

Culturally responsive teaching in the context of mathematics: a grounded theory case study

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Abstract In this grounded theory case study, four interconnected, foundational cornerstones of culturally responsive mathematics teaching (CRMT), communication, knowledge, trust/relationships, and constant reflection/revision, were systematically unearthed to develop an initial working theory of CRMT that directly informs classroom practice. These cornerstones were found to interact in unique ways. Results have implications for teachers of mathematics who aim to become more culturally responsive, mathematics teacher educators and supervisors, and school administrators who seek to promote equity in mathematics.

Keywords Culturally responsive mathematics teaching · Successful teachers of African American students · Grounded theory

Culturally responsive mathematics teaching: a grounded theory case study

Mathematically literate citizens have enhanced opportunities to impact their career trajectories; conversely, students who are not provided access to high-level mathematics are “filtered” out of certain fields (Bishop and Forgasz 2007). This filtering process happens when particular discourses, ways of speaking, and reasoning techniques are privileged (Diversity in Mathematics Education Center for Teaching and Learning 2007).

Gaps in mathematics achievement between students of color and their White counterparts imply that it is students of color who are more often denied access to mathematical knowledge. In 2007, the National Center for Education Statistics (NCES) (The Nation’s

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Report Card: Mathematics) indicated that a 26-point gap in mathematics achievement exists between Black and White students in fourth grade in the United States; this gap grows to 31 points by eighth grade, a pervasive figure that has not changed significantly since 1990. Researchers have extensively documented these persistent gaps in mathematics achievement between students of color and White students using quantitative measures (Lee 2006; NCES 2007), while others have qualitatively explored factors that provide or inhibit access to mathematics (e.g., Howard 2006). In this study, we deconstruct the practices of a culturally responsive mathematics teacher in an effort to address the aforementioned systemic issues at the classroom level.

Review of related literature

In the United States, learners from particular backgrounds experience systemic struggles such as higher dropout rates and significantly lower academic achievement scores (Pennington 2000) than their White counterparts. Students of color are often over-represented in special education (Gay 2002), are more likely to be suspended from school (Ladson-Billings 1997), and are less likely to receive a high school diploma (Greene and Winters 2005). As Gay (2010) insisted, why are students of color, who are successful in so many areas outside of school, failing in school settings? This question is critical to any quest of empowering students of color to be successful in school.

Cultural incongruities in education

The current researchers adopt the ideas that “culture consists of the behavior patterns, symbols, institutions, values, and other human-made components of society” (Banks 1979, p. 238) and that within larger cultural groups, “[culture] is a unique achievement of a human group that distinguishes it from other human groups” (p. 238). The culture of schooling is strongly based on historical precedents mandated with good intentions, but in the context of racism (Ladson-Billings 2004). Too often, individuals from diverse backgrounds are expected to abandon their home culture and assimilate into the mainstream culture (Sleeter 2001). These trends can be evidenced in schooling by specific dominant teaching practices (Howard 2006) and within and between school segregation (Gay 2002; Kozol 2005).

In neighborhoods in the United States with high populations of Black and Latino students, school buildings are more likely to have structural and staffing problems, thus providing worse conditions for learning (Kozol 2005). These schools also offer fewer advanced placement courses in mathematics and employ fewer qualified teachers (Darling-Hammond and Sykes 2003), many who are teaching out of field. Thus, many students of color face substandard experiences in mathematics education (Lee 2006).

Successful teachers of African–American students

Research that demystifies the practices of successful teachers of African–American students provides strategies that connect students’ lives with academic content while informing students and teachers that “success is not only possible...it’s taking place right now on school campuses across the country” (National Education Association 2008). Many successful teachers of African–American students have experienced segregation themselves, and they use the knowledge gained from experiences with discrimination to

connect to students (Foster 1997). Since these educators are aware of the damage caused by negative perceptions based on stereotypes, they often and purposefully verbalize high expectations to students (Ladson-Billings 1994). Such guidance has been shown to have profound effects on a student's self-concept, racial and cultural identity, and view of society (Sleeter 2001).

