1, 2, 3: Counting on Problem Based Learning to Improve Mathematical Achievement in African American Students

Kelley P. Spahr

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1, 2, 3: COUNTING ON PROBLEM BASED LEARNING TO IMPROVE MATHEMATICAL ACHIEVEMENT IN AFRICAN AMERICAN STUDENTS

by

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DEDICATION

I dedicate this dissertation to all of those who carried me along this journey. First, to my husband, Michael, whose unwavering support buoyed me even in moments of the greatest doubt. This degree would not have happened without your love and support. To my sister, Sara Akeley, who always exemplified strength and perseverance, I thank you for always modeling what it means to never give up. Thank you to B Elementary. You showed me love from the very beginning and made me feel like I was home and could accomplish anything. Lastly, I would like to share a special recognition to my current administrators, Stefanie Clarke and Salvatore Cosimo, IV, who reminded me why I love this profession and helped me find my joy in it again.
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ABSTRACT

Mathematics is an important component of our everyday lives. It involves necessary skills, such as computation, problem solving, and critical thinking. In spite of this, a significant portion of our students are unable to demonstrate proficiency. These students are typically the underserved, marginalized students who are over represented in remedial classes and behavioral statistics (Gibson, 2022; Harper, 2010, 2021; Zilanawala, et al., 2018). This research study presented two instructional interventions, culturally relevant pedagogy and problem-based learning, to examine the impact of self-efficacy, critical thinking, and mathematical achievement. This study utilized a mixed-methods triangulation design. The participants of this study were 36 third-grade students, who were assigned to this researcher’s homeroom and targets math classes. Data collection instruments included pre- and post- student surveys, behavioral checklists, and semi-structured student interviews. Results of this study indicated that culturally relevant pedagogy and problem-based learning had a statistically significant impact on student attitudes, critical thinking skills, and mathematical achievement.

Keywords: problem-based learning, culturally relevant pedagogy, attitudes, critical thinking, mathematical achievement
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LIST OF ABBREVIATIONS

AAVE.................................................................African American Vernacular English
CCR.................................................................College and Career Ready
CRP .................................................................Culturally Relevant Pedagogy
EOG .................................................................End of Grade test
NAEP ..............................................................National Assessment for Educational Progress
PBL .................................................................Problem Based Learning
CHAPTER ONE
INTRODUCTION

The start of each school year brings excitement and promises of a fresh start. Ideally, every student gets a blank slate for this new beginning. As we spend 180 days together, building relationships and knowledge, we move towards the end-of-year assessments that decide the success of this time. The end-of-the-year assessments bring a sense of relief and accomplishment – for most students. For some, however, they bring to the forefront the gross inequities our education system has wrought. These inequities can be seen especially in the area of mathematics.

The study of mathematics is an integral part of our education and is key to our society (Lefkowitz, 2021). Math enables engineers to build, technology to advance, and science to continue to find new ways to combat disease. It is indispensable. As our technology advances and computers do more and more, mathematics instruction has become more than just basic calculations. It has become focused on critical thinking and problem-solving (Gravemeijer, et al. 2016; Lefkowitz, 2021). Lefkowitz (2012) examined the etymology of the word mathematics and discovered that in Greek, the word has roots in “learning”, while in Hebrew, it is rooted in “thinking.” This etymological breakdown supports the calls to reform referenced by Gravemeijer, et al. (2016) of the National Council of Teachers of Mathematics in 1980. This report specified the need to
examine the theories surrounding mathematics and its applications rather than the specific skills students should be taught.

The mathematics performance of the nation’s students is monitored each year. The National Assessment for Educational Progress (NAEP), mandated by Congress and developed and administered through the United States Department of Education, is an assessment designed to determine students’ proficiency across the country in mathematics. Students in grades 4 and 8 are assessed utilizing this national test (Nations Report Card, 2019). Students from all areas of the country, rural, suburban, and urban areas, take this assessment. The data from 1990-2019 reveals a lack of overall proficiency across the country. In 1990, 13% of fourth graders taking this test were proficient (Nations Report Card, 2019). This percentage rose to 41% by 2019 (Nations Report Card, 2019). While it represents a significant increase in overall performance, it shows that nearly 59% of fourth graders tested performed below proficient. Perhaps even more concerning is the severe discrepancies in performance based on race. From 1990 to 2019, white students demonstrated an overall growth in proficiency from 16% proficient in 1990 to 52% proficient in 2019.

