IT’S NOT MY PROBLEM:
A QUANTITATIVE EXAMINATION OF CULTURALLY RELEVANT WORD PROBLEMS IN FOURTH GRADE MATHEMATICS

by

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A Dissertation Submitted to the Faculty in the Curriculum and Instruction Program of Tift College of Education at Mercer University in Partial Fulfillment of the Requirements for the Degree

DOCTOR OF PHILOSOPHY

Atlanta, GA

2018
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DEDICATION

I dedicate this dissertation to my dad, Norris Tomlinson, Jr. Not only has he been my father, my mentor, and my provider, he has always been my “talk partner” in the world of education. I know he is looking down from heaven with a smile on his face as I celebrate this accomplishment. I miss you, Daddy!
ACKNOWLEDGMENTS

I would like to thank my husband, Van Twyman, for his love, sacrifice, and support during my journey in the Ph.D. program and for giving me encouragement to explore this journey in the later part of my educational career. Thanks also goes to my children, Chervell Twyman and Malcolm Twyman, for allowing me to join their world as a college student. I truly appreciate my mother, Rosa Tomlinson, for being a cheerleader by monitoring my weekly schedule to ensure that I attended all classes and completed all assignments on time. My sincere gratitude goes to my brother, Norris Tomlinson, III, for being my “editor before the editor” and for reading my dissertation when no one else desired to read the many pages that I had written for submission.

Special thanks to my dissertation chair, Dr. Wynnetta Scott-Simmons, for opening my eyes to the world of history in curriculum and instruction, even more specifically, culturally relevant pedagogy. Thank you for being a sister of support through the entire doctoral program. I would also like to thank Dr. Justus Randolph, my methodologist, and Dr. Jeffrey Hall, my content expert in mathematics. I truly appreciate the knowledge, guidance, and support from my committee members for sharing their true passion for life-long learning.

Additional thanks go to the members of Cohort 7, for embracing a team effort to explore this educational experience. I value the different talents and skills that each member shared with our cohort. I also could not have completed this journey without my
unofficial advisors, Kolt Bloxson and Anaya Bryson, for sharing their Ph.D. lessons learned experiences. My sincere appreciation goes to the Mercer Atlanta faculty for my transformative experiences in the field of educational research.
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ABSTRACT

IT’S NOT MY PROBLEM: CULTURALLY RELEVANT WORD PROBLEMS IN FOURTH GRADE MATHEMATICS
By CHERYL PETRICE TWYMAN
Under the direction of WYNNETTA SCOTT-SIMMONS, Ed.D.

This quasi-experiment using a pretest/posttest with control design with randomization investigated the effects of using culturally relevant word problems in fourth grade mathematics. Study participants were African American students who attended an elementary public school in a large urban Georgia school district. The student population consisted of 48% males and 52% girls, where 85% of the students participated in the free/reduced meal program. Through randomization, 42 students comprised the control group and 61 students comprised the experimental group. Initial pretest/posttest data results yielded a left range restriction and, as a result, the Star 360 assessment data were used for the multiple regression analysis. After six weeks of using culturally relevant word problems, the analysis indicated no statistically significant difference \( p = .10; \ B = -.20 \) with the treatment group. The examination of two additional variables, gender and participation in the free/reduced meal program, revealed a positive statistically significant difference \( p = .01; \ B = .31 \) for the females in the experimental group and a negative statistically significant difference \( p = .03; \ B = -.36 \) for all of the participants in the free/reduced meal program. Despite the study’s overall
large effect size \((R^2 = .66)\), various limitations warrant additional research on the topic of culturally relevant word problems in mathematics.
PROLOGUE

What happens to a dream deferred?
Does it dry up
Like a raisin in the sun?
Or fester like a sore –
And then run?
Does it stink like rotten meat?
Or crust and sugar over –
like a syrupy sweet?
Maybe it just sags
like a heavy load.
Or does it explode?

-Langston Hughes

The words crafted by Langston Hughes came at a time after the Great Depression, in Harlem, when African Americans were hopeful about the future. They had dreams of freedom, opportunity, equality, and empowerment. The design of the poem centers around rhetorical questions which asks about the status of the progression of the dreams. There is a level of frustration that is evident in the poem, because the dreams of the African American continue to be stagnant, to be put on hold, to be deferred. With the hopes of equality in education for all African American students, a dream is the metaphorical symbol for this study. The dream of academic success, cultural competency, and social consciousness for African American students may no longer be a dream deferred with the use of culturally relevant pedagogy in an educational setting.

*Brown versus the Board of Education of Topeka* is a landmark Supreme Court decision in which the justices unanimously ruled that segregation, based upon race, in the country’s public schools was unconstitutional. This ruling should have set the public
schools system on a pathway toward establishing a more equal and just educational system for the nation’s students. Instead, the educational possibilities and potentialities provided students of color have amounted to little more than a dream deferred.

Over five decades after the landmark ruling and even after the integration of students in the classroom setting, the educational needs of the minority population have not been met. In our current educational settings with diverse populations, African American students continue to search for their dream of academic success in the classroom. Those dreams are enlivened and move closer toward fulfillment when a teacher connects the curriculum with their pedagogical practices and then aligns that with the culture and lived experiences of their students.

What is the method of making dreams come true? Dreams can come true by meeting students where they are academically. A teacher who makes the learning relevant and meaningful could be a dream come true for many students. What is the possibility for such a dream to come true for all students? What is the impossible dream of effective teaching in mathematics classes for African American students in public schools? The method that may make the dream a reality is personalization of word problems, such as changing some of the words in mathematics word problems to words that are familiar to the students, thus increasing motivation and understanding by making a connection to students’ existing knowledge (Davis-Dorsey, Ross, & Morrison, 1991).

Dreams of academic success, cultural competence, and social consciousness are the foundations of Ladson-Billings’ (1994) book, *The Dream Keepers: Successful Teachers of African American Children*. Through a combination of qualitative research, storytelling, and lived experiences, Ladson-Billings (1994) examined eight teachers who
demonstrated best practices of keeping African American students highly engaged in the classroom for their dream of a quality education to become a reality. For students in the eight classrooms, dreams were a reality of educational success (Ladson-Billings, 1994). In the classrooms of the eight teachers, clear goals were established, and students knew the teachers’ expectations of them with their class assignments. There was a focus on teaching and learning. Students knew how they were progressing in the class, and teachers differentiated the lessons by scaffolding a reading assignment or simplifying a mathematics problem to meet the needs of the students who experienced challenges with learning the content. Additionally, in these eight classes, the teacher knew the importance of connecting with students’ culture and community and often would engage in activities outside of the classroom with their students by attending church or a football game. The teachers used culture as a foundation for learning by connecting with the prior knowledge of multicultural differences in the classroom by acknowledging various holidays or celebrations of different cultures.

At the heart and basis of Ladson-Billings’ research is an insistence on the use of culturally relevant pedagogical strategies by teachers who are tasked with educating students of color. She described this practice in a journal article from *Theory into Practice* (1995b) as “just good teaching” (Ladson-Billings, 1995, p. 159). Examining the effectiveness of the components of culturally relevant pedagogy, as mentioned in the characteristics of best practices found in these eight classrooms as described by Ladson-Billings (1995b), is the basis for the foundation of this study.

Other theorists have also examined culturally relevant pedagogy. Brenner (1998), examined how mathematical knowledge was developed through everyday life
experiences of Native Hawaiian children. Moses-Snipes (2005) investigated the extent of importance of connecting a student’s culture to the content being taught in the classroom to improve mathematics achievement. Methods used in the study included ethnomathematics and multicultural activities. Additionally, May (2011) examined how comprehension strategies could be aligned more closely to students’ learning goals when using culturally relevant pedagogy. Different researchers have explored the theory of culturally relevant pedagogy; however, Ladson-Billings (1995b) sets the theoretical framework for this study.

Inspired by the work of Ladson-Billings (1995b), this study examines the practice of using culturally relevant pedagogical practices to increase student engagement and achievement in mathematics for fourth grade students. In particular, this study infuses culture into the daily word problems in mathematics. The goal is to examine whether an additional characteristic (culturally framed word problems) included in the curriculum of elementary African American students serves as hope to making their dreams of educational access and achievement a reality.

Different from the work of Ladson-Billings (1994), this study did not investigate culturally relevant pedagogy in a qualitative method, but instead utilized a quantitative method consisting of a quasi-experimental pretest and posttest design. For six weeks, students in the control group received the typical textbook word problems during their problem-solving portion of mathematics instruction. The students in the experimental group received culturally relevant word problems during the problem-solving portion of their mathematics instruction. After taking the pretest and receiving six weeks of treatment for the experimental group, all students completed a posttest. Since this is a
quantitative study, I only looked for a significant difference as measured by statistical analysis; however, the study yielded additional positive outcomes outside the measurable scope of statistics for African American students. Based on anecdotal notes, students were motivated and engaged in the culturally relevant word problems, when they saw their name or the names of familiar people, places, or things.

Part of the process of creating culturally relevant word problems is to include people, places, or things familiar to the students. Perhaps a student seeing his or her name written in a word problem about a grocery store in his or her neighborhood may be able to add fragrance to the smell of the rotten meat of stale and irrelevant word problems written in textbooks. It may lighten the heavy load of completing dull and boring worksheets of word problems when a child sees a toy or a game in a mathematics word problem that he can relate to and understand. When the context in a word problem and not the mathematical content is changed, the children do not have to defer from their dreams and wait on word problems that include their experiences, for it becomes their mathematical word problem created by their reality.

The aim of this study is to inspire other educators to make learning fun, challenging, and relevant to their students’ life experiences. I want educators to connect the daily lessons to real life examples that students can relate to and understand. Furthermore, I want educators to build a bridge, so students can make a connection between classroom learning and learning outside of the classroom. Ultimately, to make the students’ dreams come into fruition, I want the mathematics word problems to be their problem!
CHAPTER 1

INTRODUCTION TO THE STUDY

In the book, *The Dreamkeepers: Successful Teachers of African American Children*, Ladson-Billings (1994) discussed the use of culturally relevant pedagogy, the teaching methods of mathematics and literacy, and social interactions in the classroom. Ladson-Billings (1995a, 1995b) examined the influence of culturally relevant teaching and teacher education in general, keeping the dream alive and well for students to make connections to their culture, their experiences, and their academic success in the classroom. Ladson-Billings was not the first African American woman to explore the concept of culturally relevant teaching. She joined her colleague, Geneva Gay (1994), to investigate multicultural education with diverse populations specifically.

From Gay’s (1994) initial theoretical framework of examining multicultural education, Ladson-Billings (1995b) further developed the components of culturally relevant pedagogy to explore the possibility of creating something that might be the reality for African American students because of the changing demographics of the students in the nation’s public school systems after the Civil Rights Movement. Almost 50 years later, in 2017, the theory of culturally relevant pedagogy is still applicable for educators and current writers of curriculum and instruction and subject to consideration as an example of the learning theory of progressivism (Dee & Penner, 2017).
The history of the Progressive Movement dates to the 17th century. The philosophy of progressivism supports students’ need to receive opportunities to explore mathematical problems for which there are multiple paths to determine the solution (Battey, 2013; Brown-Jeffy, 2009). Progressivists believe that education should focus on the whole child, rather than on the content or the teacher (Chapman, 2008; Hubert, 2013). This educational philosophy stresses that students should test ideas through active experimentation (Gutek, 2011). Learning is rooted in the questions of learners that arise through experiencing the world (May, 2011). It is necessary to expose students to word problems where they use the problem-solving model of Polya: understand the problem, devise a plan, carry out the plan, and look back to check (Jones, 2015; Polya, 1945; Wilburne, 2006).

When teachers select word problems for students to solve, they should carefully consider the content that the students are currently studying (McKinney & Frazier, 2008) and provide opportunities for students to discuss their process for arriving at an answer with their classmates (Leonard & Guha, 2002). They should have an opportunity to reflect on the solution. Students need to be able to make the connection to their culture and the mathematical experiences (Leonard & Guha, 2002; Moses-Snipes, 2005; Wilburne, 2006).

Since the release of *Principles and Standards for School Mathematics* (PSSM) by the National Council of Teachers of Mathematics ([NCTM], 2000), efforts to enhance the teaching and learning of mathematics have increased. The document presents fundamental principles that are essential for creating learning communities in
mathematics classrooms, such as problem solving, reasoning, and conceptual understanding (NCTM, 2000). The PSSM offers recommendations for teachers to create classrooms where students can make connections from their prior experiences and connect them with new learning experiences (McKinney, Chappell, Berry, & Hickman, 2009). Since problem solving is an essential component of best teaching practices in mathematics classrooms, it is necessary to explore different instructional practices to meet the need of all students, specifically underserved African American students in public schools (Aguirre & Zavala, 2013; Chambers, 2009; Ukpokodu, 2011).

Current research suggests implications necessary to address in the content area of mathematics. This is particularly true for urban and low-income students because of school policies, curriculum guides, and teaching practices (Sheppard, 2011; Stinson, 2008; Woodward & Brown, 2006). Examples of inhibitive school polices are required seat hours for every student to graduate, no flexibility with class schedules, and limited number of vocational opportunities for students. Curriculum guides limit culturally relevant teaching in the form of pacing charts and a scope and sequence guide. Finally, teaching practices such as skill-and-drill worksheets, low-level questioning, and stoic lectures fail to engage students due to their cultural disconnect—a disconnect of culture and learning that leaves African American students in mathematics classrooms at a disadvantage.

Because of awareness of the need to address the relationship of students’ culture and learning, NCTM (2000) has developed standards that include teachers’ understanding of the influence of students’ cultural linguistic, ethnic, racial, gender, and socioeconomic
background on their learning of mathematics (McKinney et al., 2009). Herron and Barta (2009) examined the influence of culturally relevant pedagogy with the integration of problem solving, one of the main components of the NCTM standards and discovered that culturally relevant problem solving was beneficial to the students in the study.

Problem solving, considered a foundation of mathematics education, has been a major focus for years (NCTM, 1989, 2000). The publication of the NCTM standards, which include a component of culture and learning, provide teachers with a guideline to follow, as well as different teaching strategies to consider when teaching problem solving (Herron & Barta, 2009).

The NCTM (2000) standards also recommend pedagogical practices such as cooperative learning groups and inquiry-based learning—both components of culturally responsive teaching (Bonner & Adams, 2012; Chambers, 2009; Chapman, 2008). Focus on the use of methods to engage students, such as culturally relevant pedagogy, better equips students to increase their academic achievement on a national level (Chapman, 2008; Jones, 2015; Ukpokodu, 2011). In 1982, Bob Moses created the Algebra Project as part of his proposal of facilitating student connections with the basic content knowledge of mathematics, such as algebra, to give them the tools to solve more complex mathematics problems in higher-level mathematics classes (Moses & Cobb, 2001).

One of the challenges of today’s classrooms is that teachers do not use culturally relevant instruction to teach students new mathematical concepts, particularly for the underserved populations in public schools (Herron & Barta, 2009; Jones, 2015; Ukpokodu, 2011). Too often students are given word problems on mathematics
achievement tests with scenarios of people, places, and things that students simply fail to connect to their own environment (Herron & Barta, 2009; Jones, 2015; Lipka & Adams, 2004). For example, a math question from a typical mathematics test may read: The queen of England had five sugar cubes in her teacup before pouring tea. She decided to remove three sugar cubes. How many sugar cubes are there left in the teacup? A kindergarten student in an urban inner-city school most likely will have no point of reference of sugar cubes and teacups (Gay, 2000; Ladson-Billings, 2014). However, changing the wording of the mathematics problem to assess the same math skill of subtraction might allow the inner-city student to make a real-life connection (Gustein, Lipman, Hernandez, & de los Reyes, 1997; Herron & Barta, 2009; Lipka & Adams, 2004). The revised question may read: Ms. Jones took five of her students to the playground for recess. Three students ran back inside to get their snack. How many students remained outside on the playground with Ms. Jones? By changing the words of the mathematics story problem, by using a familiar person, familiar location, and an object relevant to the students, the mathematical concept of subtraction is now more accessible for the student to make the connection (Gustein et al., 1997; Herron & Barta, 2009; Lipka & Adams, 2004). Such a connection extends itself to allow the students to learn additional abstract and more complex concepts of mathematics (Herron & Barta, 2009; Ladson-Billings, 2014).

Students typically learn information that is most meaningful to them, where they can make the connection with their experiences and prior learning to the new learning introduced by the teacher in the classroom (Hubert, 2013). Culturally relevant teachers
use students’ culture as a connection for learning (Milner, 2011). As stated previously with the example of the mathematics story problem, students are willing to learn new mathematical concepts when put in the context of familiar people, places, and things (Herron & Barta, 2009; Ladson-Billings, 2014). Ladson-Billings (1995b) explained that the purpose behind culturally relevant pedagogy is to focus on the methods used to engage African American students in learning. The foundation of culturally relevant teaching is evident when the emphasis is on student learning, cultural experiences, social awareness, and academic achievement, as opposed to classroom management, low academic expectations, and the completion of stale, irrelevant assigned tasks (McKinney et al., 2009). Students begin to take ownership of their learning and develop an interest in education beyond the school (Ladson-Billings, 1995b, 2014; McKinney et al., 2009).

Many of the components of culturally relevant teaching may address the needs of both the teachers and the students (Leonard, Napp, & Adeleke, 2009). Students learn because they are motivated and able to make the connection with what they are learning in their classes to real-life experiences (Lattimore, 2005). Teachers also make a conscious effort to make cultural connections with their students (Debnam, Pas, Bottiani, Cash, & Bradshaw, 2015). Ladson-Billings (2014) explained that one of the components behind culturally relevant pedagogy is to focus on the methods used to engage African American students in learning for them to obtain high levels of academic success. That engagement of African American students in learning mathematics is the reason for the examination of culturally relevant problem solving in fourth grade students’ ability to solve word problems effectively.
Statement of the Problem

Limited research examines the effect of culturally relevant mathematics word problems in elementary classrooms. Likpa and Adams (2004) conducted a quasi-experimental design to examine the effectiveness of indigenous mathematics teaching and culturally relevant pedagogy in the mathematics curriculum for second grade students. The efforts of Likpa and Adams (2004) to create a pedagogy based on Yupik culture assisted Alaska Native students to gain greater understanding of mathematics content. Additionally, McGee (2011) conducted a phenomenological qualitative study to examine the life stories and experiences of high-achieving mathematics and engineering Black students in college. The study examined personal accounts of how these Black students could demonstrate high levels of performance in the content area of science and mathematics (McGee, 2011).

Studies such as those conducted by Brenner (1998), Gustein and colleagues (1997), Leonard and Guha (2002), and Moses-Snipes (2005) have examined culturally relevant pedagogy from a qualitative approach with a focus on various multicultural groups. Additionally, Herron and Barta (2009) conducted a quantitative study focused on culturally relevant word problems in a second grade mathematics class based on the ethnicity of the students with two categories: Caucasian or non-Caucasian. This quantitative study focused solely on African American students’ ability to accurately solve mathematic word problems in an elementary classroom setting when using culturally relevant word problems, while also considering the factors of gender and participation in the free/reduced meals program.
The lack of available research addressing the use of a quasi-experimental design of pretest/posttest, while controlling for gender and participation in free/reduced meals program for African American students culturally relevant word problems in elementary mathematics classrooms indicates a need to investigate the effects of culturally relevant word problems on students’ ability to solve word problems. According to the NCTM (2000) standards of mathematical practices, students in elementary school are required to solve word problems in mathematics class. Teachers typically use textbook word problems to teach new mathematic skills for problem solving (Dee & Penner, 2017; Herron & Barta, 2009). Frequently, students receive word problems referencing contexts or objects outside of their basic knowledge or experience (Gellert, 2013). This dilemma occurs most often for underserved populations in public schools, specifically African Americans (Keck-Staley, 2010; McKinney et al., 2009; Moses-Snipes, 2005).