This deeply entrenched knowledge and understanding of the student experience results in a familial bond between teacher and learner (Ladson-Billings 1994), wherein daily rituals and parent-like behavior are common (Howard 2001). Teachers use storytelling techniques and metaphors in the classroom (Foster 1997) to not only teach content, but also to engage students in learning about self, society, and leadership. These educators merge culture and cognition in meaningful ways that result in academic achievement and empowerment among students (Allen and Boykin 1992).

Successful teachers of African–American students have been shown to maintain a “demanding teaching style” (Walker 2000, p. 265) while incorporating culturally congruent learning patterns into their lessons. Call and response techniques (Foster 1997), communal and collaborative learning environments, and activities that incorporate movement (Allen and Boykin 1991) are examples of such pedagogical tools. When teachers provide cultural comfort for students, students are less likely to resist the mainstream influence that often dominates instruction (Allen and Boykin 1992).

Culturally responsive teaching

Culturally responsive teaching (CRT) “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 and effective for them” (Gay 2010, p. 31). The framework of CRT has been explored as a means to combat issues of inequity while promoting successful pedagogies and provides a construct that is useful in conceptualizing equitable instruction.

Methods

The intention of this research is to focus on mathematics instruction to reveal the characteristics of CRMT by addressing the following research questions:

1. How does a successful mathematics teacher working in a high-poverty, predominantly African–American school context:
 - a. structure instructional practices and interactions?
 - b. establish a learning environment that results in mathematical success?
2. What are the interactions between these phenomena?
3. What role (if any) does culture play in these phenomena?

The participant

One researcher communicated with approximately 30 community members to identify the teachers for participation in the study. These individuals were asked to identify any mathematics teachers whom they felt were successful in the community and the qualities of

the teacher that made him/her highly successful. Only one teacher, Ms. Finley,¹ was identified. Though the initial intention was to seek out other educators to corroborate research findings, circumstances and other extenuating events that were to happen later in the study led the researchers to focus solely on Ms. Finley.

Ms. Finley was a 58-year-old African–American woman who had been teaching in the neighborhood (predominantly African American) elementary school for 30 years. She began her career as a resource teacher before transitioning to first-grade language arts. Over time, her passion for teaching mathematics grew, and she was able to apply successful strategies to mathematics. She experienced such a level of success with getting “at risk” students to grade level in mathematics that all students and parents wanted access to her instruction. The demand was so high that the principal turned an old library into an extra large classroom, wherein Ms. Finley could teach at least 50 students per session. Every fifth grader in the school had Ms. Finley as a mathematics teacher.

Individuals spoke about Ms. Finley’s dedication to her students, her ability to build their confidence and discipline, and her ability to transform students’ response to and engagement in mathematics. One individual stated that both she and her daughter had been in Ms. Finley’s class and that each of them experienced “some sort of transformation; it was indescribable”.

A powerful anecdote came from a past student (now a high school junior) of Ms. Finley’s who had been labeled learning disabled during his first-grade year. This student stated that he acted out in class. In fifth grade, he was placed in Ms. Finley’s class and “immediately knew she expected more from [him].” He worked hard for Ms. Finley, eventually excelling in her class, scoring a 4 out of 5 on the state standardized achievement test (having scored no higher than a 2 in previous years), and ultimately being placed in honors mathematics courses in 6th grade.

Grounded theory

A main goal of grounded theory is to develop a “theory from data systematically obtained from social research” (Glaser and Strauss 1967, p. 2). This method consists of “systematic, yet flexible guidelines for collecting and analyzing qualitative data to construct theories ‘grounded’ in the data themselves” (Charmaz 2006, p. 2). Grounded theory is highly interpretive and interactive and does not attempt to isolate data, but considers it as part of a relevant societal context.

Data collection and analysis

Individual, semi-structured interviews (3, each between 1 and 2 hours in length (see Appendix 1 for sample interview protocols)) over 4 months with Ms. Finley were the foundations of the data set, with 50 observations and artifacts (e.g., lesson plans) serving as triangulating evidence. One researcher was a participant-observer in Finley’s classroom.