Conversely, African American students demonstrated an overall growth in proficiency from 1% proficient in 1990 to 20% proficient in 2019. This NAEP data supports the assertions by Diemer, et al. (2016) stating that African American students demonstrate much lower achievement in math than other racial and ethnic groups. The NAEP results show a large performance gap for Hispanic students as well. In 1990 5% of Hispanic students demonstrated proficiency in mathematics, and 28% were proficient in 2019.
During this time frame, there have been attempts at reform in mathematical education at the K-12 level (Berry, et al., 2014, Schoenfeld, 2004). The fluctuations from focusing on basic skills to processes of mathematics are seen from the 1990s until the present day. This struggle to determine the best manner to educate our youth in mathematics has created a gap in learning for all of our students. It has prevented them from receiving “the kind of robust mathematics education they should” (Schoenfeld, 2004, p. 283). We are generally failing to facilitate strong mathematical understanding and performance for all of our students. African American students are faring far worse than white students. Berry, et al. (2014) cites a historical lack of support for African American students in mathematics, specifically in access, images, and agency. As a result, African American students are less likely to be exposed to higher-level thinking and complex challenges (Berry, et al., 2014, Delpit, 2012, Zilanawala, et al., 2018).

**Statement of Problem**

Each year, educators are tasked with meeting the instructional needs of a diverse group of students. These students come from various backgrounds and racial and ethnic groups. The needs of these groups are distinct, and often teachers address the general needs of the class and not specifically the realities of children’s lives (Berry, et al. 2014). A review of literature and related studies by Zilanawala, et al. (2018) demonstrated that African American boys are overrepresented in special education, suspensions from school, and remedial programs. This inequity further amplified the lack of opportunity for African American students to receive access to instruction that involves critical thinking and complex tasks (Gibson, 2022; Harper, 2010). This failure to provide entry to higher-level skills maintains the performance gap demonstrated by assessment data.
In North Carolina, B Elementary School (pseudonym) utilizes the North Carolina End of Grade tests to assess students in reading and mathematics. This assessment is administered each year to determine proficiency of students. In 2019, of the African American students in grades 3-5 who took the mathematics test, 50% of them tested proficient, with only 30% testing at the higher Career and College Ready levels (NC Reports, 2020). Half of the African American students tested at the below basic skills level, and 70% were less than the Career and College Ready level. This data demonstrates that African American students are not receiving the instruction they need in mathematics to succeed. Proficiency for African American students is lower than other demographics. Additionally, the growth for African American students is less than other groups. In 2019, every demographic exceeded expected growth, except African American students and students with disabilities, of which a large percentage is African American boys (NC Reports, 2020).

This test data exemplifies the need to address mathematics instruction for all students, especially African American students. Historically, African American students have had the least access to advanced mathematical instruction and more focus on memorizing facts and procedures (Berry, et al. 2014). Because of this lack of access, African American students develop a lower sense of self-efficacy and begin devaluing school and what it can provide them (Boutte, 2016). This data points to the need to center an elementary classroom around the concepts of real-world situations and complex mathematical reasoning to enable African American students to excel in mathematics.

Culturally relevant pedagogy developed as the result of asking a different sort of question. Rather than asking what is wrong with Black children when they are deemed
unsuccessful in school, the focus became what is right with the classrooms where they succeed (Ladson-Billings, 2021). CRP is a pedagogical approach to learning whose cornerstone is understanding that student performance and test scores are not the problem but rather a symptom of a deeper issue (Gay, 2018). CRP is defined through the examination of three key components: student learning, cultural competence, and critical consciousness (Ladson-Billings, 2009; 2021). Student learning encompasses growth in academics and attitudes. Cultural competence involves understanding and appreciating cultures, your own and others (Ladson-Billings, 2021). A final part of CRP involves the emergence of understanding the greater world and one’s impact in it and by it (Ladson-Billings, 2021). Finally, through critical consciousness, teachers can provide students with the opportunity to identify real-world problems and develop solutions that improve the lives of others.