Purpose of the Study

Although the PSSM (NCTM, 2000) offers a framework for mathematics education for the 20th century, traditional methods of teaching, such as abstract algorithms and step-by-step procedures, continue to be used in mathematics classrooms. Teaching mathematical procedures receives heavy emphasis, whereas the focus on students’ conceptual understanding is lacking (NCTM, 2000). Using alternative approaches to teaching mathematics, such as including cultural relevance in the context of the mathematics content, is one method by which students can apply mathematical knowledge to real-life situations outside of the classroom and deepen their understanding by using prior knowledge (Chapman, 2008; Ukpokodu, 2011). Pedagogical practices
should be engaging, inquiry based, and include mathematics learning from diverse student populations (McKinney & Frazier, 2008).

Ladson-Billings (1995b) extended the theory of culturally relevant pedagogy (CRP) after she studied successful teachers of African American students. She combined the feedback of the students attending the classes of the successful teachers and the common traits of the effective teachers. The qualitative approach of her work was not to give a comprehensive list of teaching strategies for educators, but to offer common characteristics and approaches to teaching for other educators to explore in their classrooms, which have yielded success, not only for African American students, but also for all students (Ladson-Billings, 2009). The theory of culturally relevant pedagogy has limited exploration in mathematics classrooms for African American students.

The purpose of this “untreated control group design study with dependent pre-test and post-test samples” (Shadish, Cook, & Campbell, 2002, p. 136) was to determine if a significant difference exists in fourth grade students’ ability to solve mathematics word problems accurately when using culturally relevant word problems, as compared to traditional textbook word problems, while controlling for gender and eligibility to receive free/reduced lunch. I selected the fourth grade level for this study because of the ability to examine student achievement not only on a local level, but also at a national level. The National Assessment of Educational Progress (NAEP) administers assessment to students in the fourth grade in the content area of mathematics. Annually, NAEP conducts an analysis, which involves aggregation of data to examine the progress of each subgroup. One group is African American students, which receives consistent reports
and attention in regards to its achievement gap when compared to the performance of White students (McKinney et al., 2009). Fourth grade students are at a level in elementary school where teachers reinforce numerous mathematical foundations of concepts prior to the introduction to algebra concepts (NCTM, 2000). Therefore, it is critical to examine fourth grade students’ mathematical ability as a prerequisite for successful achievement of the content taught in prealgebra and algebra classes (Enyedy & Mukhopadhyay, 2007; Moses & Cobb, 2001; Ukpokodu, 2011).

The purpose of this quasi-experimental study was to conduct a pretest/posttest with control group design to examine the effect (if any) that culturally relevant word problems have on fourth grade students’ ability to solve mathematics word problems accurately. This study was designed to examine the effects of culturally relevant word problems on fourth grade students’ ability to accurately solve word problems. For a six-week timeframe, for five days of each week, for 10 to 15 minutes each day, the control group was exposed to textbook word problems, while the experimental group was exposed to culturally relevant word problems. Providing opportunities for students to solve culturally relevant word problems may equip them to not only solve word problems better, but also solve more complex and abstract mathematics problems.

Research Question

To address the need to of examining fourth grade students’ mathematical ability at the elementary school level, the research question for this study was as follows: To what degree do culturally relevant word problems, compared to traditional textbook word
problems, affect fourth grade students’ ability to accurately solve word problems, when controlling for gender and eligibility to receive free/reduced lunch?

Theoretical Framework

Constructivism theory suggests that learning occurs in the context and experiences of the learners’ situation and experiences (Gutek, 2011; Ornstein & Hunkins, 2013). The five main principles of constructivist teaching include: (a) valuing students’ point of views, (b) challenging students’ thinking, (c) posing relevant problems to students, (d) structuring lessons around the big ideas, and (e) using formative assessments (Brooks & Brooks, 2001). The constructivism theory involves the premise that new knowledge leads to growth and development with a focus on active and interesting learning (Brenner, 1998; Gutek, 2011; Ornstein & Hunkins, 2013). In a classroom where constructivist practices are evident, the teacher takes on the role of facilitator and guides students through problem solving and scientific inquiry (Schettino, 2016). The curriculum, based on the students’ interests, is relevant to their everyday lives (Milner, 2016). When examining key descriptive words of constructivism, such as student interests, problem solving, relevant problems, challenging thinking, and everyday situations, the words appear to run parallel with descriptive words of the theory of culturally relevant pedagogy: student experiences, understanding of culture, and questioning the circumstances of their environment. Culturally relevant pedagogy lends itself to the theoretical framework of constructivism because of the connection of the learning and the students’ lived experiences (Berry, Ellis, & Hughes, 2013; Brenner, 1998).
Concepts become meaningful to the students when their daily experiences can connect with their daily learning experiences (Schunk, 2012). Numerous qualitative and quantitative studies involving African American students indicate that African American students learn best in an environment that offers high expectations, relationship with the teacher, and connections to new concepts (Ladson-Billings, 1994, 2001, 2010; Perry & Delpit, 1998; Willis, 2003). Irvine (1989) wrote about the lack of the connection of cultural awareness between teachers and African American students and its negative influence on student achievement. Eleven years later, Irvine and Armento (2001) indicated that the use of student-centered curriculum that develops critical problem-solving skills and focuses on community awareness of the students positively impacts student achievement. Between the timeline of Irvine’s studies, Ladson-Billings (1994) conducted her own qualitative study of culturally relevant teaching and its impact on students’ academic success.

Following her study of teachers who successfully taught African American students, Ladson-Billings (1995) elaborated upon Gay’s (1994) theory of culturally relevant pedagogy (CRP) by utilizing student feedback and common characteristics among the successful teachers (Jett, Stinson, & Williams, 2015). She explained that culturally relevant pedagogy contains three criteria: (a) students must have experiences and opportunities of academic success, (b) students must have a sense or understanding of their own culture, and (c) students must question the status quo of their environment (Ladson-Billings, 1995a). The first two criteria are the premise for this research that
sought to examine the academic and content exposure of culturally relevant pedagogy and the impact of culturally relevant word problems in mathematics instruction.

Limitations

The following is a list of the limitations of this study:

- The study was limited to collecting data from one grade level at one school.
- The study was limited to a school where 98% of the students were African American, and 100% of the participants were African American.
- The study was limited with randomization. However, a pretest was administered to verify that the experimental and control group were not significantly different. This limitation was also addressed by examining the prior mathematic performance on a universal screener, Star 360 mathematics.
- Even though all teachers used the same problem-solving instructional methods with different word problems, the number of years of teaching experience may have impacted the outcome of student performance on the posttest.
- Socioeconomic status was based solely on the participants’ inclusion in the free/reduced meals program based on the students’ annual family income of federal income poverty guidelines.

Assumptions

I made the following assumptions in this study:

- The students who participated in the study were exposed to the same learning experiences from a certified teacher.
• The students answered all questions from the pretest and posttest without any assistance from their teacher.

Significance of the Study

The examination of culturally relevant problem solving in fourth grade students’ ability to solve word problems effectively provides additional research to the conceptual framework of culturally relevant pedagogy. Unlike other studies, such as those conducted by Herron and Barta (2009), Young (2010), and Wiggan and Watson (2016), the results from this quasi-experimental research design study can provide educators with more information about instructional strategies that may be used in mathematics classrooms at the elementary level for African American students. Additionally, students may be able to build on their prior knowledge of problem solving strategies to enhance their ability to solve more complex and abstract mathematics problems.

Definition of Key Terms

Problem solving has multiple meanings, but for this study, problem solving serves as a context of exploring mathematical ideas and procedures to find a solution (NCTM, 2000).

Word problems are tools in the process of problem solving. Word problems are mathematic experiences in written form where there is one solution. However, multiple methods or strategies can be used to find the solution (Ali, Hukamdad, Akhter, & Khan, 2010).
Culturally relevant word problems are mathematical word problems that include experiences, people, and places that are familiar and relevant to the culture of the students (Ladson-Billings, 1995b).

Underserved population is an offering of inadequate education to a group based on race and/or socioeconomic status (Ukpokodu, 2011).

Summary

Factors that contribute to the underperformance of African American students in mathematics provided the impetus for this study. Students are too often given mathematical word problems during their instructional time that include situations in which they have no point of reference because of their limited experiences. To meet students where they are academically, African American students should receive opportunities in their mathematics classes to experience word problems that include familiar people, places, and things in their environment (Herron & Barta, 2009). Originating with the work of Gay (1994) and further developed by Ladson-Billings (1995), the components of culturally relevant pedagogy have been researched and studies have been conducted to examine the degree of impact, if any, that it has on student achievement, specifically for groups of people who are non-Caucasian (Herron & Barta, 2009). Although some research addresses culturally relevant mathematics problem solving to improve student achievement, such as Lipka and Adams (2004), Brown-Jeffy (2009), and Aguirre and Zavala (2013), instances are few, thus warranting the conducting of more research.
Furthermore, this quantitative study is essential because additional studies are necessary for African American students and their academic success in the content of mathematics. All participants in this study were African American fourth grade students. Control variables included the gender of the participants and their participation in the free/reduced lunch program at school.

This study unfolds in the following manner. Chapter 2 provides a context of the theoretical framework and a review of literature that includes studies involving culturally relevant pedagogy; mathematics instruction and African American students; teacher and student perspectives of culturally relevant pedagogy; and counternarratives of culturally relevant pedagogy. Chapter 3 offers an explanation and rationale of the methodology used to investigate to what degree culturally relevant mathematical word problems have on students’ ability to solve the problems accurately. Chapter 4 provides a discussion of the results of the quasi-experimental pretest/posttest design. Finally, Chapter 5 addresses the implications and significance of the results to include the degree of impact associated with the use of culturally relevant word problems in mathematics.
CHAPTER 2
DREAMING THE BACKGROUND

Students in elementary and middle school are required to learn specific mathematical skills and knowledge to be successful mathematics students in high school (National Council for Teachers of Mathematics [NCTM], 2000; Wiggan & Watson, 2016). One of the problems of current mathematics classrooms is that teachers do not use culturally relevant instruction to teach new mathematical concepts to students, particularly the underserved populations in public schools, specifically African Americans (Sheppard, 2009, 2011; Villegas, Strom, & Lucas, 2012). This review of literature examines culturally relevant teaching in mathematics classes; culturally relevant pedagogy in relation to following the NCTM’s (2000) Principles and Standards for School Mathematics (PSSM) to influence student achievement, and the influence of culturally relevant teaching on African American students in mathematics classes.

Frequently, minority students are not aware of the mathematics that has developed from their own culture (Jett, Stinson, & Williams, 2015). McKinney and Frazier (2008) posited that it is possible that minority students do not see or receive information about mathematics success for people in their own culture; therefore, the students do not see people in their culture as doers of mathematics (Battey, 2013; McGee & Martin, 2011). Too often research focuses on minority students and their lack of progress in the content area of mathematics (Stinson, 2008). The annual administration of the National
Assessment of Educational Progress (NAEP) yields data to examine the progress of each subgroup. Most researchers seek to explore reasons why the achievement gap exists between the African American and White students; however, for this study, I explored culturally relevant pedagogy as a solution to one of the causes of the achievement gap (Brown-Jeffy, 2009; Chambers, 2009). Rather than only focusing on the achievement gap, perhaps research should investigate the gap in the opportunities for all students to learn mathematics that is relevant to their identities and communities (Enyedy & Mukhopadhyay, 2007; Henfield & Washington, 2012). Scott-Simmons (2007) maintained that the concepts for culturally relevant pedagogy are the joint responsibility of self and the community.

Mathematics success should be obtainable to all students (Jett, 2013). Solving mathematics problems is not only the goal of learning mathematics, it is also the process needed to obtain new skills and knowledge (Chard, Baker, Clarke, Jungjohann, Davis, & Smolkowski, 2008). Students learn to reflect on their thinking during the problem-solving process and to use the strategies to solve other problems in different contexts (Throndsen & Turmo, 2013; Villasenor & Kepner, 1993). According to NCTM (2000), students solve mathematical problems by acquiring ways to think, developing habits of persistence and curiosity, and gaining confidence in understanding unfamiliar situations that may occur outside of the mathematics classroom. Culturally relevant teaching is a method of teaching that allows students to connect the concepts they are learning in class to real life experiences (Lattimore, 2005; McKinney et al., 2009; Sheppard, 2011).
Review of Related Literature

The literature review of a dissertation is a key component in a research study. The purpose of the review of literature is to demonstrate the researcher’s knowledge about the subject under study. Additionally, the literature review allows the researcher to: (a) gain new insights about the topic, (b) establish context for the study, (c) avoid making unsuccessful inquiries, (d) make recommendations for further studies, and ultimately, (e) answer the research question of the study (Randolph, 2009). There is a process for including or excluding articles relevant to the research of the study. The most common type of literature review is a meta-analytic review, in which the researcher collects, codes, synthesizes, and examines the outcomes of studies in published articles. The review of literature allows the researcher the opportunity to add to the body of established research without duplicating previously conducted research (Randolph, 2009).

Search Strategy

To begin the process of research for this study, I conducted searches using the following terms: mathematics achievement, achievement gap, culturally relevant pedagogy, culturally responsive teaching, mathematics and African American students, problem solving in mathematics, and culturally relevant mathematics. I chose only peer-reviewed articles of studies utilizing specific methodology and published between the years of 2002-2017 because it was important to find research that was current and relevant to the instructional practices of the classroom (Creswell, 2015). I experienced uncertainty regarding which component of research to expand upon until reading the
article, *But That’s Just Good Teaching* (Ladson-Billings, 1995a). Culturally relevant pedagogy, as defined by Ladson-Billings (1995), included components of making connections to real-life experiences and the content taught in the classroom. After realizing there was terminology for such a connection to students, the research began.

The search for additional articles continued with limiting the database search to key terms, such as *culturally relevant pedagogy AND mathematics AND African American students*. Later in the search, articles that focused on the terms *gender and mathematics achievement*, *social economic status and mathematics achievement*, and *culturally relevant word problems in mathematics* were used. For the purposes of this study, I included the components of gender and social economic status because previous studies, such as Enyedy and Mukhopahyay (2007), Hubert (2013), and Bonner and Adams (2012), failed to make a direct correlation with mathematical achievement using a quantitative method.

During the initial search using key terms, over 25,000 articles surfaced; however, once the criteria for inclusion was determined, approximately 85 articles were relevant resources for research in this study. To expand the review of literature, I also utilized books with topics of culturally relevant pedagogy, mathematics, and African American students. Table 1 provides examples of the key studies that surfaced during the search for peer-viewed articles.
Table 1

*Search Strategy*

<table>
<thead>
<tr>
<th>Key Term</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culturally Relevant Pedagogy</td>
<td>Aguirre &amp; Zavala, 2013</td>
</tr>
<tr>
<td></td>
<td>Enyedy &amp; Mukhopadhyay, 2007</td>
</tr>
<tr>
<td></td>
<td>Ladson-Billings, 1995, 2014</td>
</tr>
<tr>
<td></td>
<td>Milner, 2011</td>
</tr>
<tr>
<td></td>
<td>Ukpokodu, 2011</td>
</tr>
<tr>
<td>Mathematics Achievement &amp; African American Students</td>
<td>May, 2011</td>
</tr>
<tr>
<td></td>
<td>McKinney, Chappell, Berry, &amp; Hickman, 2009</td>
</tr>
<tr>
<td></td>
<td>Walker, 2006</td>
</tr>
<tr>
<td></td>
<td>Wiggan &amp; Watson, 2016</td>
</tr>
<tr>
<td>Problem Solving</td>
<td>Ali, Hukamdad, Akhter, &amp; Khan, 2010</td>
</tr>
<tr>
<td></td>
<td>Jitendra et al., 2005</td>
</tr>
<tr>
<td></td>
<td>Schettino, 2016</td>
</tr>
<tr>
<td>Mathematics Instruction</td>
<td>Battey, 2013</td>
</tr>
<tr>
<td></td>
<td>Bonner, 2014</td>
</tr>
<tr>
<td></td>
<td>Jones, 2015</td>
</tr>
<tr>
<td>Counternarratives</td>
<td>Berry, Thunder, &amp; McClain, 2011</td>
</tr>
<tr>
<td>Opposing Views</td>
<td>Stinson, 2008</td>
</tr>
<tr>
<td></td>
<td>Sleeter, 2012</td>
</tr>
<tr>
<td></td>
<td>Paris, 2012</td>
</tr>
<tr>
<td></td>
<td>Planas, 2015</td>
</tr>
<tr>
<td>Achievement Gap</td>
<td>Chambers, 2009</td>
</tr>
<tr>
<td></td>
<td>Sheppard, 2011</td>
</tr>
<tr>
<td></td>
<td>Villegas, Strom, &amp; Lucas, 2012</td>
</tr>
<tr>
<td>Gender &amp; Socioeconomic Status</td>
<td>Chambers, Walpole, &amp; Outlaw, 2016</td>
</tr>
<tr>
<td></td>
<td>Ellington &amp; Frederick, 2010</td>
</tr>
<tr>
<td></td>
<td>Gentle-Genitty, 2009;</td>
</tr>
<tr>
<td></td>
<td>Kloosterman, Tassell, &amp; Ponniah, 2008</td>
</tr>
<tr>
<td></td>
<td>Sheppard, 2009</td>
</tr>
</tbody>
</table>
Initially, research articles were selected with the topic of best practices in mathematics, problem solving in mathematics, culturally relevant pedagogy, culturally responsive teaching in mathematics, and African American students and success in mathematics classes. During the search, additional articles surfaced that involved the topic of counternarratives of African American students with success in mathematics.

With student achievement being the focus of educational reform, I narrowed the review of literature to include three variables of interest: African American students, gender, and socioeconomic status—all centered on culturally relevant pedagogy. Table 2 is an illustration of key empirical studies for this study. Subsequent sections of this chapter offer discussions of these studies.

Table 2

_Empirical Studies_

<table>
<thead>
<tr>
<th>Study</th>
<th>Units &amp; Settings</th>
<th>Design</th>
<th>Treatment &amp; Outcome</th>
<th>Control Variables</th>
<th>Findings</th>
<th>Limitations &amp; Future Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enyedy &amp; Mukhopadhyay 2007</td>
<td>25 high school students from 6 different schools</td>
<td>mixed-method; pretest/posttest/videos/interviews</td>
<td>T: GIS tool for solving statistic problems O: test scores</td>
<td>same tool used for all presentations of statistic problems.</td>
<td>The tool did not matter as much as the relevant content of the statistic problems. Small group of high school students in a summer program; future study could involve PD for teachers. Only one grade level in one school; future study could be conducted for a longer time.</td>
<td></td>
</tr>
<tr>
<td>Leonard, Napp, &amp; Adeleke 2009</td>
<td>9th &amp; 10th grade ESOL students</td>
<td>case study; ethnography</td>
<td>N/A</td>
<td>none</td>
<td>Teacher belief, rigor of content, &amp; student interest were all factors of</td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>Units &amp; Settings</td>
<td>Design</td>
<td>Treatment &amp; Outcome</td>
<td>Control Variables</td>
<td>Findings</td>
<td>Limitations &amp; Future Research</td>
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</tr>
<tr>
<td>Hubert 2013</td>
<td>5 African American students</td>
<td>case study; interviews</td>
<td>N/A</td>
<td>none</td>
<td>Positive student perception of CRP; increased interest in math</td>
<td>5 AA students; future study could involve PD for teachers.</td>
</tr>
<tr>
<td>Leonard &amp; Guha 2002</td>
<td>2nd, 3rd, 4th, &amp; 5th grade students in Philadelphia</td>
<td>case study</td>
<td>N/A</td>
<td>none</td>
<td>New discourse of knowing and doing math</td>
<td>Students in one neighborhood at a science/math program; future study could allow for extra time.</td>
</tr>
<tr>
<td>Ukpokodu 2011</td>
<td>45 preservice teachers enrolled in the researcher’s graduate course</td>
<td>qualitative study; teacher inquiry</td>
<td>N/A</td>
<td>none</td>
<td>CRP should be included in math lessons.</td>
<td>limited to researcher’s course; future research involve teacher reflection of existing practices. One unique experience; future study involve additional participants with similar attributes of effective teaching.</td>
</tr>
<tr>
<td>Bonner &amp; Adams 2012</td>
<td>One African American woman, age 58</td>
<td>grounded theory; observations/interviews</td>
<td>N/A</td>
<td>none</td>
<td>CRP is not the only factor for effective teaching.</td>
<td></td>
</tr>
</tbody>
</table>
Hernandez & de los Reyes 1997
Mexican Americans: 8 math teachers, 5 bilingual teachers, & principal
qualitative ethnographic data; observations / interviews
N/A none
Similar teaching strategies effective; CRP was not only factor
One school in an urban district; future study may involve additional students

Table 2 (continued)

<table>
<thead>
<tr>
<th>Study</th>
<th>Units &amp; Settings</th>
<th>Design</th>
<th>Treatment &amp; Outcome a, b</th>
<th>Control Variables</th>
<th>Findings</th>
<th>Limitations &amp; Future Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herron &amp; Barta 2009</td>
<td>143 2nd grade students in Northern Utah</td>
<td>quantitative pretest/post-test; random assignment</td>
<td>T: CR word problems &amp; textbook word problems O: increase in math scores</td>
<td>gender, SES, ethnicity, &amp; reading fluency</td>
<td>multiple regression analyses used; $F (8,114) = 2.16; p = .04$ not significant</td>
<td>limited to minimal intervention; algorithms included; future study involve only CR word problems vs. textbook word problems; no algorithms</td>
</tr>
</tbody>
</table>

Theoretical Framework

According to Schunk (2012), learning is a change in behavior in a given situation resulting from practice or other forms of experience. The basis for the experience may derive from behaviorist, cognitivist, or constructivist theory (Gellert, 2013). Behavioral theory is based on a change in the form or frequency in behavior because of environmental influences (Gutek, 2011; Ornstein & Hunkins, 2013). Cognitive theory is based on the idea that learning is acquired from gaining new knowledge through information processing (Brooks & Brooks, 2001; Gutek, 2011). Cognitive thinking
emphasizes critical thinking and higher order questioning; however, responses may be based on background knowledge and core content (Schettino, 2016). Constructivists believe, “Individuals construct and reconstruct their own reality in an effort to make sense of their experience” (Prince & Felder, 2006, p. 124). The theory of constructivism can be found in present day classrooms (Milner, 2011; Sampson & Garrison-Wade, 2011; Schweinle, Meyer, & Turner, 2006).

