arguments during math lessons.	○	○	○	○	○
14.4 In general, my students are successful in the discovery of mathematics concepts.	○	○	○	○	○
14.5 When my students communicate their mathematical understandings during math lessons, it usually makes sense to me.	○	○	○	○	○
14.6 I encourage students to communicate their mathematical thinking in a variety of ways.	○	○	○	○	○
14.7 I find that most students are able to exhibit organization of their mathematical thinking.	○	○	○	○	○
14.8 I primarily use textbook examples in teaching mathematics concepts.	○	○	○	○	○

Page 4

As you respond to each statement in this section, think about the academic performance of the **African American** students in your classroom.

Question 15 *** required ***

Think about your African American students. Indicate the degree to which you **"desire to"** agree with each statement.

(AA=African American students)

1 - Strongly disagree | 2 - Disagree | 3 - Uncertain
4 - Agree | 5 - Strongly Agree

	1	2	3	4	5
15.1 I pose problems that allow AA students to apply a variety of strategies to solve algebra problems.	○	○	○	○	○
15.2 I allow AA students to find and solve problems that are related to algebraic concepts.	○	○	○	○	○
15.3 My AA students are successful in developing mathematical arguments during algebra lessons.	○	○	○	○	○
15.4 My AA students are usually successful in the discovery and solutions of algebraic concepts.	○	○	○	○	○
15.5 When my AA students communicate their mathematical understandings during algebra lessons, it makes sense to me.	○	○	○	○	○
15.6 I allow AA students to communicate their algebraic thinking in a variety of ways.	○	○	○	○	○
15.7 AA students are able to exhibit organization of their thinking during algebra related lessons.	○	○	○	○	○
15.8 I recognize the need to use examples from AA students lives in order to teach algebra concepts.	○	○	○	○	○

Page 5

Attitudes are influenced by many factors and are related to your underlying thoughts toward a particular idea. Consider your attitude toward teaching mathematics to African American students.

Question 16 *** required ***

As you respond to each item, concentrate on your instructional **attitudes/perceptions** toward African American (AA) students in your mathematics classroom.

1 - Strongly disagree | 2 - Disagree | 3 - Uncertain
4 - Agree | 5 - Strongly Agree

	1	2	3	4	5
16.1 AA students are served well by implementing a "traditional" (facts and drills) mathematics program.	○	○	○	○	○
16.2 I provide adequate assistance in order to ensure that all my AA students meet high mathematics expectations.	○	○	○	○	○
16.3 On average my AA students are successful in mathematics.	○	○	○	○	○
16.4 All students can learn algebra.	○	○	○	○	○
16.5 All AA students must be presented with opportunities to learn algebraic concepts in order to prepare them for future experiences.	○	○	○	○	○
16.6 I find it necessary to make adjustments in the mathematics curriculum in order to serve of my AA students well.	○	○	○	○	○

Page 6

Confidence is related to one's comfort level. As you respond to the following set of questions, examine **your personal confidence** in the specified area.

Question 17 *** required ***

As you respond to each item, concentrate on your instructional practices with African American (AA) students in your classroom.

1 - Strongly disagree | 2 - Disagree | 3 - Uncertain
4 - Agree | 5 - Strongly Agree

	1	2	3	4	5
17.1 I am very good at learning mathematics	○	○	○	○	○
17.2 I am very good at teaching mathematics.	○	○	○	○	○
17.3 I have experienced success in teaching mathematics to AA students.	○	○	○	○	○
17.4 I find it challenging to motivate African American students in the math classroom.	○	○	○	○	○
17.5 As a student, (when I was in elementary/middle school) I earned A's in math.	○	○	○	○	○

Page 7

As you respond to each item, concentrate on your **comfort level** with teaching in the specified area.

Question 18

To what degree are you **confident** in teaching the following mathematical concepts?

This section is for teachers Grades K-2 ONLY!!

When you are done with this section, go immediately to Part 5.

1 - Extremely Not Confident | 2 - Not Confident | 3 - Uncertain
4 - Confident | 5 - Extremely Confident

	1	2	3	4	5
18.1 Sort, classify and order by size, number, and other properties.	○	○	○	○	○
18.2 Recognize, describe and extend patterns such as sequences of sounds and shapes or simple numeric patterns and translate from one representation to another.	○	○	○	○	○
18.3 Analyze how both repeating and growing patterns are generalized.	○	○	○	○	○
18.4 Illustrate general principles and properties of operations, such as commutativity, using specific numbers	○	○	○	○	○
18.5 Use concrete, pictorial and verbal representations to develop an understanding of invented and conventional symbolic notations.	○	○	○	○	○
18.6 Model situations that involve the addition and subtraction of whole numbers, using objects, pictures and symbols.	○	○	○	○	○
18.7 Describe qualitative change, such as students growing taller.	○	○	○	○	○
18.8 Describe quantitative change, such as a students growing two inches in one year.	○	○	○	○	○

Question 19

To what degree are you **confident** in teaching students these mathematical concepts?