Problem-based learning (PBL) provides the opportunity to incorporate real-world situations with complex reasoning in a cohesive manner that is appropriate for elementary students. PBL has been proven to improve higher-order thinking and student attitudes (Dole, et al. 2017). PBL also improves the engagement of students who struggle academically. These students often disengage from challenging tasks (Delpit, 2012; Diemer, et al. 2016; Dole, et al. 2017; Gallagher & Gallagher, 2013). PBL provides the means to engross students in meaningful and demanding situations (Savery, 2006; Suastra, et al., 2019).

Research Questions

This action research study sought to determine if implementing the tenets of Culturally relevant pedagogy and Problem-based learning improved attitudes, critical
thinking, and mathematical achievement for all third graders. The study was designed to examine PBL’s impact on African American students closely. The following research questions guided it:

1. How will culturally relevant pedagogy and problem based learning impact the attitude of African American third graders as it relates to mathematics achievement?

2. How will culturally relevant pedagogy and problem based learning impact the critical thinking skills of African American third graders as it relates to mathematics achievement?

3. How will culturally relevant pedagogy and problem based learning impact the overall proficiency in mathematics of African American third graders?

**Theoretical Framework**

This research study was supported by the theoretical framework of constructivism and culturally relevant pedagogy. This theoretical framework came together with the intervention of problem-based learning to address the problem of underperformance of African American students in mathematics. This study aimed to demonstrate how these theories connect and provide greater instructional support for African American students in mathematical proficiency.

The constructivist theory of learning centers around the nuclei in that learners construct knowledge based on their experiences. Two primary precepts of constructivism are that learning is adaptive and that social interaction is key to constructing knowledge (Boethel & Dimock, 2000). For learners to develop new knowledge, they must connect it to what they already know (Bada, 2015). The constructivist pedagogy grounds real-world
contexts emphasizing collaboration and communication of ideas (Boethel & Dimock, 2000). Learners in a constructivist environment are active participants using previous schema to access new content. This construct marries well with the PBL framework. In PBL, students collaborate to develop solutions to real-world situations (Savery, 2006). There are frequently many possible solutions to the given situation, and students must adapt their thinking to determine the best outcome for the circumstances provided.

Culturally relevant pedagogy (CRP) was developed by Dr. Ladson-Billings in the early 1990s. CRP asserts that classroom instruction should focus more on the education of the whole rather than the individual (Ladson-Billings, 1995). Culturally relevant classrooms have three key indicators: academic success, cultural competence, and critical consciousness (Ladson-Billings, 1995). Expectations for success are high. Culture is used as a contrivance for learning. Understanding and appreciating culture can help students learn and grow (Gay, 2002; Ladson-Billings, 1995). For example, a love of rap music can translate to a deeper understanding of classical poetry (Ladson-Billings, 1995).

Engagement and academic achievement can be improved through the authentic use of student interest and culture (Sleeter, 2012). Finally, critical consciousness contains the imperative to address community or wider social problems. This involves guiding students in critically engaging the “world and others” (Ladson-Billings, 1995, p. 162). This key component of culturally relevant teaching harkens back to the constructivist precept of using collaboration and communication to create new knowledge (Bada, 2015; Boethel & Dimock, 2000). This mirrors the goals of PBL as well. By utilizing real issues within the community as the backdrop for learning, students are engaged with academic
struggles that are meaningful to them as people, not just as students (Delpit, 2012; Sleeter, 2012).

The theoretical frameworks of constructivism and culturally relevant pedagogy anchored this study. They both ascertain that learning must be collaborative and relevant to student culture. This relevance provides the environment for students to grow and become successful.