The use of culturally relevant pedagogy encompasses all three theories, behaviorist, cognitivist, and constructivist (Gutek, 2011; Ornstein & Hunkins, 2013; Sheppard, 2011). The learning in the classroom is based on the students’ environmental influences, previous experiences, and critical thinking—all components of culturally relevant pedagogy (Hubert, 2013; Ladson-Billings, 1995; Sheppard, 2009). When studying the way humans learn, curriculum experts must consider the external factors that have an impact on teaching and learning in the classroom (Leonard, 2008). Educators should keep in mind the constant changes in society, specifically with cultural beliefs, peer pressure, family structure, and the value of obtaining an education (Sheppard, 2009).

Ornstein and Hunkins (2013) contended that educators must continue to deal with the challenges facing our students and determine how the curriculum for schools can truly make a difference in a students’ academic success. The role of the teacher is moving from expert to facilitator, where teachers do not have all the knowledge, but allow students to discover more knowledge (Springer, Pugalee, & Algozzine, 2007; Walker, 2006). Students are no longer just turning the pages in textbooks to complete assignments, for they are becoming problem-solvers to real-life problems (Brand,
Glasson, & Green, 2006). The theoretical framework for this study is constructivism, which purports that students learn from real-life experiences that are relevant to them (Gutek, 2011; Ornstein & Hunkins, 2013). Research of the theory of culturally relevant pedagogy must continue to determine its effectiveness as a pedagogical tool (Young, 2010).

This remainder of this chapter begins with a historical background of mathematics and how students should be taught. Mathematics is the content area of focus for this study; hence, a discussion of NCTM (2000) standards is appropriate. Additional sections include the history of culturally relevant pedagogy, culturally relevant pedagogy in mathematics, teacher preparation for teaching African American students, mathematics achievement and African American students, mathematics and gender, and mathematics and social economic status. Opposing views and different perspectives to culturally relevant pedagogy are in the summary of this chapter.

Historical Background

The teaching of new mathematical knowledge and various means of pedagogy is not a recent discovery. During the Pre-Socratic Era, a Greek philosopher by the name of Pythagoras believed that all of reality was connected by numbers and that the meaning of the numbers could be discovered through the study of mathematics (Banks, 2004). The purpose and meaning behind the learning of new knowledge is a common idea. Aristotle’s epistemology influences the field of education for both learning and obtaining knowledge (Gutek, 2011). He believed that teaching and learning should give students opportunities to find the relevance and meaning of their learning by examining and
observing objects relative to their environment (Milner, 2011, 2016). Aristotle categorized knowledge into three levels: (1) productive knowledge, (2) practical knowledge, and (3) theoretical knowledge. The highest level, theoretical knowledge, is what is known to be true to the learner, his reality. The content area of mathematics is in Aristotle’s third level of knowledge (Gutek, 2011; Ornstein & Hunkins, 2013).

From the PreSocratic Era to the 21st century, theorists, philosophers, and politicians have possessed beliefs and ideas regarding how students should be taught and what students should learn in the classroom to matriculate from one grade level to the next (Gutek, 2011; Ornstein & Hunkins, 2013). One common link between the curriculum developers and philosophers is the concept that learning should be meaningful to students (Gay, 2000; Ladson-Billings, 2014; Ukpokodu, 2011). Theorists perceive meaningful learning experiences as opportunities given to students where students can make connections to previous learning and new learning (Pinar, 2012). Ladson-Billings (1995) defined “culturally relevant teaching as a pedagogy of opposition (1992c) not unlike critical pedagogy but specifically committed to collective, not merely individual empowerment” (p. 160).

History of Culturally Relevant Pedagogy

Multicultural education emerged in the 1960s during the Civil Rights Movement where social justice was evident not only in the streets, but also in the classrooms (Gay, 2000). Teachers used strategies that incorporated the students’ culture and daily experiences along with the curriculum that integrated all content areas, including
mathematics and science. Teachers encouraged students to question what they were learning and engaging in problem solving (Harmon, 2012).

During the same timeframe, the U.S. Supreme Court ruled against the desegregation of public schools. Following the ruling, many African American schools were destroyed, and the schools that remained used the curriculum and materials developed by Whites for African Americans (Harmon, 2012). The public schools of the 21st century may need to revisit and find the teaching strategy of culturally relevant pedagogy that may have been lost during the past four decades. Researchers such as Gay, Irvine, and Ladson-Billings continue to keep the topic current and relevant in educational research.

Gay (2000) described culturally relevant pedagogy as the use of “cultural knowledge, prior experiences, frame of reference, and performance styles of ethically diverse students to make learning relevant. It is culturally validating and affirming” (p. 29). Irvine (1989) presented the question of the connection of teachers and African American students. Later, Irvine and Armento (2001) described culturally relevant pedagogy as capable of transforming of curriculum, impacting critical problem solving, and building relationships between students, families, and their communities. Ladson-Billings (1994) continued the work of Gay with her experience of culturally relevant teaching of students of color in the book, *The Dreamkeepers: Successful Teachers of African American Children*. The used of culturally relevant pedagogy should continue to be explored so that perhaps history may repeat itself with the successful use of meeting the needs of African American students (Harmon, 2012).
Students’ Mathematical Achievement

An examination of the results of the fourth grade National Assessment of Educational Progress (NAEP) scores in the content of mathematics reveals the continuation of an achievement gap between African American students and White students (Brown-Jeffy, 2009; Chambers, 2009; Jett, 2013). Principles and Standards for School Mathematics (PSSM) provide a foundation for the improvement of mathematics teaching, curriculum alignment, and assessment (NCTM, 2000). Six principles describe specific components and characteristics essential to the development of an effective mathematics program:

1. Equity—Excellence in mathematics education requires equity—high expectations and strong support for all students.

2. Curriculum—A curriculum is more than a collection of activities; it must be coherent, focused on important mathematics, and articulated across the grades.

3. Teaching—Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.

4. Learning—Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.

5. Assessment—Assessment should support the learning of important mathematics and furnish useful information to both teachers and students.

6. Technology—Technology is essential in teaching and learning mathematics; it influences the mathematics that are taught and enhances students’ learning.

(NCTM, 2000, p. 2)
African American Students in Mathematics

According to NCTM (2000), the six principles outlined in PSSM are critical features needed to effectively teach mathematics, so all students can have opportunities to learn the content and gain conceptual understanding. The principles of NCTM (2000) were an effort to bring attention to the inequalities of traditional practices in the content area of mathematics. Such an effort was a correct attempt for African American students and their mathematical success in the classroom (Berry, Ellis, & Hughes, 2013; McKinney & Frazier, 2008).

Berry and colleagues (2013) conducted a qualitative meta-synthesis to determine strategies that African American use to navigate through the barriers that prevent them from achieving mathematical success in the classroom. Three themes emerged: (a) awareness and access, (b) images, and (c) agency. African American students are not aware of the various levels of mathematics opportunities and are not given access to enroll in advanced mathematics classes (Moran, 2008). If given the opportunity to enroll in an advanced class, African American students do not typically see students who look like them in these classes (Walker, 2006). The lack of role models leaves African American students curious about whether they can be successful mathematicians (Springer et al., 2007). When African American students do not see themselves as doers of mathematics, they accept the low agency of mathematics and enroll in classes with low-level mathematics (Berry et al., 2013). Along with the principles of NCTM (2000), process standards were included to enhance the mathematical conceptual understanding for students.
Culturally Relevant Pedagogy in Mathematics Instruction

Despite the framework offered by PSSM (NCTM, 2000), teachers continue to engage in outdated traditional teaching methods that stress procedures over conceptual understanding (Battey, 2013). Culturally relevant pedagogy in the mathematical promotes application of mathematics to real-life situations outside of the classroom and creates connections to students’ prior knowledge, which in turn facilitates grasp of concepts (Sheppard, 2011; Stinson, 2008). Instructional practices of teachers are the most influential factors for student achievement in mathematics (Throndsen & Turmo, 2013). Pedagogical practices should be engaging, inquiry based, and cognizant of the mathematics learning needs of diverse student populations (Villegas et al., 2012) in order to provide students with the tools to succeed academically (Chapman, 2008; McKinney & Frazier, 2008; Ukpokodu, 2011).

Culturally relevant pedagogy (CRP) focuses on both the teacher and the student (Walker, 2006). The three components related to the aspects of the teacher are: (a) the CRP teacher has a positive conception of self as an educator; (b) the CRP teacher maintains positive relationships with students, parents, and community; (c) the CRP teacher has passion for teaching and learning. The students of CRP teachers should realize the following benefits: (a) academic achievement, (b) cultural integrity, and (c) recognition and analysis of social inequities. CRP was designed to create successful learning environments for African American students (Hubert, 2013).
Student Perspective of CRP in Mathematics

Hubert (2013) described the components of culturally relevant pedagogy as defined by Ladson-Billings (1995). There are three criteria: (1) students must have experiences and opportunities of academic success, (2) students must have a sense or understanding of their own culture, and (3) students must question the status quo of their environment. A study conducted by Hubert (2013) revealed the perspectives of African American high school students who experienced culturally relevant pedagogy. This qualitative case study involved interviews with five students who received the instructional strategies of culturally relevant mathematics intervention. The results of the interviews from the case study revealed six themes: (a) home-like classrooms, (b) ethic of caring, (c) participation opportunities, (d) use of technology, (e) confidence to learn, and (f) motivation to learn (Hubert, 2013). The six themes that surfaced from the study relate closely to the components of culturally relevant pedagogy. The students found the lessons taught using culturally relevant strategies to be more effective and engaging. In addition, the students felt that learning the content was easier and grasping the concepts occurred at a faster pace. The students in the study found culturally relevant pedagogy to be a positive asset to their learning of mathematics (Hubert, 2013). When CRP is used in the classroom, students begin to take ownership of their learning and develop an interest in education beyond the school (Woodward & Brown, 2006).

When the mathematics taught at school and the mathematics that students encounter in the real world are unrelated to each other, students typically learn just enough of the content to pass the class, rather than learn to use it as a tool to understand
the mathematics in the world (Battey, 2013; Springer et al., 2007). Students should be motivated by their teachers to actively engage in the learning (Walker, 2006). In a study conducted by Schweinle and colleagues (2006), instructional practices, positive feedback, and challenging material surfaced as important factors of motivation for students’ mathematics achievement. Teachers should understand the impact of their instructional practices and work to find a balance to meet the needs, culturally and academically, of their students (Schweinle et al., 2006).

**Teacher Perspective of CRP in Mathematics**

Some teachers may be receptive to embracing culturally relevant teaching, while others may not (Milner, 2011). Milner (2011) conducted a qualitative study with a White teacher and students who came from diverse cultures. Results indicated that a teacher who is of a different race from his students has the potential to develop culture knowledge to maximize learning opportunities for students. Teachers need resources to help build relationships with students and deepen their knowledge about the impact of identity and race in the urban community (Sampson & Garrison-Wade, 2011).

Not only should teachers be able to make the connections culturally, they also need to have a proficient amount of content knowledge of the mathematics content they are teaching (Battey, 2013; Hubert, 2013). To teach students in underserved populations successfully, teachers should be highly qualified and competent to teach the content of mathematics at a rigorous level (Berry et al., 2013; Bonner, 2014). Too often children in underserved populations in public school are placed in classes where the teacher has a deficit in the content knowledge of mathematics (Bonner, 2014; Milner, 2011; Stinson,
It is vital that teachers receive the proper resources and training to assist students with understanding the required grade-level standards (Jitendra et al., 2005).

Brand et al. (2016) stressed the importance of teacher reflection in acknowledging the differences in their students. Often, teachers possess preconceived ideas and beliefs about different cultures. Therefore, they should include experiences of different cultures inside of the classroom as well as experience their culture outside of the classroom (Aguirre & Zavala, 2013). Such experiences could include technology, music, games, drama, and other cultural interactions. Successful teachers of African American students can incorporate storytelling, activities involving movement, and collaborative learning in their classrooms (Ukpokodu, 2011). An environment that is supportive and makes a connection with the students’ culture by accepting multiple perceptions and perspectives motivates and engages students (Bonner & Adams, 2012; Sampson & Garrison-Wade, 2011; Ukpokodu, 2011).

In the current school environment, where high stakes testing takes priority, it is necessary for teachers to teach basic skills and knowledge (Berry et al., 2013). Teachers may possibly work to close the achievement gap by taking on both responsibilities of teaching the skills and knowledge that the students must know and learn by making the learning culturally relevant to the student (Chambers, 2009; Hubert, 2013; Woodward & Brown, 2006). This involves including cultural experiences and social awareness in the instructional design of the curriculum.

There may be a solution to finding a balance of teaching the required curriculum while also including components of students’ cultural experiences (Berry, Thunder,
McClain, 2011). The pedagogy of culturally relevant teaching and culturally responsive teaching are often used interchangeably; however, there are subtle differences (Gay, 2010; Ladson-Billings, 2014). Culturally relevant education involves teachers trying to gain an understanding of, or find a connection to, students’ cultures (Bonner & Adams, 2012). Culturally responsive education involves a conceptual understanding of the students’ experiences with the content being taught in the classroom (Banks, 2004). For the purposes of this study, culturally relevant will be used according to the definition from the work of Ladson-Billings (1995); however, culturally responsive teaching will be defined and used accordingly.

One of the characteristics of a culturally relevant teacher is positive self-efficacy as an educator (Herron & Barta, 2009). One of the components of PSSM to improve mathematics teaching is content knowledge of the teacher, where teachers have high outcome expectancy of their students (NCTM, 2000). A study conducted by Utley, Bryant, and Mosely (2005) examined both components: teacher efficacy and outcome expectancy. Utley and colleagues (2005) completed their study to explore teacher efficacy and the relationship of content specific teacher efficacy before, during, and after preservice experiences in a U.S. college. Preservice components consisted of 15-hour content specific course work, a three-week education seminar class, and a 12-week student teaching experience. During the nine months of coursework, the researchers assessed the teachers on two types of efficacy: general teaching efficacy and personal teaching efficacy. General teaching efficacy (GTE) is the measure of a teacher’s belief about whether environmental factors have more of an influence than a student’s intrinsic
motivation. Personal teaching efficacy (PTE) is the measure of the teachers’ intrinsic beliefs that they can make a difference in the academic achievement of the most unmotivated and challenging student (Utley et al., 2005). Utley et al. also examined the correlation of teacher efficacy with outcome expectancy. After working with the 51 preservice teachers who completed the assessments and administrations, Utley et al. (2005) discovered a significant correlation with the personal mathematics and science teachers’ efficacies at the end of the course work of the methods classes; however, there was a decline in outcome expectancy after the student teacher experience. When teachers have high self-efficacy and high outcome expectancy, then students tend to rise to the expectations (Bonner & Adams, 2012). High expectation for students is one of the components of CRP; however, there are still basic numeracy skills that students must have to obtain high student achievement (Bonner & Adams, 2012; Moses-Snipes, 2005; Young, 2010).

Mathematics Achievement

Chard and colleagues (2008) examined the effectiveness of testing kindergarten students in the content area of mathematics. The focus of the mathematics curriculum was early numeracy, geometry, measurement, and vocabulary. A mixed-method model of covariance was used to determine the difference in pretest scores and posttest scores of the Standard Early Achievement Test. The results of the study indicated that poor academic achievement in the content area of mathematics is due to the lack of missed opportunities of early intervention and lack of an understanding of mathematics vocabulary (Chard et al., 2008).
Purpura, Reid, Eiland, and Baroody (2015) discussed indicators that explain why children have difficulty in the content area of mathematics at the elementary level. The research explored an assessment tool for numeracy for preschool students, conducted in two stages through measurement development and validation. During the first stage, 393 preschool children were assessed on their numeracy skills. During the second stage, 129 preschool children were assessed using the Test of Early Mathematics Ability (3rd edition). Based on the conclusion of the study, the results of early assessment of mathematical skills in preschool students should inform instructional decisions (Purpura et al., 2015). Students need a solid mathematical foundation with early numeracy to be successful as they matriculate from one grade level to the next (Leonard & Martin, 2013).

In a study conducted by Hemphill and Hill (2013), the researchers evaluated the readiness of sixth grade students to complete early challenge math coursework. Thirty students (15 males, 15 girls) in one school setting met the requirements (tested in) for the algebra class, while 30 randomly selected students were enrolled (placed in) the class based on teacher recommendations. The data were collected from the students’ math achievement on the Orleans Hana Algebra Prognosis Test scores and the students’ final posttest challenge math report card scores. The results of the study indicated that regardless of whether the students were placed in or tested in the challenge math coursework, they were adequately prepared to be successful in the math course. One can also conclude that readiness for advanced coursework should not be based solely on a qualifying test score, but also on a well-designed rigorous mathematics curriculum, skilled teachers, and motivated students (Hemphill & Hill, 2013; Howard, 2001).
Foegen (2008) explored the adequacy of six measures for monitoring student progress in the content area of mathematics at the middle school level. The six measures, administered three times during the academic school year, were MBSP Basic Math Computation, MBSP Concepts and Applications, Basic Facts, Estimation, Complex Quantity Discrimination, and Missing Number. The study utilized a sample of 563 sixth, seventh, and eighth grade students in two Midwestern school districts. One district was in a large suburban area, while the other district was in a small Midwestern town. The results of the investigation indicated that for measures of monitoring to be useful, three characteristics must be evident: the reliability and criterion validity of measures, distribution produced by the measures, and the measures that reflect change in student performance. One score on a valid and reliable mathematics test should not determine the instructional path for a student from elementary school through high school (Foegen, 2008). Additional factors contribute to a students’ mathematical success at any educational level, including postsecondary (Henfield & Washington, 2012; Keck-Staley, 2010).

Moran (2008) conducted a comparative study to examine the preparedness of first-year college students for college-level math courses. The factors examined were gender, ethnicity, level of math course work, and number of years of study in high school. Moran selected the student participants based on the following criteria: graduated from a high school in Connecticut in June 2001, completed the placement test at Central Connecticut State University (CCSU), and engaged in no college course work prior to enrolling at CCSU. Students completed the Accuplacer for the placement test at CCSU.
The results of the study indicated that students who completed four or more years of mathematics coursework in high school were not likely to be required to complete developmental mathematics classes when compared with students who had three years or less. In this study, two factors, ethnicity and level of math coursework, were parallel to components of culturally relevant pedagogy (Moran, 2008).