The researchers employed simultaneous data collection and analysis practices (Glaser and Strauss 1967) with the goal of eventual pattern and theme repetition through methodical coding. The researcher began by listening to, coding, and analyzing the first interview. These data were compared with observation notes and artifacts collected from the same time period, themes emerged, and gaps in the data became evident. The

¹ A pseudonym has been used.

researcher returned to the teacher and classroom and repeated the process, constantly comparing the new themes to those already emerged.

Coding of interview transcripts was done in three stages: open, axial and selective. From these codes, major themes and core concepts in the data became apparent (see Appendix 2 for a summary of selective codes). Data collection and analysis were in progress when Ms. Finley died, with the last interview 2 days before she died, and the final observation the day before her death.

Findings

The graphic presented as Fig. 1 is representative of the results of this analysis. These results represent areas that are foundational to CRMT and are subject to refinement through research and discussion.

CRMT’s cornerstones are embedded in practice and foundational to pedagogy. Four cornerstones are represented: knowledge, communication, relationships/trust, and constant reflection and revision. The movement embedded in the figure is intentional, as these entities are not mutually exclusive, nor could any of them be in place without the support of the others. Encompassed within these cornerstones are pedagogical and disciplinary practices. The interconnections between the cornerstones do not allow for isolated anecdotes that illustrate only one of these foundational pieces; rather, these anecdotes may serve the purpose of highlighting one aspect of Ms. Finley’s mathematics teaching, but is still strongly linked to the other components.

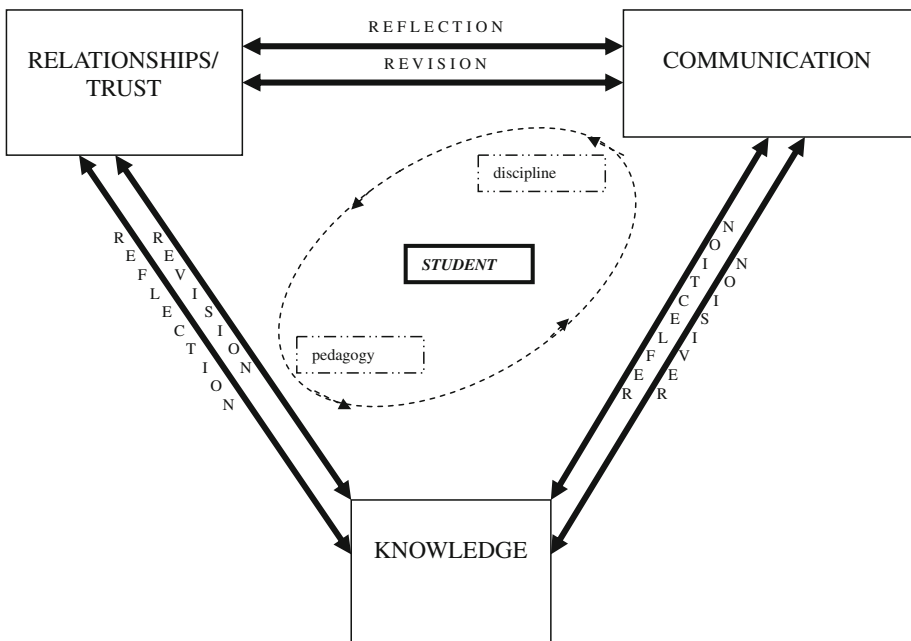


Fig. 1 Culturally responsive mathematics teaching (CRMT)

Knowledge

Ms. Finley recalled and utilized personal history, knowledge of mathematics content and pedagogy, knowledge of her students and knowledge of the community that she was able to activate while teaching mathematics. Most obvious was her strong command of mathematics and her ability to utilize this knowledge in instruction. Ms. Finley's mathematics teaching was highly interactive and improvisational and was able to shift her approach in the midst of instruction to address students' weaknesses or misunderstandings.