For Teachers Grades 3-5 ONLY!!!

When you are done with this section, go immediately to Part 5.

1 - Extremely Not Confident | 2 - Not Confident | 3 - Uncertain
4 - Confident | 5 - Extremely Confident

	1	2	3	4	5
19.1 Describe, extend, and make generalizations about geometric and numeric patterns.	○	○	○	○	○
19.2 Represent and analyze patterns and function, using words, tables and graphs.	○	○	○	○	○
19.3 Identify such properties as commutativity, associativity, and distributivity and use them to compute with whole numbers.	○	○	○	○	○
19.4 Represent the idea of a variable as an unknown quantity using a letter of a symbol.	○	○	○	○	○
19.5 Express mathematical relationships using equations.	○	○	○	○	○
19.6 Model problem situations with objects and use representations such as graphs tables and equations to draw conclusions.	○	○	○	○	○
19.7 Investigate how a change in one variable relates to a change in a second variable.	○	○	○	○	○
19.8 Identify and describe situations with constant or varying rates of change and compare them.	○	○	○	○	○

Question 20

To what degree are you **confident** n teaching the following mathematical concepts?

This section is for Teachers Grades 6-8 ONLY!!!

When you are done, go immediately to Part 5.

1 - Extremely Not Confident | 2 - Not Confident | 3 - Uncertain
4 - Confident | 5 - Extremely Confident

	1	2	3	4	5
20.1 Represent, analyze, and generalize a variety of patterns with tables, graphs, words and when possible, symbolic rules.	○	○	○	○	○
20.2 Relate and compare different forms of representation for a relationship.	○	○	○	○	○
20.3 Identify functions as linear or nonlinear and contrast their properties from tables, graphs or equations.	○	○	○	○	○
20.4 Develop an initial conceptual understanding of different uses of variables.	○	○	○	○	○
20.5 Explore relationships between symbolic expressions and graphs of lines, paying particular attention to the meaning of intercepts and slope.	○	○	○	○	○
20.6 Use symbolic algebra to represent situations and to solve problems, especially those that involve linear equations.	○	○	○	○	○
20.7 Recognize and generate equivalent forms for simple algebraic expressions and solve linear equations.	○	○	○	○	○
20.8 Model and solve contextualized problems using various representations, such as graphs, tables, and equations.	○	○	○	○	○
20.9 Use graphs to analyze the nature of changes in quantities in linear relationships.	○	○	○	○	○

Page 8

Part 2 of this study involves a series of **four** (4) professional development sessions on incorporating culturally responsive teaching in the area of algebra for teachers of grades 3-8. If you are teach any one or more of these grades AND are interested in learning more about and/or participating in the next phase of this study, please respond to the next set of questions. You will be contacted by the researcher shortly.

If you are **not interested in Part 2,** I sincerely thank you for your **time** and **participation** in the first part of this research on Exploring Inservice Teachers' Implementation of Culturally Responsive Teaching in Algebra with African American Students. Your responses are very instrumental in this endeavor.

Your time and input is deeply appreciated!!

Thank You!

Question 21

Please respond to the following questions. The researcher will contact you shortly!!

(Note: Your name will be separated from your responses and will only be used for contact purposes.)

What is your first and last name?

Characters Remaining: 200

Question 22

Which grade/s do you currently teach?

- K-2
- 3-5
- 6-8

Question 23

Where do you teach? (Which school building?)

Characters Remaining: 200

Question 24

What is a phone number where you can be contacted? (What is the best time to reach you?)

Characters Remaining: 200

Question 25

What is your email address?

Characters Remaining: 200

Question 26

Consider, which day/times would be most preferrable for the (4) professional development sessions. Please indicate your preference (if you want to type in your preference, you may do so in the space provided)

- After school (4:30-7:30pm)-Dinner provided (Specific days-TBD)
- Saturday (10:00am-1:00pm)-Lunch and Childcare provided
- Other:

Closing Message

Thank you very much for your time and participation in this research study.

- End of Survey -

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