When teachers use culturally relevant pedagogy, students experience academic success and possess a sense of their own culture (Debnam, Pas, Bottiani, Cash, & Bradshaw, 2015; Gay, 2010; Ladson-Billings, 2014). When culturally relevant pedagogy is infused with the PSSM of NCTM (2000), student mathematical achievement may have a positive outcome (Jones, 2015; Schettino, 2016; Sheppard, 2009).

Culturally Relevant Pedagogy and Social Economic Status

In general, schools are the opportunity all students need to escape poverty (Battey, 2013; Moses-Snipes, 2005). The schools that exist in large urban school districts are not in need of more funding for school supplies and materials, but rather funding to provide more resources to families living in poverty (Howell, 2015; McKinney & Frazier, 2008). So often, students come to school to receive two hot meals and learn in a place where it is safe and comfortable (Leonard & Moore, 2014). Students who go home to a place where their basic needs are not being met will not get the support needed for reading, reviewing math facts, and completing homework (McKinney et al., 2009). The goal for many students is survival and not academic success (Moses-Snipes, 2005; Sampson & Garrison-Wade, 2011; Ukpokodu, 2011). The majority of students with low-economic
status are generally members of a minority group, such as African Americans (Strutchens & Silver, 2000).

Secada (1992) discovered a negative correlation between social economic status and mathematics achievement. McKinney and colleagues (2009) compiled results from the Mathematical Instructional Practice and Assessment in an attempt to determine the best pedagogical practices for teaching mathematics to students of low socioeconomic status. During NCTM conferences, 99 in-service teachers were selected, based on the guidelines of high poverty K-5 elementary schools, to participate in a survey to investigate some of the top indicators of increasing mathematics performance. The results of the data indicated that most teachers use the Principles and Standards for School Mathematics when they teach. The mathematical research-based best practices from the NCTM standards have been found to be highly effective. However, teachers in high poverty school districts are often limited to following pacing guides and curriculum guides and, as a result, teacher creativity is stifled with required to teach the state standards (McKinney et al., 2009).

In a case study, Battey (2013) found that effective teaching occurred for Latino and African American students when the teacher encouraged the students’ use of mathematic strategies, affirmed the students’ mathematical ability, and connected the mathematics content to a familiar context. The same teacher was deemed ineffective when she used sarcasm, questioned students’ ability to solve the mathematics problems, and isolated students (Battey, 2013). Unfortunately, all students do not receive the same quality mathematics instruction, specifically those students living in high poverty
communities (Enyedy & Mukhopadhyay, 2007). Often students in underserved populations receive mathematics instruction from teachers who have the least amount of teaching experience, lack adequate certifications, and lack content knowledge (McKinney & Frazier, 2008). Additionally, mathematics is taught with limited vocabulary, a focus on following steps in algorithms, and a disconnect of concepts (Leonard & Moore, 2014). It is difficult for African American students to thrive mathematically when instruction is monotonous, repetitious, and static (Lattimore, 2005).

The ideal example of effective mathematics instruction for African American students would include hands-on activities, project-based learning, field trips, and guest speakers to make a connection to life experiences that involve mathematics (Battey, 2013). In such a classroom, where culturally relevant teaching occurs, the use of worksheets, workbooks, textbooks, and skill-and-drill activities decreases (Battey, 2013; Lattimore, 2005; Polly et al., 2014).

Culturally Relevant Pedagogy and African American Students

Culturally relevant teachers demonstrate confidence in African American students by exhibiting high expectations for them and making cultural connections with the students’ identity (Leonard & Guha, 2002; May, 2011). Culturally relevant instructors facilitate activities in their classrooms that support African American students by engaging them in instructional activities that are relatable to real-life experiences (Leonard, Napp, & Adeleke, 2009). Lastly, culturally relevant teachers are not sympathetic, but they are keenly aware of the socio inequities of their students (Henfield
The characteristics of culturally relevant teacher run parallel to the tenets of culturally relevant pedagogy (Ladson-Billings, 2001).

Henfield and Washington (2012) conducted a study to analyze White teachers’ perceptions of their experiences in a school where the enrollment of African American students was gradually increasing. The 26 participants engaged in discussions in focus groups and interviews. Henfield and Washington (2012) also conducted classroom observations. The teachers were candid and revealed that their own personal and professional experiences made it difficult for them to discuss issues of race and diversity. Many of the teachers stated that they lacked confidence in their ability to connect with African American students primarily due to their lack of information about the students. The participants were open to opportunities of professional development in teaching African American students; however, it was not a priority of their school (Henfield & Washington, 2012). It is encouraging that the teachers were open and honest because educators who deny that racism is in our educational settings are not as likely to be sensitive to the academic needs of African American students (Henfield & Washington, 2012; Leonard & Moore, 2014). For African American students to be academically successful, they need teachers who are competent in multicultural issues (Gay, 2000; Henfield & Washington, 2012). Often, African American students believe that their teachers lack the interest in them and do not see them as academic scholars (McGee & Martin, 2011). Further, African American students state that they receive different discipline consequences, the classwork is different as it reflects low expectations, and teachers show no interest in them as human beings (Leonard & Moore, 2014). The use of
culturally relevant teaching is not only an effective method for teaching African American students, it also discourages instances of educational inequalities (Henfield & Washington, 2012; McGee & Martin, 2011; Walker, 2006).

In 2009, Sheppard (2009) made an effort to examine the opportunities of prospective teachers with tutoring African American male students in the first through the fourth grade at Title 1 schools. The teachers worked with the students after school, and the study was not part of the student teaching field experience. During the study, Sheppard (2009) attempted to dismantle some preconceived notions that these African American male students did not have the ability to be successful mathematic students because of the “Hidden or UnMet Potential (HUMP)” (p. 230). The HUMP that the 42 prospective teachers wanted to uncover was the reason behind low academic performance in mathematic classes for these students. The teachers spent 15 hours during an eight-week timeframe mentoring and tutoring the students. Data generated through study vignettes, which document the conversations the prospective teachers had with the students. Sheppard (2009) discovered that when prospective teachers have an opportunity to make connections with African American male students’ real-life experiences and mathematics, there may be improvement in their mathematical performance.

The results discovered by Sheppard (2009) do not seem exclusive to African American male students. When teachers, whether they are prospective or experienced, can make a connection to real-life experiences and the content their students are learning, there may be an improvement in academic performance (Gellert, 2013; Sheppard, 2009).
The prospective teachers received opportunities to work one-on-one with the students, which gave way to open dialogue not guided by any form of curriculum. The teachers could glean information about the students that may not have been discovered during daily classroom instruction. One consistent factor that surfaced from the vignettes was that during the tutoring sessions, the teachers could teach the mathematic content using different strategies, for they were not restricted to following a written curriculum (Sheppard, 2009). Some of the tutors used manipulatives, drawings, and flash cards, while others wrote songs or told stories to help students understand the math skills. The prospective teachers realized the importance of incorporating nontraditional approaches to solving mathematics problems (Gellert, 2013; Sheppard, 2009). The argument that teachers should make some form of a connection with students prior to daily instruction is a valid argument; however, such a best practice should not be only for teaching African American males (Sheppard, 2009; Sheppard, 2011). The prospective teachers’ experiences are beneficial to exploration of a more global perspective for all students in mathematics classes (Gellert, 2013).

When students are engaged in situated learning opportunities, they can apply new learning to real-life situations, as well as create new learning opportunities from the real-life experiences (Brooks & Brooks, 2001). In situated learning, learning is grounded in the actions of everyday situations, knowledge is acquired in situations and transferred to previous situations, learning is the result of the social processes (thinking, perceiving, problem solving, and interacting) in addition to procedural knowledge, and learning is not separated from the world of action (Brooks & Brooks, 2001; May, 2011).
Culturally Relevant Pedagogy and Problem Solving

A study conducted in 2010 indicated a significant difference between the effectiveness of traditional methods and the problem-solving method in teaching mathematics at the elementary level (Ali, Hukamdad, Akhter, & Khan, 2010). Even if students are engaged in mathematical problem solving using the Polya model, learning may be effective when students can make real world connections to the content (Brown-Jeffy, 2009). Table 3 depicts the connection of Polya’s four step approach to problem solving and the researcher’s components of culturally relevant word problems.

Table 3

Crosswalk of Polya and CR Word Problems

<table>
<thead>
<tr>
<th>Polya’s 4 Steps</th>
<th>Approach</th>
<th>Culturally Relevant Word Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation:</td>
<td>What is being asked?</td>
<td>Students understand the problem because the vocabulary words are familiar to the students.</td>
</tr>
<tr>
<td>Understand the</td>
<td>What do the terms mean?</td>
<td></td>
</tr>
<tr>
<td>problem.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thinking Time:</td>
<td>Use strategies:</td>
<td>Students devise a plan based on their understanding of the real-life connect to the word problem because it includes, names of students, names teachers, names of local settings, familiar sports/games, names of foods or restaurants, or celebrations.</td>
</tr>
<tr>
<td>Devise a plan.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insight:</td>
<td>Keep trying until something works</td>
<td>Students carry out the plan based on their experiences of the familiar items in the culturally relevant word problem.</td>
</tr>
<tr>
<td>Carry out the</td>
<td></td>
<td></td>
</tr>
<tr>
<td>plan.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verification:</td>
<td>Check to see if your solution works.</td>
<td>Students check their answers based on their solution being reasonable and logical based on their experiences.</td>
</tr>
<tr>
<td>Look back and</td>
<td>Does it answer the question?</td>
<td></td>
</tr>
<tr>
<td>check answer.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Whether learning occurs inside of a classroom or outside of the classroom on a field trip to another country, the meaningfulness and context of the learning environment may influence the transfer of learning (Brooks & Brooks, 2001). The combination of effective mathematical problem-solving strategies and culturally relevant mathematics teaching may be a significant effort to close the achievement gap for African American students in underserved public schools (McGee & Martin, 2011; Sheppard, 2011; Walker, 2006).

Achievement Gap of African American Students

According to the results of the National Assessment of Educational Progress (NAEP), in 2013, 83% of fourth grade students performed at or above the Basic achievement level, and 42% performed at or above the Proficient level in the content area of mathematics (National Center for Education Statistics [NCES], 2014). The NAEP achievement levels define what students should know and be able to do, where Basic indicates partial mastery of fundamental skills, and Proficient indicates demonstrated competency of the subject matter. A key data point that leads to one of the significant variables of this study is the performance of African American students. At the fourth level, the average mathematics scores, in 2013, for mathematics were as follows: White students—250, Hispanic students—231, and Black students—224 (NCES, 2014). Even though progress has occurred from 1990 to 2013, in the content of mathematics of NAEP, African American students continue to perform at a lower level of achievement (NCES, 2014).
The gap in achievement has become a priority in the United States. The purpose of the No Child Left Behind Act (NCLB) was to close the achievement gap between high and low performing students. Since the inception of NCLB, raising the achievement levels of ethnic minorities is still a major goal for federal policy (Brown-Jeffy, 2009). Conducted research affirms an achievement gap exists between African American students and their counterparts; however, not much has been done to specifically equip teachers with instructional tools to use in their mathematics classrooms (Chambers, 2009; Chapman, 2008; Howell, 2015). Leonard and Moore (2014) discussed an innovative lesson analysis tool, created to focus on the integration of components of culturally responsive teaching in mathematics. The tool affords teachers the ability to analyze and critique their mathematics lessons to include opportunities for mathematical thinking, language, culture, and social justice (Leonard & Martin, 2013). The tool also enables teachers to be deliberate and intentional in including pedagogical dialogue with culturally responsive components. The ultimate purpose of the tool is to improve the quality of mathematics teaching in the classroom (Aguirre & Zavala, 2013).

An additional tool that teachers may use derives from the exploration of Jones (2015) regarding the use of a rubric to determine if selected tasks were culturally relevant to the students. Using the grounded theory approach, Jones (2015) sought to derive a theory based on teachers’ use of the Culturally Relevant Cognitive Demanding (CRCD) Mathematics Task Framework and Rubric. Jones (2015) related the resulting five themes: (a) changes made to the mathematics, (b) changes to the wording of the task, (c) engagement required in the mathematics task, (d) clarification of the task, and (e)
discussion for making a connection with the task and real-life experiences. Two concepts serve as the basis of the CRCD Framework: a definition of high-level cognitive learning and features of culturally relevant teaching (Jones, 2015). High-level tasks include learning opportunities where students can make connections with familiar contexts and their communities. The tasks do not include memorization of facts and procedures that do not connect to real life experiences (Schettino, 2016). The high-level tasks provide a context for learning that gives students access to content that is familiar to them, their community, and the world around them (Jones, 2015). The CRCD tasks give students opportunities to make connections to other subject areas and issues. The contexts of the tasks do not create a culturally relevant classroom environment; rather it is the thinking behind the tasks and the activities that the students complete (Jones, 2015). If the appropriate discussion and connection does not occur after completing the tasks, then students will not see the tasks as culturally relevant (Jones, 2015; Milner, 2011; Schettino, 2016).

Numerous research studies address school failure for African American students. Typical case studies have been conducted to examine components of culturally relevant and culturally responsive teaching in mathematics classrooms. Wiggan and Watson (2016) found that implementation of multicultural curricula and related educational experiences have a positive effect on the academic achievement of students.

Bonner and Adams (2012) conducted their research based on grounded theory. The researchers selected a teacher, Ms. Finley, to complete 50 observations and a collection of artifacts to analyze over a four-month period. Bonner and Adams (2012)
selected Ms. Finley, a 58-year-old African American woman, because she had over 30 years of teaching experience and was in high demand at the school. She had a reputation for being able to build confidence and discipline in students and keep them highly engaged in their mathematical learning. Based on the results of the study, Bonner and Adams (2012) concluded that when teachers provide an environment where students are comfortable with their culture and learning is relevant to their experiences, then students are successful in mathematics.

Numerous factors influence a students’ ability to succeed in mathematics, but a major contributing factor is a student’s mathematics identity (Brand et al., 2006). Part of the identity for African American students is race (Keck-Staley, 2010). Sheppard (2011) provided insight to a critical framework that examines the complexity of how race and racism influence the mathematical educational experiences of African American children. The researcher contended that the way students make sense of and respond to their mathematical experiences is critical to their conceptual understanding (Moses-Snipes, 2005; Sheppard, 2011).

With factors, such as relevance, engagement, identity, and motivation, one may question if mathematics pedagogy is an influencing factor with a students’ success in mathematics. Enyedy and Mukhopadhyay (2007) challenged the notion that culturally relevant pedagogy was an influencing factor in comparison to mathematics pedagogy. They conducted research using a mixed-methods approach to analyze the pre-assessments and post-assessments of final projects for 25 high school students. One key lesson that the researchers learned was the importance of consistent and coherent norms that
integrated the mathematical goals and the goals of culturally relevant pedagogy. The findings of the research indicated that classroom culture—the way teachers conduct instructional conversations—is just as important as any technical tool or curriculum (Enyedy & Mukhopadhyay, 2007). In retrospect, the researchers offered three interpretations of the term relevant in culturally relevant pedagogy: (a) a focus on context that is familiar to students’ everyday lives, (b) focus on motivational value of lesson to be applied outside of the school, and (c) focus on the process rather than the content or purpose of the instruction (Enyedy & Mukhopadhyay, 2007).

Teacher Deficit Thinking

For teachers to meet the needs of their students, they must first be reflective of the biases and misconceptions that they bring to the classroom (Henfield & Washington, 2012; Leonard & Moore, 2014). Debnam and colleagues (2015) examined how teachers’ self-report their proficiency levels of culturally relevant teaching in comparison to actual observations in the classroom during mathematics instruction. The findings of the study suggest that teachers did not use the culturally relevant practices in mathematics classes as often as they did in the other content areas. The teachers found it more difficult to make connections with students’ interests and their culture. However, teachers who had received culturally relevant teaching practices during their preservice experiences could make the connections with their students in the mathematics classes (Debnam et al., 2015).

Sheppard (2011) conducted a qualitative study with eight of his preservice teachers who conducted their student teaching experience with African American
students in Title 1 schools. He collected data based on their journal entries and written papers submitted during length of the coursework. The study included vignettes from each of the participants, and one key theme that emerged from the experiences was experience-centered instruction (Sheppard, 2011). Each preservice teacher used the components of culturally relevant pedagogy to make the connection with the students and their mathematical learning. In one of the cases, the preservice teacher used rhythm and pattern to develop a song to help a student understand the minute hand and the hour hand on the clock. Another case involved a student who had health issues that impacted his ability to comprehend quickly; however, the preservice teacher continued to have high expectations for the student.

At the conclusion of the study, it became evident that African American students are often misdiagnosed as being incapable of learning mathematics when, on the contrary, they have the ability but lack exposure to the components of culturally relevant pedagogy (Jitendra et al., 2005; Sheppard, 2011). Exposing preservice teachers to various experiences has the potential to influence their beliefs as well as their identity (Sheppard, 2009, 2011). As defined by Martin (2000), mathematics identity is the “ability to perform in mathematical contexts, (b) the instrumental importance of mathematical knowledge, (c) constraints and opportunities in mathematical contexts, and (d) the resulting motivations and strategies used to obtain mathematics knowledge” (as cited in Leonard & Moore, 2014, p. 78). The teachers’ mathematics identity impacts how they will expose students to the content (Debnam et al., 2015).
Racial identity of the teacher is also an important factor in the mathematics achievement of African American students. Villegas and colleagues (2012) made an argument for two reasons why African American students should receive instruction from African American teachers. The first argument is that students are most influenced by teachers who look like them. The African American teachers serve as role models for African American students. The second argument is that students can relate more to a teacher who has similar background and experiences. The African American teachers may be able to share experiences of discrimination or inequality that the African American students may be dealing with currently in their lives (Ukpokodu, 2011).

The analysis conducted by Villegas et al. (2012) suggested that states implement five types of policy strategies to bring about diversity in mathematics classrooms: (a) financial incentives, (b) government mandates, (c) recruitment programs, (d) recruitment centers, and (e) alternative certification programs. By 2010, 31 states had adopted a teacher recruitment policy for minorities. The policy includes teacher financial incentives and mandates of support from various teacher work groups (Villegas et al., 2012). Despite the efforts of recruitment programs and diversity policies, it is difficult to keep up with the growing population of the minority student population (Howell, 2015). Additionally, efforts are also necessary to retain teachers in the classroom who represent minority groups, such as African Americans (Gentle-Genitty, 2009; Villegas et al., 2012).

Mathematics and Gender

Specific experiences may impact the mathematical success of African American students, but additional factors impede the access of quality instruction specifically for
girls (Chambers, Walpole, & Outlaw, 2016). Chambers and colleagues (2016) examined the self-efficacy of African American females and its influence on their enrollment in college and discovered a correlation between the two factors. African American females seldom receive the same encouragement to enroll in higher-level mathematics classes as their male counterparts; thus, the females do not have the same access to rigorous mathematics instruction (Chambers, 2009). Perhaps culturally relevant teaching practices may be even more critical for the influence of mathematical success for female students to influence higher levels of self-efficacy (Moran, 2008; Walker, 2006; Wiggans & Watson, 2016).

Traditionally, public opinion perceives males to be better mathematics students than females (Jett et al., 2015). In a study conducted in 2008, the results from the data indicated that, like the findings from the early 1970s, students believed that gender is a neutral factor in the content area of mathematics (Jett, 2013; Kloosterman, Tassell, & Ponniah, 2008; McGee & Martin, 2011). The students in the study did indicate a difference in the way females and males were treated in the mathematics classroom, but the academic outcome was not altered because of the gender of the student (Kloosterman et al., 2008).

The most recent results from the NAEP also dispute the assumption that males are better than females in the content area of mathematics (Chambers, 2009; Lattimore, 2005; Milner, 2016). A minimal two-point achievement gap occurred within the results of the NAEP between males and females (Kloosterman et al., 2008). Data results regarding different curricula written specifically for females or specifically for males and various
methods utilized to teach the mathematical concepts suggest that there is little to no difference in mathematical performance based on the gender of a student (Jett et al., 2015).