Ms. Finley also had extensive knowledge about her students, which illustrated her extensive community knowledge base (Gutstein 2006). This allowed her to communicate her mathematical knowledge using interactive methods. Having grown up during segregation in the neighborhood where she would later teach, Ms. Finley had a unique, personally derived perspective of the daily struggles of her students and their families. "Every once in a while I have to tell them about society," she would say. "Society says that you can't learn because of your social status. Low socioeconomic, free lunch, so they think you can't learn but that's not true, so it's up to you to show that you can learn." Ms. Finley often connected these issues to her own experience, telling students "I can understand it because of where I come from. I tell them about my house where I used to live, and I say look I'm in front of you now, so it can be done." Ms. Finley also demonstrated a great deal of critical knowledge (Gutstein 2006) used to empower her students as agents of social change.

Ms. Finley's knowledge of the community surrounding the school also impacted her mathematics teaching. When Ms. Finley discovered that students were not getting help at home with mathematics, she reached out to adults in the neighborhood by inviting them to a night course in which she volunteered to teach them the same mathematics that she was teaching the students. Parents "let their hair down when they are in my class...we have a good time, and I have a good time explaining the problems to them, no put downs whatsoever." These interactions allowed Ms. Finley to connect with families, deepen her understanding of students' lives, strengthen ties with the community, and empower parents to be active in their children's education. The parents "just come in here and talk, and we talk about how to solve a problem...I have a good relationship with my parents."

Ms. Finley often "walk[ed] the neighborhood", taking time out in the evenings to visit with students and their families. She knew that this type of connection with the community was important, and she was able to weave the knowledge that she gained through these interactions into the mathematical content that was the basis for her lessons. One mathematics lesson that illustrated this integrated knowledge addressed the concept of greatest common factors. Ms. Finley gave an example in which students were expected to find a common factor for 2 and 4 in regards to $\frac{1}{4}$ and $\frac{1}{2}$. She asked students to explain the relationship between 2 and 4, eliciting ideas from students about fact families and multiples. Next, she described that these two numbers are indeed in the same family; 4 is the big brother and 2 is the little brother, and they are closely related—acknowledging the powerful notion of relationships among family members. She asked students "how do you know they are related?" Students were expected to respond in unison, "Because when you count by 2's you say 4."

Ms. Finley continued to tell a story about big brother and little brother. In one such story, she described big brother walking little brother home from school. Students got involved in the story, understanding that in their community, an older sibling is often responsible for the care of a younger sibling before and after school. She asked students "when you are walking down the street behind big brother and little brother, who do you

see first?” Students responded that you see big brother, because he is bigger in size and can protect little brother. She described that little brother could grow to be as big as big brother, but big brother could not shrink to little brother’s size. She tied this idea to the concept of finding a common factor for the denominators, showing that finding the greatest common factor is the simplest way to find this connection. After this initial explanation, Ms. Finley held up large laminated pieces of colored paper with similar examples and asked the students to find the common factors for each. Often, she incorporated some sort of rhythm into these practice sessions, requiring all students to respond in unison.

Communication

Ms. Finley’s involvement as a community member allowed her to successfully communicate with students. These communication techniques were woven throughout her pedagogical and disciplinary practices and ranged from specific teaching techniques to everyday ways of speaking. Ms. Finley’s explicit and intentional connection to student culture and language was essential in developing student self-esteem, as “language is one of the most intimate expressions of identity, indeed, ‘the skin that we speak,’ then to reject a person’s language can only feel as if we are rejecting him” (Delpit 2002, p. 47).

Ms. Finley incorporated music (in some instances, original tunes she had specifically created for the mathematics), movement, and rhythm into her teaching. Dance was used because “the kids love to dance...if you can put math into action they can retain the information just by doing, developing, and moving,” while music was an integral part of many lessons because students “look at BET [Black Entertainment Television] all the time...the music plays an important part with our kids so why not use it in math?”

Choral responses “like they are in church” were used for nearly every concept, and student involvement was demanded. Ms. Finley used her knowledge of students’ lives to deconstruct difficult mathematics concepts. When discussing the idea of least common multiple, for example, “we talk about numbers being in the same family...I always use family ties because the kids pick up on that.” Incorporating these culturally connected ways of knowing into mathematics lessons meant that Ms. Finley was explicitly drawing on students’ funds of knowledge.