Counternarratives and Opposing Views of CRP

Much of the current research of African American students and mathematics centers around the negative attributes of low achievement and performance (Jett, 2013). Lack of interest, low socioeconomic status, negative teacher attitudes, culturally irrelevant curriculum, and a history of underachievement are often used to explain the lack of mathematical success of African American students (Ellington & Frederick, 2010).

Counter to negative explanations, Ellington and Frederick (2010) completed a case study with African American college students. The researchers focused their study on the positive attributes of the high mathematics achievement for African American juniors and seniors in college. The students’ mathematical success was attributable to their enrollment in high-level mathematics classes, accelerated academic studies, and support from their teachers, peers, and family (Ellington & Frederick, 2010). In a similar study conducted by Stinson (2008), documentation focused on four African American males who had success in the content area of mathematics. The participants had a strong mathematic identity and could make connections of the mathematical knowledge beyond the classroom room (Stinson, 2008). They believed that the content area of mathematics was a “culturally free discipline” (Stinson, 2008, p. 1002). Additionally, Stinson (2008) discovered there were commonalities that the participants attributed to their success: (a)
observation of family members who had a formal education, (b) family members who had high expectations, (c) teachers who cared about them as students, and (d) peers who desired the same level of high achievement. Even though the ages of the participants were different, both studies had similar outcomes. High expectations and a caring attitude from a teacher support the components of culturally relevant pedagogy, as evidenced in both studies (Ellington & Frederick, 2010; Stinson, 2008).

When discussing the achievement gap, African American students are compared to the progress of their White counterparts, where White students are the norm and students of color have deficits (Chambers, 2009; Chapman, 2008; Schweinle et al., 2006). Counternarratives exist to challenge the notice of the achievement gap (Berry et al., 2013). Berry and colleagues (2011) conducted a study involving 32 Black male students in the fifth, sixth, and seventh grades and discussed their academic success in mathematics classes in a southern rural school district. Their success was measured on the high passing rate of standardized tests and above average grades in mathematics. Four factors contributed positively to the males’ mathematics identity: (a) the development of computational fluency by third grade, (b) extrinsic recognition, (c) relevant connections, and (d) engagement with the unique qualities of mathematics. Berry et al. (2011) discussed three additional components that may contribute to a positive mathematic identity for African American males: (a) motivation to succeed in mathematics, (b) solid belief in their mathematical skills and performance, and (c) a caring mathematics teacher.
Sampson and Garrison-Wade (2011) completed a mixed-method study to examine the preference of African American students toward culturally relevant lessons and nonculturally relevant lessons. For the purpose of the study, Sampson and Garrison-Wade (2011) defined culturally relevant lessons as lessons that teach the various concepts for students through the integration of cultural artifacts, language, ethnic references, and context familiar to the student. The participants from a Colorado high school received six lessons, three culturally relevant and three nonculturally relevant. The students had to rate their favorite lessons by numbering from one to six. The findings from both the quantitative and qualitative study were the same. The students preferred the culturally relevant lessons. Three key themes derived from the students: (a) challenging topics can be interesting, (b) lessons should be fun, and (c) the teacher should have high energy and a sense of humor (Dee & Penner, 2017; Sampson & Garrison-Wade, 2011). The students also recommended integration of culturally relevant lessons as part of the curriculum and not as something separate or different (Sampson & Garrison-Wade, 2011; Wiggan & Watson, 2016).

Other Factors May Impact Student Success

Even when delivery of content is through culturally relevant teaching, students still face external obstacles (Milner, 2016). For example, the accountability component measures students’ academic success as well as the teachers’ performance (Lattimore, 2005). If students who are underserved in public schools are asked why they are in an unsuccessful school, they may share that the building is old, the teachers are incompetent in the content area, the teachers do not care about their well-being, or the lessons are not
engaging (Leonard & Moore, 2014; Leonard, Moore, & Brooks, 2014). If teachers are asked why a school may be labeled as unsuccessful, they may share that the students live in poverty, there is violence in the neighborhood, parents neglect their children, and students lack motivation (Leonard & Guha, 2002; Leonard & Martin, 2013). Research also indicates that socioeconomic status is a determining factor of student achievement, resulting in the theory that an individual’s poverty level has a greater influence that any other factor (Brown-Jeffy, 2009; Sheppard, 2011; Walker, 2006).

In addition to the challenges of learning mathematics, African American students encounter other challenges that have impact on their learning, such as stereotypes (Brand et al., 2006). Stereotypes mentioned by the student participants in a study conducted by Brand and colleagues (2006) included: (a) Black males tend to drop out of school, (b) males with dreadlocks or braids tend to be trouble makers, (c) Blacks are intellectually inferior, (d) Blacks do not enroll in advanced courses, and (e) only smart people can be successful in mathematics. If teachers fail to address these stereotypes, then students may have a negative perspective on learning and participating in mathematics classes (Leonard & Martin, 2013; Leonard & Moore, 2014).

A qualitative study conducted by May (2011) revealed that both culturally relevant teaching and strategic comprehension instruction challenge students academically, while also paying due respect to their culture. May (2011) utilized the ethnographic method over a two-year period to determine if culturally relevant text had an influence on a students’ ability to master reading standards. Narratives were used to make the connection of culturally relevant pedagogy and comprehension strategies.
From a culturally relevant point of view, three criteria were met: academic development of the student, cultural competence, and social/political awareness. Even with using culturally relevant pedagogy, the results of the study were mixed. While students made a connection with the text, the students still struggled with mastering the reading standards (May, 2011). The study conducted by May (2011) focused on reading standards; however, it points to the idea that culturally relevant pedagogy may not be the only strategy needed to assist students with conceptual understanding of new skills and knowledge (Paris, 2012; Young, 2010).

A teaching approach in mathematics where mathematical tasks include classroom discourse that allows students to make meaning of their own individual mathematical experiences may be effective (Keck-Staley, 2010). In a case study, Keck-Staley (2010) observed and interviewed nine students in their Algebra 1 class. Even with the teacher using primarily the lecture method of teaching, the students were intrinsically motivated to create their own learning community of mathematics students (Keck-Staley, 2010). The students discovered a connection with the mathematics content they were taught in the classroom to their own relevant personal experiences (Young, 2010). The students also discovered that their own mathematics identity needed to collaborate and communicate during mathematics instruction (Paris, 2012; Young, 2010).

Summary

The purpose of the Principles and Standards for School Mathematics (NCTM, 2000) was to establish a mathematics curriculum to benefit all students (Brown-Jeffy, 2009; Gellert, 2013). This study provides a foundation for educators who may question
the effectiveness of culturally relevant pedagogy, specifically for African American students. It may answer questions for educators looking for effective teaching practices that meet the needs of minority students in underserved populations in public schools.

When teachers use components of culturally relevant pedagogy, student motivation, student interest in the content, student ability to engage in high levels of discourse, positive student perception, and overall confidence as a mathematics student may increase (Ladson-Billings, 1995; Leonard & Martin, 2013). Overall, culturally relevant mathematics teachers build on students’ skills and knowledge, connect the mathematical instruction towards the students’ culture and life experiences, and develop students’ critical mathematical thinking (Enyedy & Mukhopadhyay, 2007; Leonard & Moore, 2014). Ultimately, instead of students solving problems from textbooks and worksheets, culturally relevant teachers engage students in problem solving connected to their environment and culture (Gay, 2010; Herron & Barta, 2009; Ladson-Billings, 1995). The students become active and successful participants in the mathematics classrooms (Ali et al., 2010; Jones, 2015; Moses-Snipes, 2005).

In this study, the focus of the collection of research articles was primarily on the first two criteria of culturally relevant pedagogy: (a) students having experiences and opportunities of academic success, and (b) students having a sense of understanding their own culture. The third criteria of culturally relevant pedagogy—students acquiring a critical consciousness by questioning issues of social justice—was not a primary focus for this study. Additional research and exploration may be done to further examine how African American students can critique cultural norms, values, and institutions of social
inequities. Such extended research may be challenging because of the limited studies found involving culturally relevant pedagogy and social injustices for African American students in mathematics classrooms.

The examination of problem-solving research to examine the impact of culturally relevant word problems in mathematics may empower educators with an additional strategy when teaching minority students, specifically students who are African American (Leonard & Martin, 2013). Additional factors, such as gender and socioeconomic status, may influence the success of students in mathematics classes who are in minority groups (May, 2011; Young, 2010). Educators should use methods of instruction, such as culturally relevant pedagogy, that promote success with mathematics problem solving. Chapter 3 offers a description of how this quantitative study was conducted. The chapter includes the research questions, choice and rationale of design, instrumentation, data analysis method, measures, and ethical safeguards.
CHAPTER 3

METHODOLOGY

The method that may make the dream of culturally relevant education a reality for African American students is for teachers to change some of the words currently used in mathematics word problems in textbooks. Personalization of word problems makes solving the word problems more motivating and easier to understand by making a connection to existing knowledge (Davis-Dorsey, Ross, & Morrison, 1991). Corp (2017) used African American mathematics stories with African American characters to engage students in new mathematical learning each week during instructional time. She measured the level of engagement and motivation by giving students brief surveys to complete at the end of each mathematics lesson.

Engagement is an essential part of the learning process. Without engagement in cognitive learning, students become rote learners and do not make essential mathematical connections (Corp, 2017). African American students who feel inferior to their classmates become disengaged and withdraw from learning (Sciarra & Seirup, 2008). McMillian (2003) examined African American students who learned to solve word problems by following procedural steps, such as circling key information in word problems and underlining number facts. The students became disengaged because they had no connection to the mathematics problem, which resulted in inaccurate answers (McMiliam, 2003). The components of culturally relevant mathematics word problems,
cultural connection and academic achievement, are essential to keep students motivated and engaged in new mathematical concepts (Corp, 2017).

Limited research has been conducted to examine the effect on achievement of culturally relevant word problems in elementary mathematics classrooms serving African American fourth grade students from lower socio-economic communities. Likpa, Parmelee, and Adams (2004) conducted a quasi-experimental design to examine the effectiveness of indigenous mathematics teaching and culturally relevant pedagogy in the mathematics curriculum. The efforts of Likpa and Adams (2004) to create a pedagogy based on Yupik culture assisted Alaska Native students to gain greater understanding of mathematics content.

Additionally, McGee (2011) conducted a phenomenological qualitative study to examine the life stories and experiences of high-achieving mathematics and engineering Black students in college. McGee (2011) examined personal accounts of how these Black students could demonstrate high levels of performance in the content area of science and mathematics. Herron and Barta (2009) conducted a quasi-experimental study on the impact of culturally relevant word problems for students in second grade mathematic classes. The focus of the participants in the study was Caucasian versus NonCaucasian. The study of Herron and Barta (2009) comes close to a few of the aspects of this study; however, this study is a quasi-experimental study for fourth grade African American students only, while also controlling for two additional factors: gender and participation in the free/reduced lunch program. All participants in the study were African American.
This chapter describes the methodology used in this experimental study. It provides an explanation of how word problems are considered culturally relevant or not, based on a checklist derived from the previous study of Herron and Barta (2009). Inclusion of the variables used in the study serves to increase its validity. An explanation of the data collection method is given, along with the safeguards taken to protect the identity of the participants. The chapter concludes with a statement of the researcher’s role in this body of research and a summary of the methods used to conduct the study.

Research Question Reiterated

The purpose of this study was to answer the following question: To what degree do culturally relevant word problems, compared to traditional textbook word problems, affect fourth grade students’ ability to accurately solve word problems, when controlling for gender and eligibility to receive free/reduced lunch?

Hypothesis

The null hypothesis stated that compared to traditional word problems, when using culturally relevant word problems, while controlling for gender and eligibility to receive free/reduced lunch, there will be no significant difference on the effect of fourth grade students’ ability to solve mathematics word problems.

Sample Population

The participants selected for this study were fourth grade students in one school in a large urban school district in Georgia. The school consisted of students where 98% of them identified themselves as African American, and 2% identified themselves as belonging to more than one ethnic group. The student population consisted of 48% males
and 52% females, and 85% of the students were part of the free/reduced lunch program. The control group consisted of two fourth grade classrooms, with 23 students in one class and 19 students in the other classroom. The experimental group consisted of three fourth grade classrooms, consisting of 19 students in two of the classrooms and 23 in the other classroom. The teachers in each of the classrooms followed similar mathematics instructional practices where they encouraged students to underline key vocabulary words and circle numbers significant to solving the problem.

Research Design

For this study, I used a pretest/posttest control group design with random assignment of the participating classrooms to the control group to the experimental group. During the month of September, the participants completed a pretest consisting of basic multiplication and division word problems selected from previous districtwide benchmark assessments. During the months of September, October, and November, mathematics instruction occurred daily for 75 minutes, with 10 to 15 minutes of explicit problem-solving strategies implementation. During the six weeks, which consisted of 24 sessions of culturally relevant sessions, teachers used a single word problem to conduct the instruction of mathematical word problems. For five days of each week, for a six-week period, the control group of two classes received word problems from the district-adopted textbook. The experimental group of three classes received culturally relevant word problems for the same length of time as the control group.

At the end of the six-week treatment of 24 sessions, students completed a posttest, which consisted of basic multiplication and division word problems selected from
previous districtwide benchmark assessments. After analyzing the results of the pretest and posttest, I discovered that the scores of the students on the Benchmark pretest and posttest resulted in a strong left range restriction. Because of the left range restriction complication, I used the pretest and posttest results of the Star 360 assessment for the research design analysis.

Measures and Covariates

The synthesis of research by Aronson and Laughter (2016) suggests that social economic status and gender may impact students’ mathematics achievement; therefore, efforts were made to control for these variables as well as the prior mathematics achievement performance of the students. Controlling for these variables strengthened the validity of the study.

For this study, social economic status refers to a student who receives free, reduced, or no funding assistance for the lunch program at the participating school. I collected the mathematic scores from the Star 360 universal screener for each participant in the five participating classrooms. I examined the third grade Georgia Milestone Assessment System (GMAS) mathematics scores for each of the participants to reference prior mathematics achievement.

Instrumentation Development

I used a Culturally Relevant Problem Revision checklist (see Appendix E) to ensure that the culturally relevant word problems met certain criteria. The problems had to include three of the six criteria: (1) names of students in the class, (2) local locations, (3) food or restaurants familiar to the students, (4) names of teachers, (5) games, sports,
activities, or objects of students in the class, or (6) holidays or special celebrations connected to the students. For the word problems to be considered culturally relevant, three or more of the components of the culturally relevant revision guide had to be evident and reviewed by school district experts. The checklist used by the school district experts was adapted from the revision guide of Herron and Barta (2009). The district experts, consisting of the elementary mathematics coordinators, reviewed all 24 revised culturally relevant word problems and used the checklist to assess for validity of meeting the criteria of containing at least three components of the six criteria of the revision guide. As a result of their review, three culturally relevant revised word problems were removed from the study and not given to students in the experimental groups. According to the experts, the three questions did not meet the criteria for being culturally relevant. The resulting list is located in Appendix F.

The original pretest and posttest questions (see Appendix H) were selected from previous districtwide benchmark assessments reflecting word problems from basic mathematical skills of multiplication and division. The use of 14 questions for the pretest and posttest was appropriate for establishing tentative findings. An increase in the number of questions would have allowed for a broader range of the types of questions and level of difficulty (DeCorte, Verschaffel, & deWin, 1985; Villasenor & Kepner, 1993).

During observations, I utilized a recording sheet (see Appendix G) to keep a record of teacher implementation of mathematics instruction using textbook problems or culturally relevant word problems. The following components were examined during
classroom observations: length of explicit problem-solving instruction (10-15 minutes), consistency of problem solving strategies, and use of culturally relevant problems for the five days of the week for a six-week period.

Data Collection Procedures

The teachers in the study taught mathematics instruction for approximately 75 minutes each day during the six-week period. I observed the control and the treatment groups weekly to ensure the consistency of the implementation of the mathematics instruction in each of the classes. I observed the methods the teacher used to present each word problem. I also checked the student folders where the students completed their work of solving the assigned word problems each day. Folders were maintained for each student during the collection of data to ensure all students were completing the assigned word problem each day. To maintain consistency of mathematics instruction, students solved the mathematic word problems using a combination of the eight problem solving strategies: guess and check, finding a pattern, making a table, working backwards, drawing a picture, making a list, acting it out, or making a chart (Wilburne, 2006). A recording sheet was used weekly to document the consistency of instruction or lack of consistency for each of the teachers in the study.

Control Group

The teachers in the control group explicitly taught students how to solve word problems involving either multiplication or division skills for approximately 10 to 15 minutes. The teachers used problems selected from the district-adopted textbook. For
the remainder of the mathematical instructional time, the teacher continued with the assigned mathematic concepts as designed by the districtwide scope and sequence.

Treatment Group

The teachers in the experimental group explicitly taught problem solving involving multiplication and division for approximately 10 to 15 minutes daily. The teachers used the culturally relevant word problems developed for the study. The teachers and I had a training session for writing culturally relevant problems for the students. The 21 revised word problems met the criteria for being culturally relevant. Problems included people, places, and things relevant to the students in the classrooms.

Data Analysis

The analysis of the data included the scores from the pretest and posttest, as well as a statistical analysis of the research question. For the first analysis conducted, I used Analysis of Covariance (ANCOVA) to compare the mean of two groups: control and treatment. Multiple regression techniques were used to examine the effects of gender, social economic status, treatment group, and prior mathematics achievement scores. The reason for using multiple regression techniques was to characterize the relationship between the change in test scores and variables of gender, social economic status, treatment group, and prior mathematics achievement scores. This technique allowed for an exploration of the relationship between one variable and the change in test scores while controlling for another variable.

This quasi-experiment using a pretest/posttest with control design allowed for the use of Analysis of Covariance (ANCOVA) and the Statistical Package for Social
Sciences (SPSS, Version22.0.0.0) to perform the analysis. Field (2009) asserted that the data met the following assumptions to perform ANCOVA on it. According to Field (2009), because the $p$ value corresponding to the pretest group is greater than .05, then there will be homogeneity of regression of the slopes. To ensure the assumptions were met, the results of an independent samples $t$-test had to be greater than .05 to determine if there was no statistically significant difference between the two groups on the pretest. Additionally, the Levene’s test was used to assume the homogeneity of the variances where the standardized residual was greater than .05. All variables were written as continuous or categorical.

Ethical Safeguards

After receiving approval from the Institutional Review Board (IRB) of Mercer University (see Appendix A), I obtained consent from the student participants and their parents (see Appendices B and C respectively) and from the teacher participants (see Appendix D). I did not collect any data prior to receiving these approvals.

A component of culturally relevant word problems is to use the name of the students or teachers in the word problems. However, I assigned pseudonyms to protect the identity of the students and teachers. The data collected were stored in a highly secure desk file drawer to protect the privacy of the participants.

Following the completion of the study, the students in the control group received the same culturally relevant word problems as the treatment group during the second semester of the school year. By the end of the school year, all fourth grade students at the
study site will have been exposed to the instructional practices of problem solving using culturally relevant word problems.

Role of the Researcher

My interest during my entire matriculation in school has always been mathematics. It was no surprise that I would major in education and become a mathematics teacher. During my graduate work, my thesis involved mathematics and the use of manipulatives. I thought I would continue the study during my doctoral studies; however, when I encountered the concept of culturally relevant pedagogy with Dr. Scott-Simmons in the History of Curriculum class, I knew this was a topic I had to research. Ultimately, I decided to combine the two and research culturally relevant pedagogy in mathematics classes.

Initially, I thought I would examine test scores from the state assessment for the students at the school where I was the principal. However, after collaborating with my Quantitative 1 professor, Dr. Hall, I realized my chosen topic was a bit too broad. After completing additional courses in Seminar, I decided to conduct a quantitative study with a treatment group and a control group. The research design evolved into a quasi-experimental study. Even though I am quite passionate about the topic of culturally relevant pedagogy in mathematics, I was open to the unbiased stance that I had to take as I collected and analyzed the data.