Ms. Finley communicated high expectations continuously in verbal and non-verbal ways. She unambiguously and actively rejected the deficit model and insisted that

if you don’t expect the kids to do anything they’re not going to do it, but if you set your standards high and advocate [that] you’ve got to reach for this goal and understand that I’m up here for a reason. Because I want you to learn.

Ms. Finley recognized that “the kids have to be encouraged and taught in ways they understand.” When students did not meet these expectations, Ms. Finley used a very firm tone and powerful body language to express her displeasure. This warm demander pedagogy (Ware 2006) was a hallmark of Ms. Finley’s mathematics teaching. It was largely a matter of “understanding [a student’s] home life” and responding in congruent ways. In this community,

the majority of the parents do not say ‘Okay now I’m going give you one more turn or you’re going be in time out.’ Rather, the parent might say, ‘Johnny if you don’t go sit down, somewhere, you and I are gonna have it!’ It’s a cultural thing.

When used in the classroom, this style of communication provided cultural comfort for students and clearly indicated Ms. Finley's high expectations and determination for the students to succeed in mathematics.

Ms. Finley's classroom reflected this "cultural thing," and students were comfortable rising to the expectation. She focused her attention on students who needed to work on particular concepts, often calling on them to work problems on the board. She pushed students until they had clear understanding of mathematics. When students were learning about changing a mixed number to an improper fraction, for example, Ms. Finley had the class learn a particular strategy and work problems in unison. Given a mixed number on the board, such as $5\frac{1}{2}$, students chanted, "Five times two equals ten plus one equals eleven over two, eleven over two." She put up to 10 examples up at a time and had the class work through them in unison. Eventually, she put these examples to music and occasionally altered them or added to them.

There was often an individual component to these "performances," within which she pointed to a particular student, and he or she was expected to continue the song, working the problem individually. The whole class came in on the final repeat of the solution. During one of these sessions, Ms. Finley noticed a student, Alicia,² in the back of the class who was not singing aloud and appeared to be simply mouthing along with the rest of the class. Ms. Finley walked back to stand near the student. She described this instance stating that she "wasn't sure if Alicia was singing or not, and I always walk the room so [Alicia] didn't think anything of it. I heard that she wasn't really keeping up, though, and there is no excuse for that." Ms. Finley then moved on to the individual portion of the practice session and called on Alicia to perform. Alicia was clearly caught off guard and stammered through the problem, but was not as strong as the others had been. Rather than shrugging this off or coddling the student, Ms. Finley stopped the session and addressed the student individually. "Alicia, why are you not with us on this? We've been practicing for days, and you haven't asked a single question. Get with it girl!" Alicia was quiet and continued to minimally participate for the rest of the class period.

The following morning, the researcher found Alicia standing at the white board practicing the concept (changing a mixed number to an improper fraction) with Ms. Finley's help. They were chanting together, stopping only when the student had a quick conceptual question. Ms. Finley called on Alicia during another practice session, and she was able to quickly work the problem. Though there was still some hesitation in Alicia's voice, there was a vast improvement from the previous day, and clear satisfaction and enjoyment on her face. After the class was finished with the lesson, Ms. Finley said, "wooo Alicia! You my sista [sister] now! You got it, you got it!"

Relationships and trust

Ms. Finley's connections to the community created relationships that were essential to her practice (Ladson-Billings 1994), allowing her to maintain a highly structured, mathematically focused environment while facilitating student development and self-esteem (Foster 1987). Ms. Finley served as the catalyst through which mathematics was communicated, and she refused the status quo of instruction. As a warm demander, she told the students directly how much she cared, set high expectations for students (Ware 2006), and helped them to reach these goals. Ms. Finley communicated her deep care for students in tangible ways. For example, Ms. Finley noticed that a student had only one pair of old,

² A pseudonym has been used.

worn out shoes to wear to school. One morning, she asked the student to look in the front seat of her car, as there was a bag there for him. In that bag was a new pair of shoes. After that day, she did not speak of this incident again and was hesitant to discuss it with us. Similarly, Ms. Finley provided essentials such as snacks, basic school supplies, and other items of clothing for her students in need. For instance, Ms. Finley organized a fifth-grade graduation each year for which she sewed gowns for the girls. Further, she started the annual *Evening of Elegance* at the school, which was “like a prom for the fifth graders.” If a student were unable to purchase or borrow a formal gown or suit, Ms. Finley provided one for the student. She amassed a collection of donated and purchased formal clothing from which she could draw from for students in need of clothing.

This deep commitment to every aspect of students’ lives seemed to stem from Ms. Finley’s own previous socioeconomic struggles. She was able to connect to students as if “she was connecting to herself as a young girl,” a colleague once stated. This personal connection allowed Ms. Finley to demand that students do not use others’ perceptions of them as an excuse for failure. She told them directly “others might not think you can learn, but what you are doing right now shows me you can. It shows me you can learn.”

As a result, student empowerment, success in mathematics in later grades and beyond (as indicated by subsequent student interviews and test scores), and confidence in racial and cultural identity were common among her students. “I’m almost like their mama or grandmamma,” she would say, “we work together to raise them.” These relationships were supported by all of the outside commitments that Ms. Finley made to the children. She organized, practiced with, and traveled with the “Math Team”, a group of fifth-grade students who showed great commitment to learning mathematics and talent for showcasing their mathematics knowledge. She also wrote and directed the fifth-grade play each year, made the girls’ attire for the fifth-grade graduation ceremony, and worked to find free formal dresses for another annual fifth-grade event.

Constant reflection and revision

Ms. Finley constantly reflected, responded to students’ feedback, and revised her knowledge, communication styles, and relationships with students. This type of reflection and revision was deeply entrenched in everyday occurrences. Her reflective process intimately used all of the other cornerstones (Fig. 1) and connected them in indistinguishable ways. This process was vital to Ms. Finley, as “I get tired of the same thing over and over, so sometimes it’s time for me to change and get to something else.” For example, “we added a dance to the math rap...I’ve never done that before, but the dance really helps the kids.” As such, she was willing to learn and change her mathematics instruction.

Moment to moment revision happened in the course of teaching because “if I see that I’m having problems with the class, then I have to go back and do my lesson differently.” Noting students’ misunderstandings, Ms. Finley often changed her approach completely, saying “okay, let’s try this way, then this way until they get it...like when I use the music it really helps them because they hear it constantly [at home].” She asked students for new ways of explaining troubling mathematical concepts. She integrated their impromptu ideas into the lessons, revising the lessons based on students’ perception of the mathematical idea.

This constant revision occurred often. During one class period, Ms. Finley was going over the concept of data collection and representation. Though she had movements in place to show the students where various parts of the graph should go, she noticed that a small group of students in the back of the class had taken this strategy and refined it with more

words and a simple beat. She immediately called on them to share with the rest of the class what it was they were doing. The students modeled their technique, and with little hesitation Ms. Finley said, “I like that; everybody do it that way.” The small group was then invited to teach their method to the rest of the class until everyone felt comfortable. The class continued to use this student-created technique.

Ms. Finley also engaged in long-term reflection and revision. At the end of the day, she often debriefed with students, teacher aides, or researchers about the successes of the day. Frequently, when she observed that a mathematical concept was not making sense to students, Ms. Finley went back to students to gain new information about their lives, music, and interests so that she could build a mathematics lesson to which they could connect. She constantly communicated with students in this way because “a teacher’s got to learn from the kids. I don’t have any idea about what’s hip or what’s not hip, but the kids will tell you.” These practices informed her knowledge, communication patterns, and helped her to build trusting relationships, and in turn these foundational aspects of her mathematics instruction informed the reflection and revision process. As such, Ms. Finley constantly reflected on her beliefs about teaching and learning mathematics, observed her students to try to understand students’ thinking, and examined her own teaching practice (Goldsmith and Schifter 1997).