Summary

In summary, a quasi-experimental using a pretest/ posttest with control group design was used to determine the degree of impact that culturally relevant word problems
have on fourth grade African American students’ ability to solve word problems accurately. The study occurred in a Title 1 school where the student body was 98% African American and 85% of the students in the school were eligible for the free/reduced lunch program. The variables of the study consisted of pretest scores, previous mathematics achievement, gender, and social economic status.

The qualitative study of Corp (2017) was specific to African American elementary students and the use of incorporating African American mathematical literature in the lessons in the classroom. The results of the study of Corp (2017) indicated that the incorporation of culturally pedagogy had a positive impact on the students’ mathematical achievement, along with engagement and motivation. This quasi-experimental pretest/posttest design examined culturally relevant pedagogy in elementary mathematics for African American elementary students in the form of a quantitative study. The results of this study did not measure engagement or motivation, but the analysis was made strictly on the results of the pretest and posttest scores of the Star 360 assessment, while controlling for gender and socioeconomic status. Chapter 4 presents an analysis of covariance after meeting the assumptions as suggested by Fields (2009) to determine the effect of the intervention represented by the posttest scores.
CHAPTER 4
DREAMING THE PROCESS

What is the hope of the dream deferred? Did the dream deferred become a reality for the African American students in this study? Is there hope for the dream of academic success and cultural competence with the use of culturally relevant word problems in mathematics classrooms? In this study, there was an inclusion of people, places, things, and areas of interest for the students in the fourth grade mathematics classes which connected them with new learning of mathematical concepts. Did this cultural connection make a difference by giving students additional access to new learning in their mathematics classes and give life to their deferred dream?

Results of Statistical Analyses of Data

In the previous chapters, which include the literature of related studies of culturally relevant pedagogy in mathematics, are descriptions of the methodology used to collect the data on the impact of using culturally relevant pedagogy in mathematics. Students are more motivated to solve mathematical word problems when they can make a connection to the new learning of the concepts (Lattimore, 2005). Teachers in an elementary classroom should make a conscious effort to create cultural experiences that are familiar to their students (Debnam, Pas, Bottiani, Cash, & Bradshaw, 2015). Additionally, Chapter 2 offered discussions of previous studies involving culturally relevant pedagogy and determined that existing studies were limited to qualitative
studies, with only one quantitative study of a general exploration of culturally relevant pedagogy in mathematics (Bonner & Adams, 2012; Enyedy & Mukhopadhyay, 2007; Hubert, 2013; Ukpokodu, 2011).

The results of the literature indicate a need for additional research of culturally relevant pedagogy in mathematics, specifically using a quantitative approach. The one quantitative study indicated in the literature review measured not only textbook word problems, culturally relevant word problems, but also the impact of progress with using algorithms in mathematics (Herron & Barta, 2009). This investigation focused solely on the mathematical concept of word problems for one distinct group of students, African American, who may or may not receive free/reduced lunch. The investigation of the study sought to determine the impact of culturally relevant word problems in comparison to textbook word problems.

Chapter 3 provided an explanation of this study’s quasi-experimental pretest/posttest design and a description of the random selection of the control group and the experimental group participants. After collecting data for six weeks, including 24 days of treatment with culturally relevant word problems, I conducted a detailed data analysis to determine if there was a statistically significant difference between the posttest scores of the students in both the control group and the experimental group.

To be included in the list of word problems for the treatment group, the mathematics word problems had to meet the criteria of being culturally relevant. The word problems had to include at least three of the six components: (1) names of students in the class, (2) local locations, (3) foods or restaurants familiar to the students, (4) names
of teachers, (5) games, sports, activities, or objects of students in the class, or (6) holidays or special celebrations connected to the students. The validity of the word problems was vetted by the mathematics experts in the school district where the study occurred. The mathematics coordinators used the Culturally Relevant Problem Revision Checklist (see Appendix E) to determine the validity of the questions. After the questions were vetted three of the twenty-four questions were omitted from the study because they did not meet the criteria for three of the six components on the checklist.

This chapter presents the results of the quasi-experiment using a pretest/posttest with control design to determine if the use of culturally relevant word problems had an impact on the posttest scores of the fourth grade students. First is a description of the study participants. Next is a discussion of the research question, hypothesis, and statistical analysis of the data. Also addressed is how the data set met the assumptions of the test and the analysis of using the test. Lastly is a summary of the findings from the statistical analysis of data from the control and the experimental groups.

Characteristics of Participants: Students and Teachers

The participants in this study were fourth-grade African American students where the majority was eligible to receive free/reduced lunch meals in one school in a large urban school district in Georgia. All the fourth grade participants identified themselves as African American and 84% of the students qualified for the free/reduced meals program.

According to the U.S. Department of Agriculture, the eligibility guidelines for free and reduced-price meals were calculated by multiplying the 2017 federal income
poverty guidelines by 1.30 (reduced price) and 1.85 (free price) and then rounding the product to the nearest dollar (U.S. Department of Health & Human Services, 2017). Using the measure of free/reduced lunch in a study to define social economic status, specifically poverty, is a limitation because there is a major restriction of range in the upper end of the free/reduced lunch variable for students. This restriction in range will vary to a degree with the level of poverty for the students (Randolph & Prejean-Harris, 2017). However, typically a students’ social economic status is based on the household family income of the student and the eligibility of free/reduced lunch. A family with a low income may not have financial assets, community support, educational resources, and adequate healthcare (Strutchens & Silver, 2000).

The control group consisted of two fourth grade classrooms, one class with 23 students and the other class with 19 students. The total number of participants in the control group was 42, where 36 of the students were eligible for the free/reduced meals program. The control group was comprised of 21 females and 21 males. Of the 21 males in the control group, 19 qualified for the free/reduced meals program. Of the 21 females in the control group, 17 qualified for the free/reduced meals program.

The experimental group consisted of three fourth grade classrooms, consisting of 19 students in two of the classrooms and 23 in the other classroom. The total number of participants in the experimental group was 61, and 51 of the students were eligible for the free/reduced meals program. The experimental group was comprised of 31 females and 30 males. Of the 30 males in the experimental group, 25 qualified for the free/reduced
meals program. Of the 31 females in the experimental group, 26 qualified for the free/reduced meals program.

All the teachers in the study were of African American heritage and implemented similar pedagogical practices for problem solving in their classrooms. Their teaching experience at the elementary level ranged from seven to ten years. The teachers in the study had received satisfactory ratings on the teacher evaluation instrument for the school district in current and previous years. The 10 components of the instrument used to evaluate teachers include: (1) professional knowledge, (2) instructional planning, (3) instructional strategies, (4) differentiated instruction, (5) assessment strategies, (6) assessment uses, (7) positive learning environment, (8) academically challenging environment, (9) professionalism, and (10) communication (Georgia Department of Education).

Research Question and Hypothesis

The research question investigated for this study was: To what degree do culturally relevant word problems, compared to traditional text-book word problems, affect fourth grade students’ ability to accurately solve word problems, when controlling for gender and eligibility to receive free/reduced meals as measured by the Star 360 assessment?

To develop a reasonable conclusion for this investigation, the following statement was the research null hypothesis, which corresponds to the research question: Compared to traditional word problems, when using culturally relevant word problems, while controlling for gender and eligibility to receive free/reduced lunch, there will be no
significant difference on the effect of fourth grade students’ ability to solve mathematics word problems. The $p$ value for the intervention was set to be less than or equal to .050 for the rejection of the null hypothesis.

Complications

To try to resolve the first complication, there was an exploration of using transformations, Tobit regression, and robust regression. However, the measures became too complicated and complex for this study. Fortunately, during the collection of data, I noticed that the fourth grade students had completed the Star 360 assessment two days before I administered the Benchmark posttest to the participants in the study. The same participants completed the Star 360 assessment prior to the start of the study. As a resolution to the left range restriction, I decided to use the data from the Star 360 assessment for the pretest and posttest for this study. Using the pretest and posttest data from Star 360, a different set of data, resolved the other complication of lack of normality for Classroom C.

Complications Related to the Benchmark

The test questions used for the originally intended pretest and posttest for the study were selected from released questions from the districts’ Benchmark assessments. However, the Benchmark pretest and posttest results had a strong left range restriction (see Figures 1 through 5).
Figure 1. Histogram for benchmark pretest for control group.
Figure 2. Histogram for benchmark pretest for experimental group.
Figure 3. Histogram for benchmark posttest for control group.
Figure 4. Histogram for benchmark posttest for experimental group.
Complications Related to Lack of Normality

The lack of normality in Classroom C had uncharacteristically large gain scores compared to the other classrooms when using the results of the Benchmark assessment as the posttest. It appeared the teacher gave the students additional culturally relevant word problems created by the students. The students in this class received additional practice, which may have had an impact on the outcome of their scores for the posttest when using the Benchmark. Figure 6 depicts the error plot of gain scores.
Complications Related to Lack of Convergence

To consider the cluster of students within the classrooms, I attempted to conduct a linear mixed model with the classroom as the random factor. However, SPSS gave an error message (see Figure 7) prior to displaying the chart seen in Table 4. After seeing this warning, I realized I could not trust the results of the chart because the model specification involves redundant covariances parameters (West, Welch, & Galecki, 2007).
Figure 7. SPSS warning message for ANCOVA.

Table 4

*Linear Mixed Model of Means for Each Classroom*

<table>
<thead>
<tr>
<th>Class</th>
<th>Count</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Coefficient of Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Posttest</td>
<td>19</td>
<td>28.8947</td>
<td>24.85490</td>
</tr>
<tr>
<td></td>
<td>Pretest</td>
<td>19</td>
<td>13.4211</td>
<td>13.88171</td>
</tr>
<tr>
<td>B</td>
<td>Posttest</td>
<td>19</td>
<td>36.4211</td>
<td>23.96367</td>
</tr>
<tr>
<td></td>
<td>Pretest</td>
<td>19</td>
<td>24.3684</td>
<td>19.88079</td>
</tr>
<tr>
<td>C</td>
<td>Posttest</td>
<td>23</td>
<td>39.5217</td>
<td>14.70581</td>
</tr>
<tr>
<td></td>
<td>Pretest</td>
<td>23</td>
<td>12.3478</td>
<td>13.00562</td>
</tr>
<tr>
<td>D</td>
<td>Posttest</td>
<td>19</td>
<td>37.1053</td>
<td>25.30019</td>
</tr>
<tr>
<td></td>
<td>Pretest</td>
<td>19</td>
<td>26.0000</td>
<td>19.57890</td>
</tr>
<tr>
<td>E</td>
<td>Posttest</td>
<td>23</td>
<td>21.7391</td>
<td>18.81541</td>
</tr>
<tr>
<td></td>
<td>Pretest</td>
<td>23</td>
<td>11.1304</td>
<td>11.82564</td>
</tr>
<tr>
<td>Total</td>
<td>Posttest</td>
<td>103</td>
<td>32.5728</td>
<td>22.19857</td>
</tr>
<tr>
<td></td>
<td>Pretest</td>
<td>103</td>
<td>17.0097</td>
<td>16.68185</td>
</tr>
</tbody>
</table>

Regression Assumptions

I used the data from the Star 360 to determine if the assumptions had been met prior to running the ANCOVA. Since all of the data met the assumptions, then
ANCOVA indicated the effect of using culturally relevant word problems in mathematics. *Figures 8 and 9* depict the descriptive statistics for Star 360.

*Figure 8*. Histogram for Star 360 posttest for control group.
**Assumptions**

To determine if there are influential points, I examined all cases that had a standardized residual above three. There was not a standardized value of three or above; thus, there were no influential data points. The $R^2$ value of .66 indicated that this model accounted for 66% of the variation in the model. Since the value of Durbin-Watson (2.17) statistic is between 1 and 3, I assumed that there is no autocorrelation. The
statistically significant $F$ value indicated that the model with the pretest and the intervention is a better model than the one with the only grand mean.

This data set met all of Fields’ (2009) assumptions for multiple regression. The results of a Durbin-Watson test indicated no auto correlation, $d = 2.17$. There were no cases with a standard residual above 3.00 for the Casewise diagnostics. A visual analysis of, residual plots, scatterplots, and a histogram of regression standardized residuals indicated linearity, homoscedasticity, and normal distributed errors. The outcome was continuous, and predictors were continuous. Neither variable had zero variance. Independence of observations was assumed. See Figures 10 and 11.

![Histogram](image)

*Figure 10. Histogram of regression standardized residuals.*
Table 5 and Figure 12 indicate the results of the regression. The constant in the B column (.27) was the predicted value of the posttest when the pretest is zero. In regression, the B coefficient for continuous variables was the slope; the B coefficient for dichotomous variables was the difference between one group and another. The pretest is a continuous variable; therefore, 0.81 was the slope between the pretest and the posttest. The intervention variable is a dichotomous variable, so it indicates the expected difference on the posttest if a participant was in the experimental group.
### Table 5

**Predictors of Posttest Star 360 Scores**

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>β</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>.27</td>
<td></td>
<td>[−.09, .62]</td>
</tr>
<tr>
<td>Pretest Score</td>
<td>.81</td>
<td>.81</td>
<td>[.69, .93]</td>
</tr>
<tr>
<td>Group - Experiment</td>
<td>-.20</td>
<td>-.10</td>
<td>[−.45, .04]</td>
</tr>
<tr>
<td>Gender – Female</td>
<td>.31</td>
<td>.15</td>
<td>[.07, .54]</td>
</tr>
<tr>
<td>FRL-Participant</td>
<td>-.36</td>
<td>-.13</td>
<td>[−.68, -.04]</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>.66</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( F )</td>
<td>48.27</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. N = 103; CI = confidence interval; * \( p < .01 \); ** \( p < .01 \); *** \( p < .001 \)*

![Scatterplot of unadjusted pretest and posttest scores labeled by group.](image)

**Figure 12.** Scatterplot of unadjusted pretest and posttest scores labeled by group.
The coefficient for the intervention group was -.20, indicating that the intervention had a negative impact; however, the $p$ value (.10) was greater than .05 indicating that the coefficient for the intervention was not statistically significant. I accepted the null hypothesis that there is no difference between the experimental and control group posttest scores when controlling for the pretest.

The coefficient for gender group was .31 and the $p$ value (.01) for gender was less than .05 indicating that the coefficient for gender is statistically significant. I rejected the null hypothesis that there is no difference between the posttest scores of the participants in the experimental group and the participants in the control group based on gender when controlling for the pretest.

The coefficient for the free/reduced meals group was -.36 and the $p$ value (.03) for participation in the free/reduced meals program was less than .05, indicating that the coefficient for participation in the free/reduced meals program is statistically significant. I rejected the null hypothesis that there is no difference between the posttest scores of the students who participate in the free/reduced meals program in the experimental group and the students who participate in the free/reduced meals program in the control group when controlling for the pretest. See Figures 13 through 16.
Figure 13. Partial residual plot: Group. Control—left side; experimental—right side.

Figure 14. Partial residual plot: Gender. Boys—left side; girls—right side.
**Figure 15.** Partial residual plot: Free/reduced lunch. No free/reduced lunch—left side; yes free/reduced lunch—right side.

**Figure 16.** Partial residual plot: Zscore (Star pretest).
Summary

This chapter has an explanation of how the Shadish, Cook, and Campbell (2002) quasi-experimental design study, with randomization, and with dependent pretest and posttest samples of the data analysis from the 103 participants in the study, met the assumptions for conducting an analysis of covariance. Also, in this chapter are discussions of complications and resolutions for the data set for the analysis of the data and explanation of how an analysis of covariance was conducted. I presented both the assumptions and the results of ANCOVA. Analysis of the data led me to accept the null hypothesis: there was not a statistically significant difference between the posttest scores of students who received culturally relevant word problems in mathematics and students who did not receive the culturally relevant word problems. The covariates of gender and participation in the free/reduced meals program did have significant effect as measured by the dependent variable, the posttest scores.

Chapter 5 presents a discussion of the implications from the results of this study and influence of using culturally relevant word problems in mathematics. The limitations and complications of this study are also addressed in Chapter 5. Additionally, in Chapter 5, I make recommendations for further studies and future investigations involving culturally relevant word problems in mathematics.
CHAPTER 5

DO DREAMS COME TRUE?

Yes, dreams can come true. Students may receive equality in education in their mathematics classes with the incorporation of culturally relevant word problems. Teachers may decide to implement any of the following at the beginning of their mathematics classes to expose students to culturally relevant word problems: (a) problem of the day, (b) brain challenge, (c) do now, (d) mind-buster, or (e) a similar activity. The incorporation of the name of a classmate, an item in the classroom, the name of a local grocery store, or the mention of the name of a teacher in the school, may be the connection needed for a student to engage in new mathematical knowledge.

Findings, Conclusions, and Implications

Most teaching practices in urban settings do not capitalize on the students’ experiences that they bring to the classroom in order to make mathematics learning successful for them (Gay, 2000; Guitierrez, 2000; Ladson-Billings, 1997; NCTM, 2000; Tate, 2005). The experiences that are brought to the attention of students may not be experiences that are relevant to the students. Additional studies should be conducted to explore cultural relevance in mathematics for African American students. This study is significant because it provides a quantitative approach to the effects of the use of culturally relevant pedagogy in mathematics classes. There is also the addition of the control variable of gender and eligibility of free/reduced meals. In the content area of
mathematics, the achievement gap continues to grow for African American students, specifically for students with low socio-economic status (Brown-Jeffy, 2009; Chambers, 2009; Chapman, 2008; Harmon, 2012). There continues to be the need for additional studies to explore culturally relevant pedagogy in mathematics to provide additional teaching strategies for educators.

This chapter provides an overview of the findings from the quasi-experimental pretest/posttest design of this study. In addition, the chapter offers a discussion of the analysis of the limitations of the study and the limitations of the research design. In addition, the findings of this study are compared with the only other quantitative study that explored culturally relevant pedagogy in mathematics at the elementary level (Herron & Barta, 2009), as discussed in Chapter 2. Following this is an exposition of the implications of the study and postulations for future studies.

This quasi-experimental pretest/posttest design investigated whether culturally relevant word problems would have an impact on fourth grade students’ ability to solve word problems accurately, when compared to traditional textbook word problems, while controlling for gender and eligibility to receive free/reduced meals. Two randomly selected groups of students comprised the control group and the experimental group. The fourth grade African Americans student participants were from one school in a large urban school district in Georgia. The control group received problem-solving instruction by using the textbook word problems for six weeks, while the experimental group received problem-solving instruction by using the culturally relevant word problems. The score on the posttest, the Star 360 assessment, served as the dependent variable to
indicate progress in mathematical learning with accuracy of solving word problems. The covariates used in this study were the pretest of the Star 360 assessment, gender, and eligibility of student participation in the free/reduced lunch program.

Research Question Revisited

The following research question was used to investigate the study: To what degree do culturally relevant word problems, compared to traditional textbook word problems, affect fourth grade students’ ability to accurately solve word problems, when controlling for gender and eligibility to receive free/reduced meals?

Research Hypothesis and Criteria of Rejection of Hypothesis

To determine an answer for the research question, the following statement was used as the research null hypothesis, which corresponds to the research question. It should be noted that if the \( p \) value for the intervention parameter is less than or equal to .050, the null hypothesis will be rejected. The null hypothesis states that compared to traditional word problems, when using culturally relevant word problems, while controlling for gender and eligibility to receive free/reduced meals, there will be no significant difference in the effect of fourth grade students’ ability to solve word problems.

Findings and Conclusions

Analysis of covariance (ANCOVA) with pretest scores as a covariate did not illustrate a statistically significant difference between the posttest scores of the experimental and control group \( (p = .10; \beta = -.20) \), thus suggesting that the use of culturally relevant word problems does not influence fourth grade students’ ability to
solve word problems accurately. There was a statistically significant difference in the posttest scores for gender in the experimental and control group ($p = .01; \beta = .31$).

There was a statistically significant difference in the posttest scores for students who were eligible to receive free/reduced meals in the experimental and control group ($p = .03; \beta = -.36$).