Cycle of pedagogy and discipline

Ms. Finley’s pedagogical actions were intertwined and upheld by her disciplinary actions to the extent that the impact upon students during each lesson appeared fluid and complementary. The cycle of instruction, assessment, and discipline occurred continuously and was clearly shaped by the cornerstones and supported and influenced by her craft of instruction, assessment, and discipline. The student was explicitly at the center of these practices and was therefore encompassed by Ms. Finley’s foundational beliefs and everyday practice. This piece of the model represents the most immediate, tangible experiences of the student in Ms. Finley’s classroom. Specific pedagogies relating to specific stories, chants, and rhythms were evident in this space. The cornerstones by which the student was constantly influenced shaped each of these decisions and enactments.

Pedagogies and disciplinary practices (i.e., teaching students to be disciplined learners of mathematics) vary widely from classroom to classroom; however, this immediate space in which the student learns is reflective of teacher beliefs and influences. Assuming that the foundational aspects of teacher practice are based in communication, knowledge, relationships, and reflections, these spaces are highly cultural and reflective of entrenched teacher beliefs. It is fundamental that teachers focus on these foundational cornerstones, which lie at the root of pedagogical decisions.

Conclusions and implications

The cornerstones of CRMT give some structure to the practices of a highly successful teacher of African–American students and exemplify the structure of the mathematics classroom. Knowledge, communication, relationships/trust, and constant reflection and revision guide the structure of the learning environment and interact in dynamic ways that contribute to student success.

The implications of this study of CRMT and the success of Ms. Finley impact many areas including classroom practice, teacher education programs, and future research in

mathematics education. Teachers of mathematics must continually reflect on the foundational beliefs that drive pedagogy while examining the ways in which they communicate with students, their knowledge of their students, and the relationships and trust with students and parents. Teachers who are equipped with knowledge about the teachers' students and the students' families can support teacher-to-student communication in mathematics. This knowledge will provide support for situating mathematics in real-life contexts that are meaningful to students. For students who have not previously obtained success in mathematics or for students who have not had high expectations placed on them for success in mathematics, it is imperative that the teacher of mathematics understands the power of strong and demanding, but caring discipline and classroom structure to propel children forward in their mathematics learning.

As models for prospective mathematics teachers, mathematics teacher educators should engage the CRMT cornerstones while encouraging such action among mathematics teacher candidates. In mathematics methods courses, successful, culturally responsive models should be revered and presented as the norm so that students from diverse backgrounds can access essential mathematical knowledge. Exposure to CRMT and the importance of CRT in general should be woven throughout teacher education programs to ready prospective teachers for being able to reach children where they are and to make children's mathematics learning experiences strong.

School administrators and policy makers can also draw from this work. These cornerstones can be used as an evaluative or reflective observation tool and may drive mathematics professional development efforts and curricular reform and development. The realization of these cornerstones as foundations of practice may serve to shift dominant ways of thinking about one-size fits all and scripted curricula and high-stakes assessment practices that do not take into account the localized cultural knowledge of students. Teacher candidates' perceptions about the CRMT cornerstones may inform those responsible for school hires about the candidates' potential to successfully and specifically engage all students in the mathematics classroom, particularly students who have been on a track of "tuning out" mathematics. Furthermore, it is important that teacher candidates recognize the importance of engaging the family in supporting students' mathematics learning. Too often, family members do not have positive perceptions about mathematics and hence shy away from the discipline, but like Ms. Finley, teachers must be prepared to combat this negative situation and develop a culture around mathematics that is inviting for students and their families.

There is not a single formula for or path to CRMT. Rather, the multidimensional nature of the foundational components of CRMT requires that it, and the teachers who enact it, are flexible and continuously evolving. CRMT will not look the same in every classroom, and the enactment of the framework may vary widely. Teachers should not aim to emulate Ms. Finley, as such actions would simply be another form of prescriptive teaching.