The results of this study do not support the findings of other studies involving the use of culturally relevant pedagogy in mathematics. Studies on the use of culturally relevant instruction, including Gustein, Lipman, Hernandez, and de los Reyes (1997); Brenner (1998); Lopez and Sullivan (2004); and Lipka and Adams (2004), and more specifically in mathematics instruction, including Ladson-Billings (1994), Hubert (2013), and Leonard and Guha (2002), revealed positive implications with the use of culturally relevant pedagogy for students. The results of this study do not support similar implications to the other studies with the use of culturally relevant word problems in mathematics with regard to African American students in the fourth grade.

Herron and Barta’s (2009) quantitative study was similar to this study. Both studies examined the use of culturally relevant word problems in mathematics at the elementary level. Both made comparisons on the use of textbook word problems and culturally relevant word problems, while controlling for gender and social economic status. There was a distinction with the identification of the students’ social economic status in that in the Herron and Barta’s (2009) study, comparisons were made with students who received free or reduced lunches, whereas in this study, participants were identified as receiving free/reduced meals or not receiving free/reduced meals. It was
challenging to define students’ social economic status based solely on eligibility for free/reduced meals based on the results of Randolph and Prejean-Harris (2017).

The two investigations had similar components and the quantitative measures were in close range. After conducting the analysis for multiple regression for the posttest controlling for the variable of the pretest, the overall effect size for Herron and Barta (2009) was .76. The overall outcome for this study, after conducting the multiple regression, was .66, indicating a similar effect size. A difference in the two studies was the ethnicity of the participants. In Herron and Barta’s (2009) study, the participants were Caucasian or non-Caucasian in northern Utah. In this study, all the participants were African American students in an urban setting in Georgia.

It is somewhat surprising that the variable of gender surfaced as statistically significant in both studies based on the meta-analysis of Linberg, Hyde, and Petersen (2010), which indicated that males and females perform similarly in the content area of mathematics. However, also in the meta-analysis, the researchers concluded that the function of factors such as age and the difficulty level of the assessment may impact the component of gender differences in the performances of mathematics (Linberg et al., 2010). For this study, the pretest and posttest scores were based on students’ accuracy of answering the questions. The more the students answered the questions correctly, the more the level of difficulty increased.

Limitations of Research Design

One limitation to this study was the choice of a sole study site, with one grade level, in one school district. Another limitation to this study was that all the participants
were African American. This was an intentional limitation because one of the key differentiated factors for this study was ethnicity. For the purposes of this study, I wanted to discover if culturally relevant word problems in mathematics would impact mathematics performance for one unique group of people, African American students in a public-school setting in a large urban school district at the elementary level.

Even though all the teachers were African American females, this was not an intention limitation. The teacher performance and years of experience were also similar. The teachers used similar problem-solving techniques each day in their classroom settings during mathematics instructional time. Additionally, the teachers received a minimum amount of professional learning centered on culturally relevant pedagogy. This was limited to two one-hour sessions with me for this study.

Another limitation to this study was the amount of time the treatment of culturally relevant word problems was given to the students. The study was conducted over a six-week period where students in the experimental group received the culturally relevant word problems daily for approximately 15 to 20 minutes each day during their mathematic instructional time. Perhaps if the students received the treatment for a longer time, the treatment would have had more of an influence.

One key limitation, which led to a complication of this study, was the results of the initial pretest and posttest scores of the Benchmark assessments. When using the released questions from the Benchmark assessment, the pretest and posttest scores yielded a left range restriction, which indicated the questions on the test were too difficult
for the purposes of this study. As a result, the pretest and posttest scores of the Star 360 assessment were used for the study.

Lastly, the identification of social economic status was limited to the eligibility of students receiving free/reduced meals. There was no data point to indicate the exact family income for each student participant. The study of Randolph and Prejean-Harris (2017) discussed the negative aspects of using free and reduced lunch as a measure for poverty.

Regardless of the limitations, it was my intention to conduct this study without error. Factors beyond my control may have impacted the outcome of the results of this study. However, the large effect size of this study was a positive factor that contributed to the implications of this study regarding the impact of culturally relevant pedagogy in mathematics.

Implications

This study was timely in that it addressed the theory of culturally relevant pedagogy from a quantitative point of view for a specific group of people who continue to surface in the achievement gap of mathematics achievement (Jones, 2015; May, 2011; Ukpokodu, 2011). Based on the results of the analysis of the multiple regression, I had to accept the null hypothesis that there was not a statistically significant difference between the posttest scores of students who received culturally relevant word problems in mathematics and students who did not receive the culturally relevant word problems when controlling for pretest scores. However, the covariates of gender and participation
in the free/reduced meals program did have a significant effect as measured by the dependent variable, the posttest scores.

It may be that for the specific group of students, who participate in the free/reduced meals program, which represented 84% of the participants in the study, the use of culturally relevant pedagogy may yield a positive influence if used for a longer length of time. I suggest daily implementation during the first 15 to 20 minutes of the mathematical instructional time for the entire school year to truly have an impact.

Statistically, the results of this study indicated that the use of culturally relevant word problems does not have an impact on a students’ ability to solve word problems. However, additional investigations should occur to reach a more definitive conclusion. Professional learning for teachers would be a good place to start with impacting best practices for teachers when using culturally relevant pedagogy in mathematics. It is uncertain if changing the name of a person, place, or thing written in a word problem has a direct impact on students’ ability to solve a mathematics word problem accurately. Even so, there are implications that that such a change may allow students opportunities to engage in learning tasks in which they can connect to by building on prior knowledge and experiences in their environment.

Future Research

Even though the implications for this study were based only on the results of the data analysis of the multiple regression, the observation of student motivation did surface during the collection of data. When I made classroom observations to ensure that the word problems were being used as designed by the study, I could not help but notice the
difference in student motivation to solve the word problems when the student saw his or her name written in the word problem. I also observed the same motivation when an item that the students were familiar with was mentioned in the word problem. Perhaps future research could be conducted using an observation instrument or student survey to determine the level of motivation or engagement of students within the experimental group in comparison to the control group.

The literature review in Chapter 2 consisted mostly of qualitative studies or mixed-method research. The use of a qualitative study, centered on student language, is typically conducted when investigating culturally relevant pedagogy (Harmon, 2012). Additional research is warranted for culturally relevant pedagogy in the content area of mathematics using a quantitative method. The content area of mathematics includes mathematical vocabulary and lends itself to exploration with the additional teaching method of using culturally relevant word problems.

Final Thoughts

To reiterate, the results from the gap analysis of the NAEP for fourth grade suggested a need to address implications in the content area of mathematics. Such an analysis holds true for urban and low-income students, often because of school policies, curriculum guides, and teaching practices that do not keep students engaged, perhaps because of their cultural disconnect (Sheppard, 2011; Stinson, 2008; Woodward & Brown, 2006). The disconnect of culture and learning places African American students in mathematics classrooms at a disadvantage by the lack of building the bridge to make their dreams their reality.
This quantitative study focused solely on African American students’ ability to solve mathematic word problems accurately in an elementary classroom setting when using culturally relevant word problems, while also considering the factors of gender and participation in the free/reduced meals program. Perhaps culturally relevant pedagogy is the bridge to make the connection of real life experiences and new academic learning in mathematics classrooms. It was important to examine African American students specifically because they are part of a large minority group that continues to trail behind their peers who are not minorities (Sheppard, 2011; Stinson, 2008; Woodward & Brown, 2006).

Anecdotal Thoughts

After the experts of the school district vetted the culturally relevant questions, the students in the experimental group received an opportunity to solve a culturally relevant word problem for 15 to 20 minutes, each day for six weeks. The students made connections to the word problems, and they were very motivated to solve the problems. When students saw their name or the name of their classmate, they immediately started making connections to other items that were familiar to them and their learning. Even after the mathematics instruction had concluded, students continued to talk about the mathematics problem and started creating their own word problems informally. For the students who received culturally relevant word problems in their mathematics class for this study, the culturally relevant experiences were no longer a dream, but a reality. The personalization of the word problems motivated and encouraged students to engage in the
assigned mathematics problems quickly and for a longer time period than with the textbook mathematics questions.

The impact of using culturally relevant word problems may not have been statistically significant from a quantitative perspective, yet I hope that educators will be inspired to include real-life connections when teaching problem solving. This study was designed to give educators another instructional theory to consider when designing curriculum for all students by making mathematics word problems their students’ word problems.

Now I know the answers to the question,
Do dreams come true?
Still staring at the world through my rearview.
I said, now I know the answer,
Do dreams come true?
Staring at the world through my rearview

-Tupac Shakur
REFERENCES


APPENDICES
APPENDIX A

IRB APPROVAL
Friday, August 25, 2017

Ms. Cheryl Tuymen
3001 Mercer University Drive
Trinity College of Education - Atlanta
Atlanta, GA

RE: It's not my problem: Culturally relevant word problems in fourth grade mathematics (H1708205)

Dear Ms. Tuymen:

On behalf of Mercer University’s Institutional Review Board for Human Subjects Research, your application submitted on 16-Aug-2017 for the above referenced protocol was reviewed in accordance with Federal Regulations 21 CFR 50.101(b) and 21 CFR 46.110(b) (for expedited review) and was approved under category(ies) 7 per 45 FR 50364.

Your application was approved for one year of study on 25-Aug-2017. The protocol expires on 24-Aug-2018. If the study continues beyond one year, it must be re-evaluated by the IRB Committee.

Item(s) Approved:
A pre-test/post-test quasi-experimental design will be used to examine the effect of the culturally relevant word problems on the fourth grade students’ ability to solve word problems.

NOTES: Please report to the committee when the protocol is initiated. Report to the Committee immediately any changes in the protocol or consent form and ALL accidents, injuries, and serious or unexpected adverse events that occur to your subjects as a result of this study.

We at the IRB and the Office of Research Compliance are dedicated to providing the best service to our research community. As one of our investigators, we value your feedback and ask that you please take a moment to complete our Satisfaction Survey and help us to improve the quality of our service.

It has been a pleasure working with you and we wish you much success with your project! If you need any further assistance, please feel free to contact our office.

Respectfully,

[Signature]

[Aunt Chambless-Richardson, Ph.D., CR, CIOM]
[Associate Director of Human Research Protection Programs (HRPP)]
[Member Institutional Review Board]

“Mercer University has adopted and agrees to conduct its clinical research studies in accordance with the International Conference on Harmonization’s (ICH) Guidelines for Good Clinical Practice.”
APPENDIX B

STUDENT INFORMED ASSENT
Culturally Relevant Word Problems in Mathematics

Informed Assent/Verbal Script
For Children Under 12 Years Old (3rd, 4th, 5th, 6th Graders)

Hello, my name is Cheryl Twyman and I am a researcher at Mercer University who is trying to learn how students understand and solve word problems.

The purpose of this study is to determine if using culturally relevant word problems has an effect on students’ ability to solve word problems accurately.

You are being asked to participate in this study because you are a student in the fourth grade.

I will be the person in charge of this study and it will take place at Deerwood Academy for 12 weeks.

What will happen is that you will solve word problems that may be different from the word problems in your textbook. In order to keep everything you say or write private, your names will not be used on the forms we collect from you. Your names will be replaced with made up identification numbers on your classwork and tests.

Your parent(s) have said that it is okay for you to be in this research study. You do not have to be in this study if you do not want to be. You can change your mind at any time by telling your Mom, Dad, My Assistant, or Me.

___ NO, I do not want to be in this study.  ___ YES, I want to be in this study.

[Signature of Participant]

[Signature of Person Obtaining Assent]

Date
[Signature]

Date
[Signature]

Mercer IRB Approval Date 08/25/2017
Protocol 08/24/2018
Expiration Date
APPENDIX C

PARENTAL INFORMED CONSENT FORM
Culturally Relevant Word Problems in Mathematics

Parent or Guardian Informed Consent Form

Your child is being asked to participate in a research study entitled, Culturally Relevant Word Problems in Mathematics. The study is being conducted by Cheryl Twyman at Cheryl.P.Twyman@live.mercer.edu and Wynetta Scott-Simmons at SCOTTSIMM_WA@mercer.edu. The results will be used to further my understanding of the use of culturally relevant pedagogy in mathematics classes. Your child's participation is voluntary. A decision to participate in the research will not affect his/her relationship with Deerwood Academy, his/her relationship with other teachers, or his/her academic standing.

I. The purpose of my study is to explore:

This research study is designed to examine the effects of culturally relevant problem solving in students' ability to accurately solve word problems.

The data from this research will be used to provide educators with additional information involving strategies that include culturally relevant pedagogy. As a result of the study, the researcher will be more informed about the effect of culturally relevant pedagogy in mathematics classes.

II. Procedures

If you allow your child to volunteer for this study, your child will be asked to solve mathematics word problems. Your child’s participation will take approximately 30 minutes of their regular mathematics instructional time during the school week for approximately 12 weeks.

Your child will be asked to assent to participate in this research (Assent means that your child will be asked to voluntarily participate in this research). Your child will tell the teacher they want to participate by answering YES or NO after the teacher verbally reads to your child what the research is about and what he or she will be asked to do.

Parent/Guardians who allow students to participate must:
Read and complete the consent form. Give permission to researcher to examine your child’s data from classroom test scores, Georgia Milestone Assessment System (GMAS) mathematics scores, and STAR mathematics data.

III. Potential Benefits to Students and/or Society

While there may be no benefits to the participants, the results of the study will provide teachers with additional strategies to use in their mathematics classes.
IV. Potential Risk and Discomforts

There are no foreseeable risks for this study.

V. Withdrawal of Participation

Your child's participation is voluntary. Your child will not be penalized or lose any benefits that he/she are otherwise entitled to if you decide that your child will not participate in this research project.

If your child decides to participate in this project, he/she may discontinue participation at any time without penalty or loss of benefits. You have the right to inspect any instrument or materials related to the proposal. Your request will be honored within a reasonable period after the request is received.

VI. Payment for Participation

Students will not be paid for their participation. There is no financial obligation for participants.

VII. Confidentiality and Data Storage

The information for this study will be held with the highest confidentiality and stored for at least 3 years with the researcher.

Your child’s name will not be associated with his or her individual responses and will be identified only by an assigned coded number. At no time will your child’s name be associated with the results of the research or shared with parents or others. Any identifying information provided by your child will never be used as part of the research or associated with the results of the study.

Your child’s responses will be stored in a locked location and will only be used for research purposes by Mercer University School.

Questions about the Research

If you have any questions about the research, please speak with Cheryl Twyman. If you have questions later, you may contact Cheryl Twyman at (404) 661-2948 or Wynnetta Scott-Simmons at (678) 547-6582.

You have been given the opportunity to ask questions and these have been answered to your satisfaction. If you agree to allow your child to participate in this research, please complete the information below:

I, [Name of Parent or Legal Guardian], grant my child, [Name of Child Participating in Study] permission to participate in this research study.

Mercer IRB Approval Date 08/25/2017
Protocol Expiration Date 08/24/2018

Rev. January 2017 Page 2
Please return to Cheryl Twyman as soon as possible.

In order to conduct this research, this project has been reviewed and approved by Mercer University’s Institutional Review Board (IRB). If you believe there is any infringement upon your child’s rights as a research subject, please contact the IRB Chair at (478) 301-4101. The IRBs are the governing bodies that are set in place to ensure responsible and safe conduct of research investigations.
APPENDIX D

TEACHER INFORMED CONSENT
Culturally Relevant Word Problems in Mathematics

Informed Consent

You are being asked to participate in a research study. Before you give your consent to volunteer, it is important that you read the following information and ask as many questions as necessary to be sure you understand what you will be asked to do.

Investigators
Cheryl Twyman, Ph.D. candidate at Mercer University, Tift College of Education
3001 Mercer University Drive, Atlanta, GA 30341, 678-547-6398

Purpose of the Research
This research study is designed to examine the effects of culturally relevant problem solving in a students’ ability to accurately solve word problems in mathematics.

The data from this research will be used to provide educators with additional information involving instructional strategies that include culturally relevant pedagogy.

As a result of this study, the researcher will be more informed about the effect of culturally relevant pedagogy in mathematics classes.

Procedures
If you volunteer to participate in this study, you will be asked to teach problem solving explicitly for 10 to 15 minutes, two out of five days a week for a twelve week period.

Teachers in Group A will be asked to use word problems from the district adopted textbook. Teachers in Group B will be asked to use the revised culturally relevant word problems.

Your participation will take approximately 2 days out of a 5 day week for 12 weeks. There will be no additional time needed outside of your regular work day.

Potential Risks or Discomforts
There are no foreseeable risks for this study.

Potential Benefits of the Research
While there may be no benefits to the participants, the results of the study will provide teachers with additional instructional strategies for facilitating their mathematics classes.

Confidentiality and Data Storage
The information for this study will be held with the highest of confidentiality and stored for at least 3 years with the researcher.
Participation and Withdrawal
Your participation in this research study is voluntary. As a participant, you may refuse to participate at any time. To withdraw from the study please contact Cheryl Twyman at CheryLP.Twyman@live.mercer.edu or call (404) 661-2948.

Questions about the Research
If you have any questions about the research, please speak with Wynnetta Scott-Simmons at SCOTTsimm_wa@mercer.edu.

In Case of Injury
It is unlikely that participation in this project will result in harm to subjects. If an injury to a subject does occur, he or she may be seen at a local or regional medical facility. All expenses associated with care will be the responsibility of the participant and his/her insurance.

Reasons for Exclusion from this Study
There is no known reason why a participant would be excluded from this study.

This project has been reviewed and approved by Mercer University’s IRB. If you believe there is any infringement upon your rights as a research subject, you may contact the IRB Chair, at (478) 301-4101.

You have been given the opportunity to ask questions and these have been answered to your satisfaction. Your signature below indicates your voluntary agreement to participate in this research study.

Research Participant Name (Print)________________________ Name of Person Obtaining Consent (Print)________________________

Research Participant Signature________________________________ Person Obtaining Consent Signature________________________

Date________________________ Date________________________
For a word problem to be considered culturally relevant, three instances of any of the six components should be evident. A repeated instance within the same component should be counted more than once as an instance towards the relevance of the problem. This checklist has been derived from the components of a revision guide based on Herron and Barta (2009).

Table E1

Checklist for Culturally Relevant Word Problems

<table>
<thead>
<tr>
<th>Question</th>
<th>Component 1</th>
<th>Component 2</th>
<th>Component 3</th>
<th>Component 4</th>
<th>Component 5</th>
<th>Component 6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Names of students or teachers in class</td>
<td>Local settings familiar to students</td>
<td>Games, sports, hobbies, or items familiar to students</td>
<td>Foods or restaurants familiar to students</td>
<td>Names of family members or pets</td>
<td>Special celebrations of students</td>
</tr>
<tr>
<td>1</td>
<td>-</td>
<td>X</td>
<td>XX</td>
<td>-</td>
<td>-</td>
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</tr>
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<td>3</td>
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<td>4</td>
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<td>11</td>
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<td>X</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>12</td>
<td>X</td>
<td>XX</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>13</td>
<td>XX</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>14</td>
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</tr>
<tr>
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<td>16</td>
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</tr>
<tr>
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<tr>
<td>18</td>
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</tr>
<tr>
<td>19</td>
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<td>-</td>
<td>-</td>
<td>X</td>
</tr>
<tr>
<td>20</td>
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<td>X</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>21</td>
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<td>-</td>
<td>XX</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>22</td>
<td>X</td>
<td>-</td>
<td>XX</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>23</td>
<td>X</td>
<td>XX</td>
<td>-</td>
<td>XX</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>24</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
</tr>
</tbody>
</table>
One of the requirements for a question to be culturally relevant is the use of students’ names and teachers’ name familiar to the students. For this document, the researcher used pseudonyms to protect the confidentiality of the participants in the study. During the collection of data, he researcher used the real names of the students and teachers.

Table F1

*Textbook Questions and Culturally Relevant Questions*

<table>
<thead>
<tr>
<th></th>
<th>Textbook Question</th>
<th>Culturally Relevant Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A grocery store orders 47 bags of onions and 162 bags of potatoes. The onions cost $2 per bag, and the potatoes cost $3 per bag. How much is spent on onions and potatoes?</td>
<td>Mr. Jones, the new manager at the Kroger grocery store orders 47 bags of Jolly Rancher candy and 162 bags of Airheads candy. The Jolly Rancher candy cost $2 per bag, and the Airhead candy cost $3 per bag. How much did he spend when he ordered the Jolly Rancher candy and the Airhead candy?</td>
</tr>
<tr>
<td>2</td>
<td>Sharon’s Stationery Store contains 1,219 boxes of cards. May’s Market contains 3 times as many boxes of cards. How many boxes does May’s market contain?</td>
<td>Big Daddy’s Store contains 1,219 boxes of M &amp; M candies. The Family Dollar Store contains 3 times as many boxes of M &amp; M candies. How many boxes of M &amp; M candies does the Family Dollar Store contain?</td>
</tr>
<tr>
<td>3</td>
<td>A hardware store ordered 4 packs of large screws and 5 packs of smaller screws from a supplier. Each pack contains 150 screws. How many screws did the store order?</td>
<td>Tamika ordered colored pencils from the Walmart to complete her art project. Tamika order 4 packs of large colored pencils and 5 packs of smaller colored pencils. Each pack contains 150 colored pencils. How many colored pencils did she order?</td>
</tr>
<tr>
<td>4</td>
<td>Angel sold 15 magazine subscriptions for $30 each. Walt sold 22 subscriptions for $20 each. Who raised the most money?</td>
<td>Kentravious sold 15 hand spinners for $30 each. Kyjuan sold 22 hand spinners for $20 each. Who raised the most money?</td>
</tr>
<tr>
<td>Textbook Question</td>
<td>Culturally Relevant Question</td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------------------</td>
<td></td>
</tr>
<tr>
<td>5. The height of each story of an <em>apartment</em> building is measured from the bottom of one floor to the bottom of the next floor. There are 3 stories. Each story has a height of 18 feet. How tall is the building?</td>
<td>Gabrielle wants to know how big her new school is because she keeps getting lost in it. ABC school has three levels. The height of each level is measured from the from the bottom of one floor to the bottom of the next floor. Each level of ABC school has a height of 18 feet. How tall is ABC school?</td>
<td></td>
</tr>
<tr>
<td>6. The flagpole in front of City Hall in Lou’s town is 35 feet tall. How many inches tall is the flagpole? Remember, there are 12 inches in a foot.</td>
<td>Mrs. Ugonna hangs the flag in the front of Monique’s school each morning. The flagpole in the front of ABC school is 36 feet tall. How many inches tall is the flagpole? Remember, there are 12 inches in a foot.</td>
<td></td>
</tr>
<tr>
<td>7. Each family of Florida Scrub Jays inhabits 25 acres of land. How many acres of land are needed for 24 families of Florida Scrub Jays?</td>
<td>Mrs. Powell teaches at Thérrell High School in the APS school district. Each high school in the district has 25 acres of land. How many acres of land are needed for 24 high schools in the APS district?</td>
<td></td>
</tr>
<tr>
<td>8. A ferry carried 37 cars per trip on the weekend. If the ferry made 11 trips on Saturday and 13 trips on Sunday, how many cars did it carry on the weekend?</td>
<td>Mr. George, the school bus driver, can carry 37 students on his bus, per trip, in one weekend. If Mr. George makes 11 trips on Saturday and 13 trips on Sunday, how many students did he carry on his bus in one weekend?</td>
<td></td>
</tr>
<tr>
<td>9. One bushel of asparagus weighs 24 pounds. One bushel of carrots weighs 50 pounds. How much do 18 bushels of asparagus and 7 bushels of carrots weigh?</td>
<td>Tequan has one bag of apples that weighs 24 pounds. Shantwan has one bag of oranges that weighs 50 pounds. How much do 18 bags of apples and 7 bags of oranges weigh?</td>
<td></td>
</tr>
<tr>
<td>10. Elaine is making 20 pinecone wreaths to sell at a fair. She needs 13 pinecones for each wreath. How many pinecones does Elaine need in all?</td>
<td>Monet is making 20 Lifesaver candy bracelets for the Fall Festival. She needs 13 Lifesaver candies for each bracelet. How many Lifesaver candies does Monet need in all?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Textbook Question</td>
<td>Culturally Relevant Question</td>
</tr>
<tr>
<td>---</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>11</td>
<td>Tess has 15 pages in her coin collector’s album. Each page holds 32 coins. How many coins will fit in her entire album?</td>
<td>Shantrice has 15 pages in her Beyonce picture book. Each page contains 32 pictures of Beyonce. How many pictures will fit in Shantrice’s entire picture book?</td>
</tr>
<tr>
<td>12</td>
<td>The farmers picked 50 dozen apples at Mr. Piper’s apple grove and 37 dozen apples at Mr. Stuart’s apple grove. There are 12 apples in one dozen. How many apples did the farmers pick?</td>
<td>Kyjuan wants to bring treats for the party on the last day of school. Kyjuan bought 50 dozen cookies from the Family Dollar Store and 37 dozen cookies from Walmart. There are 12 cookies in one dozen. How many cookies did Kyjuan buy for the party?</td>
</tr>
<tr>
<td>13</td>
<td>Jose has 270 hockey cards to arrange equally in 9 boxes. Each box can hold the same number of cards. How many cards should Jose place in each box?</td>
<td>Chance and Shantrice have collected 270 Kool-Aid squeeze bottles to arrange equally in 9 boxes. Each box can hold the same number of bottles. How many Kool-Aid squeeze bottles should Chance and Shantrice place in each box?</td>
</tr>
<tr>
<td>14</td>
<td>Mr. Diaz ordered a supply of 1,800 pastels. He wants to divide them equally among his class and 5 other art classes. How many pastels does each class receive?</td>
<td>Mr. Jenkins, the art teacher, ordered a supply of 1, 800 crayons. He wants to divide them equally among his 1st period class and the other 5 classes. How many crayons does each class period receive?</td>
</tr>
<tr>
<td>15</td>
<td>A bakery produced two batches of bread with 80 loaves in each batch. It sold 30 loaves each hour. How many loaves of bread were sold in 4 hours?</td>
<td>During the Christmas season, Small Cakes Bakery sold two boxes of cupcakes with 80 cupcakes in each box. It sold 30 cupcakes each hour. How many cupcakes were sold in 4 hours?</td>
</tr>
<tr>
<td>16</td>
<td>Tammy decorated her art project with 12 different colors of sequins. If she used 15 of each color, how many sequins did Tammy use?</td>
<td>Sanisha decorated her blue jean jacket with 12 different colors of Bidazzle gems. If she used 15 of each color, how many Bidazzle gems did Sanisha use?</td>
</tr>
<tr>
<td></td>
<td>Textbook Question</td>
<td>Culturally Relevant Question</td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>17</td>
<td>Paulo has 39 patches from states he and his relatives have visited. He wants to pin them onto a board and arrange them equally in 3 rows. How many patches will be in each row?</td>
<td>Dayshawn wants to clean up his room at home. Dayshawn has 39 pairs of Jordan sneakers in his closet. He wants to arrange them equally in 3 rows. How many pairs will be in each row?</td>
</tr>
<tr>
<td>18</td>
<td>Ben has 165 pictures from his summer trip to Austria. He put 6 pictures on each page of a photo album. How many pages of the album did Ben fill?</td>
<td>Dayshawn has 165 mechanical pencils. He wants to put 6 mechanical pencils in each of the boxes he got from his Auntie Lynn. How many boxes did Dayshawn fill?</td>
</tr>
<tr>
<td>19</td>
<td>A square dance set is made up of 4 couples (8 dancers). There are 150 people at a square dance. What is the greatest number of sets possible at the dance?</td>
<td>At the school dance, the students had a dance contest. Each dance group in the contest had 4 couples (8 dancers). There are 150 people who participated in the dance contest. What is the greatest number of sets of dancers for the dance contest are possible at the school dance?</td>
</tr>
<tr>
<td>20</td>
<td>At the airport, there are a total of 1,160 seats in the waiting areas. There are 8 separate, same size, waiting areas. How many seats are in each waiting area?</td>
<td>In the gymnasiums at the middle schools in APS there are a total of 1,160 seats. There are 8 separate, same size middle schools in the APS district. How many seats are in each gymnasium at each APS middle school?</td>
</tr>
<tr>
<td>21</td>
<td>There are 174 games scheduled for 6 different leagues. Each league has the same number of games scheduled. How many games does each league have scheduled?</td>
<td>There are 174 baseball games scheduled for 6 of Coach A’s different leagues. Each of his leagues has the same number of baseball games scheduled. How many baseball games does each baseball league have scheduled?</td>
</tr>
<tr>
<td>22</td>
<td>Trace has 453 trading cards. He puts an equal number of cards into each of 3 books. What is the number of cards Trace put in each book?</td>
<td>Malik has 453 Pokemon trading cards. He puts an equal number of Pokemon trading cards into each of his 3 Pokemon books. What is the number</td>
</tr>
</tbody>
</table>
Table F1 (continued)

<table>
<thead>
<tr>
<th>Textbook Question</th>
<th>Culturally Relevant Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>23 The Pizza Stand gives patrons a free pizza when they collect 8 coupons.</td>
<td>At the Cookie Company at Greenbriar Mall, each person gets a free big cookie after buying 8 small cookies.</td>
</tr>
<tr>
<td>How many free pizzas can Mrs. Fowler get if she has 78 coupons?</td>
<td>How many free big cookies can Mr. Jenkins get if he has 78 small cookies?</td>
</tr>
<tr>
<td>24 Some of the tallest selenite crystals in a cave in Chihuahua, Mexico are 50</td>
<td>Some of the tallest trees in Cascade Glenn Townhomes are 50 feet tall.</td>
</tr>
<tr>
<td>feet tall. Nathen is 4 feet tall. About how many times as tall as Nathan are the</td>
<td>Malik is 4 feet tall. About how many times as tall as Malik are the tallest trees?</td>
</tr>
<tr>
<td>tallest crystals?</td>
<td></td>
</tr>
</tbody>
</table>

of Pokemon trading cards Malik put in each book?
APPENDIX G

TEACHER OBSERVATION CHECKLIST
Table G1

_Problem Solving Instruction Recording Sheet for Teacher A (CR Word Problems)_

<table>
<thead>
<tr>
<th>Date</th>
<th>Start Time</th>
<th>End Time</th>
<th>Problem Number</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/22/17</td>
<td>8:05 am</td>
<td>8:20 am</td>
<td>#4</td>
<td>Teacher A had students to read the question independently first. She then asked for a volunteer to read the question to the class. The student whose name was mentioned in the problem was the first to give a response. Students worked independently and after about 10 minutes, the teacher asked for students to share their answers with the class. Students who answered correctly received a piece of candy from the teacher. <strong>85%</strong> of the students answered accurately.</td>
</tr>
<tr>
<td>9/28/17</td>
<td>8:30 am</td>
<td>8:50 am</td>
<td>#10</td>
<td>Teacher A had students to read the question independently first. She then asked for a volunteer to read the question to the class. Most students solved the question quickly and <strong>80%</strong> of the students answered accurately. They did not need much assistance from Teacher A.</td>
</tr>
<tr>
<td>10/6/17</td>
<td>8:05 am</td>
<td>8:25 am</td>
<td>#14</td>
<td>Teacher A had students to read the question independently first. She then asked for a volunteer to read the question to the class. Teacher A reviewed the problem strategies because a few students were having difficulty setting up the problem to solve it. She guided the students to the correct answer by asking clarifying questions. <strong>75%</strong> of the students solved the problem accurately.</td>
</tr>
<tr>
<td>10/19/17</td>
<td>8:05 am</td>
<td>8:25 am</td>
<td>#16</td>
<td>Teacher A had students to read the question independently first. She then asked for a volunteer to read the question to the class. Mostly girls volunteered to respond to the question because it involved a question with clothing fashion. Most of the students immediately determined multiplication should be used to solve the problem. <strong>89%</strong> of the students solved the problem accurately.</td>
</tr>
</tbody>
</table>
### Table G1 (continued)

<table>
<thead>
<tr>
<th>Date</th>
<th>Start Time</th>
<th>End Time</th>
<th>Problem Number</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/23/17</td>
<td>8:35 am</td>
<td>9:00 am</td>
<td>#18</td>
<td>Teacher A had students to read the questions independently first. She then asked for a volunteer to read the question to the class. As the students begin solving the problem, Teacher A noticed that students were uncertain about what should be done with the remainder in the division problem. She read the question aloud and guided students through the process of solving the division problem. <strong>76%</strong> of the students answered the question accurately.</td>
</tr>
<tr>
<td>10/31/17</td>
<td>8:25 am</td>
<td>8:45 am</td>
<td>#24</td>
<td>Teacher A had students to read the questions independently first. She then asked for a volunteer to read the question to the class. As the students begin solving the problem, Teacher A noticed that students were uncertain about which method should be used to solve the problem. She emphasized that there were several methods to use to solve the problem. She allowed students extra time to solve the problem. After 10 minutes, students started sharing their answers with the class. <strong>90%</strong> of the students answered the question accurately.</td>
</tr>
</tbody>
</table>
**Problem Solving Instruction Recording Sheet for Teacher E (Textbook Word Problems)**

<table>
<thead>
<tr>
<th>Date</th>
<th>Start Time</th>
<th>End Time</th>
<th>Problem Number</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/22/17</td>
<td>12:30 pm</td>
<td>12:50 pm</td>
<td>#4</td>
<td>Teacher E read the word problem to the class. She asked students to underline key vocabulary words and to circle important number values in the problem. Students were given about 5 minutes to solve the problem independently, then she asked the students to share their answer with their classmates. They were given about 2 minutes to discuss before sharing with the whole class. Teacher E gave the correct answer and then asked for a volunteer to share their answer and strategy for solving the problem. 70% of the students answered accurately.</td>
</tr>
<tr>
<td>9/28/17</td>
<td>12:30 pm</td>
<td>12:50 pm</td>
<td>#10</td>
<td>Teacher E read the word problem to the class. She asked students to underline key vocabulary words and to circle important number values in the problem. Students were given about 5 minutes to solve the problem independently, then she asked the students to share their answer with their classmates. They were given about 2 minutes to discuss before sharing with the whole class. Teacher E gave the correct answer and then asked for a volunteer to share their answer and strategy for solving the problem. 75% of the students answered accurately.</td>
</tr>
<tr>
<td>10/6/17</td>
<td>1:00 pm</td>
<td>1:15 pm</td>
<td>#14</td>
<td>Teacher E read the word problem to the class. She asked students to underline key vocabulary words and to circle important number values in the problem. Students were given about 5 minutes to solve the problem independently, then she asked the students to share their answer with their classmates. Students were having difficulty with the word problem, so she allowed students to work in groups. They were given about 5 minutes to discuss before sharing with the whole class. Teacher E gave the correct answer and then asked for a volunteer to share their answer and strategy for solving the problem. 65% of the students answered accurately.</td>
</tr>
<tr>
<td>Date</td>
<td>Start Time</td>
<td>End Time</td>
<td>Problem Number</td>
<td>Comments</td>
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<td>10/19/1</td>
<td>12:55 pm</td>
<td>1:15 pm</td>
<td>#16</td>
<td>Teacher E read the word problem to the class. She asked students to underline key vocabulary words and to circle important number values in the problem. Students were given about 7 minutes to solve the problem independently, then she asked the students to share their answer with their classmates. Teacher E gave the correct answer and then asked for a volunteer to share their answer and strategy for solving the problem. <strong>78%</strong> of the students answered accurately.</td>
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<tr>
<td>10/23/1</td>
<td>1:00 pm</td>
<td>1:15 pm</td>
<td>#18</td>
<td>Teacher E read the word problem to the class. She asked students to underline key vocabulary words and to circle important number values in the problem. Students were given 10 minutes to work in groups. Teacher E gave the correct answer and then asked for a volunteer to share their answer and strategy for solving the problem. <strong>69%</strong> of the students answered accurately.</td>
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<tr>
<td>10/31/1</td>
<td>12:30 pm</td>
<td>12:45 pm</td>
<td>#24</td>
<td>Teacher E read the word problem to the class. She asked students to underline key vocabulary words and to circle important number values in the problem. Students were given about 5 minutes to solve the problem independently, then she asked the students to share their answer with their classmates. They were given about 2 minutes to discuss before sharing with the whole class. Teacher E gave the correct answer and then asked for a volunteer to share their answer and strategy for solving the problem. <strong>76%</strong> of the students answered accurately.</td>
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APPENDIX H

SAMPLE WORD PROBLEMS FOR PRE/POSTTEST
Pretest Benchmark Assessment

1. Last week, Sharon’s mother ordered 60 roses for her shop. This week, she will order 5 times as many roses. How many roses will she order?

2. There are 60 books that need to be shipped to the bookstore. Each shipping box holds 8 books. How many boxes are needed?

3. A company sold 352 DVD players last year. Each DVD player sold for $53. What is the total amount of money the company earned from the DVDs?

4. A total of 68 awards will be given away to the soccer team. Each box holds 6 awards. How many awards are in the partially filled box?

5. Aubrey’s school has two meeting rooms. The small room seats 25 students. The large room seats three times as many students. How many students does the large room seat?

6. Each basketball game ticket is $12. Jim bought 12 tickets for him and his friends. How much did Jim spend on the tickets?

7. Barbara works in a bakery. She puts 12 blueberries in each blueberry muffin she makes. How many blueberries does Barbara need to make 8 blueberry muffins?

8. Christa is making 8 flower arrangements for a wedding using tulips and lilies. If each arrangement will be made of 5 tulips and 3 lilies, how many flowers will she need to make all the arrangements?

9. Each month, Margie's pets need 3 bags of dog food and 2 bags of cat food. How many bags of pet food would she need for 4 months?

10. A marble factory produces 3,250 marbles a day. The marbles are gathered in groups of 8 and placed in a bag. How many bags of marbles does the factory produce each day?

11. The Walters family bought 3 ham sandwiches and 4 fruit cups for lunch. Each sandwich cost $4 and each fruit cup cost $2. How much did the family spend on lunch?

12. There are 70 students going on a trip to the museum. If each school van holds 12 students, how many vans will they need?
13. A truck driver wants to drive a total of 1,845 miles in 5 days. For each day’s mileage to be the same, how many miles should she drive each day?

14. At the school carnival, students sold 483 hamburgers for $4 each and 214 hot dogs for $2 each. How much money did the students make from the sale of hamburgers and hot dogs?

Posttest Benchmark Assessment

1. Last week, Ben’s mother ordered 36 roses for her shop. This week, she will order 3 times as many roses. How many roses will she order?

2. There are 45 books that need to be shipped to the bookstore. Each shipping box holds 9 books. How many boxes are needed?

3. A company sold 652 DVD players last year. Each DVD player sold for $42. What is the total amount of money the company earned from the DVDs?

4. A total of 72 awards will be given away to the soccer team. Each box holds 4 awards. How many awards are in the partially filled box?

5. Lisa’s school has two meeting rooms. The small room seats 30 students. The large room seats five times as many students. How many students does the large room seat?

6. Each basketball game ticket is $15. Tom bought 8 tickets for him and his friends. How much did Tom spend on the tickets?

7. Barbara works in a bakery. She puts 7 blueberries in each blueberry muffin she makes. How many blueberries does Barbara need to make 12 blueberry muffins?

8. Christa is making 5 flower arrangements for a wedding using tulips and lilies. If each arrangement will be made of 3 tulips and 6 lilies, how many flowers will she need to make all the arrangements?

9. Each month, Melissa’s pets need 5 bags of dog food and 3 bags of cat food. How many bags of pet food would she need for 6 months?

10. A marble factory produces 3,250 marbles a day. The marbles are gathered in groups of 5 and placed in a bag. How many bags of marbles does the factory produce each day?
11. The Smith family bought 2 turkey sandwiches and 5 fruit cups for lunch. Each sandwich cost $5 and each fruit cup cost $3. How much did the family spend on lunch?

12. There are 84 students going on a trip to the museum. If each school van holds 8 students, how many vans will they need?

13. A truck driver wants to drive a total of 1,840 miles in 10 days. For each day’s mileage to be the same, how many miles should she drive each day?

14. At the school carnival, students sold 365 hamburgers for $3 each and 125 hot dogs for $2 each. How much money did the students make from the sale of hamburgers and hot dogs?