The development of a culturally responsive classroom involves a very personal commitment to the teaching and learning process. This theory is an initial attempt to inform educators how to become more culturally responsive in mathematics classrooms. Though the results obtained through this study cannot be generalized because of the unique nature of classroom practices and interactions, principles of mathematics teaching are informed by this work. In deconstructing techniques and practices of such teachers, the field of mathematics education can begin to take strides in providing an equitable, culturally responsive education across lines of diversity in classrooms.

Appendix 1

Interview protocols

The following interview protocols were guides for interviews that occurred while Ms. Finley was still alive and teaching. Interviews between her and the researcher were long and semi-structured, meaning that they often veered off of the course provided by the protocols. As such, many questions that came up during interviews and subsequently impacted the data are not included in the lists. The following questions are provided as samples, however, to give the reader an idea of how theoretical sampling was used in the interview process. The protocol for interview #1 was designed from questions generated by a few observations and literature. Each successive interview protocol was constructed subsequently from perceived holes in the data at the time of the interview. Here, the reader can follow the progression of questions that were generated in this manner.

Interview #1

1. Tell me about your background. What was school like for you? When did you decide that you wanted to be a teacher? Where and how were you prepared to become a teacher?
2. How would you describe your way of teaching? Have you always taught this way?
3. Does your role in the community influence your teaching? How do you use what you know about students in the course of teaching?
4. What types of teaching methods have given you the most success with this population? As a group, what do you feel it is that they need from a teacher?
5. How do you handle the various ability levels of children in your classroom?
6. Can you tell me about a student who is struggling or has struggled in your class? How did you handle it?
7. How do you handle discipline in your classroom? What do you consider to be misbehavior in the classroom?
8. What types of support (from administration, parents, etc.) are key to your success as a teacher?

Interview #2

1. Can you tell me more about the math team?
2. Tell me more about the Evening of Elegance and the 5th grade Graduation. How do rites of passage events like these benefit kids?
3. You talked about cultural influences during our last interview. How does being in your class help students develop racially?
4. When a student acts up in your class or doesn't participate, you sometimes take them out of the room, might have them call home, and always address them directly with a particular tone. Why does this work with this group of students?
5. You communicate with students in very specific ways. Can you talk about that?
6. You mentioned that as a product of this community, you understand where students are coming from. In what other ways does your background influence your teaching?

Interview #3

1. Last week a new student came into your classroom and was almost immediately sent out. Can you talk about why you handled the situation in this particular way?
2. You mentioned that you won't teach your children to act white. What did you mean by this? How does that relate to your students' racial identity development?
3. You have said several times that you believe that your teaching has an impact on generations and the entire community. How do you feel that the successes at East Elementary (pseudonym) have transformed the community?
4. What are the main outcomes of your teaching?
5. How can we better prepare teachers to work in schools like East Elementary (pseudonym)?

Appendix 2

See Table 1.

Table 1 Selective codes and cornerstones

Selective codes (major category)	Cornerstone
Mathematical expertise (classical knowledge)	Knowledge
Focus on [state standardized test] curriculum (classical knowledge)	Knowledge, R/T ^a , R/R ^b
Understanding of students/student behaviors (community knowledge)	Knowledge, communication, R/T, R/R
Instruction driven by student identities (community/critical knowledge)	Knowledge, communication, R/T, R/R
Involvement in community/neighborhood (community knowledge)	Knowledge, communication, R/T
Explicit attention to issues of (in)equity (critical knowledge)	Knowledge, R/T
Mathematical knowledge as tool for empowering students (classical/critical knowledge)	Knowledge, R/T, R/R
Focus on the arts as a medium for instruction (community knowledge, ways of knowing)	Knowledge, communication, R/R
Warm demander pedagogy (communication, relationships)	Communication, R/T
Culturally based language (community knowledge, communication)	Knowledge, communication
Student funds of knowledge (trust)	Communication, R/T, R/R
Rites of Passage (trust)	Relationships/R/T
Connecting concepts to culture/storytelling	Communication, R/R
Meeting student needs (trust, communication)	Communication, R/T

^a R/T stands for relationships/trust

^b R/R stands for constant reflection and revision

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