**Purpose of the Study**

The purpose of this study was to determine the effectiveness of problem-based learning (PBL) and culturally relevant pedagogy (CRP) on the academic development of all students, but specifically African American students. Historical assessment data demonstrates that African American students need to receive the mathematics instruction they need to be successful. The findings of Diemer, et al., (2016) clarify the need for pertinent mathematics instruction, specifically for African American students. African American students demonstrate less math achievement than other racial and ethnic groups (Diemer, et al., 2016). This lack of achievement is owed to a diverse level of intersectionality but stems from underrepresentation in challenging classes, school racial climates, and lack of belief held by teachers (Delpit, 2012; Diemer, et al., 2016; Harper, 2021).

This study hypothesized that implementing PBL and CRP in a third-grade classroom would improve students’ mathematical proficiency and attitudes, and close the achievement gap for African American students. PBL is an instructional model that uses real-world problems and situations to activate learning (Nariman & Chrispeels, 2016). It merges content information with sophisticated thinking skills and problem-solving
PBL allows students to collaborate with peers to solve problems in unique ways. This creates an environment of positive attitudes as children find success in this process. It also improves their thinking skills and desire to work through challenging tasks (Nariman & Chrispeels, 2016; Suastra, et al., 2019). Students who engage in strategic problem-based learning activities become efficient at problem-solving and improve their academic proficiency overall (Karatas & Baki, 2013).

CRP has at its core the examination of societal inequities and the use of academic achievement and cultural relevance (Ladson-Billings, 2009). CRP grounds instruction in cultural and background knowledge to make learning relevant for diverse populations of students (Gay, 2013).

**Positionality**

“We don’t see things as they are, we see things as we are.” This quote ascribed to Anaïs Nin and referenced by Dana & Yendol-Hoppey (2020, p. 78) highlights the potential pitfalls of the researcher-practitioner. Because these studies are developed and implemented by the insider in their setting, it is imperative to identify biases, beliefs, and expected outcomes to ensure the data’s validity. Also, as insiders are often invested in the practices, procedures for addressing the biases must be employed (Herr & Anderson, 2015).

This researcher-practitioner was a third-grade teacher in Lee County Schools and has 26 years of teaching experience. This researcher has been at this school for five years, the first three years in fifth grade and the past two in third grade. As the classroom teacher conducting the research on her instructional practices, this researcher assumed the position of an insider researcher. The problem of practice addressed the need for more
complex and culturally rich instruction resulting in lower scores in mathematics for African American students. This researcher examined the causes of this gap in achievement and delved into an intervention to confront this performance inequity using problem-based learning activities through constructivism and culturally relevant pedagogy. The focus was on the purpose of this study as a means to find instructional practices that improve the learning and academic performance of these third-grade students.

Being the classroom teacher, the imbalance of power was in the researcher’s favor. The students could be unduly influenced to respond to survey questions or act in certain manners out of the possibility of grade or behavioral consequences. Therefore, it was imperative that this researcher remained clear in both her expectations and her role. B Elementary is approximately 33% white. As a white woman, the researcher had to continually guard against the “hegemonic deficit-focused positioning” (Kennedy-Lewis, et al. 2016, p. 10) of these third-grade students. For this research study to be conducted in a manner that asserts its validity, the researcher approached all aspects as a reflective practitioner, using the activities and data generated to improve instructional practices for herself via self-reflection and growth (Herr & Anderson, 2015).

As the researcher is the practitioner, bias is inherent in action research studies (Herr & Anderson, 2015). This researcher understood that her position as researcher-practitioner created the possibility for bias to be present in this study. Therefore, the triangulation of qualitative and quantitative data was used to ensure the validity of the information. This researcher also utilized video and transcription to take away the subjectivity inherent in studying her practice.
Significance of the Study

This study was conducted in a third-grade classroom. This is the grade where students first encounter standardized assessments. The work contained in this study stands to improve the overall knowledge and performance in mathematics for third graders. This overall gain in knowledge impacts the potential scores on these tests for the school, district, and, conceivably, the state.

In the local school district where this research was conducted; currently, 46% of students in grades 3-5 are not proficient on the state mathematics assessment. African American students fare worse, coming in at 60% not proficient. Less than 5% of all African American students in grades 3-5 are scoring at the top of the mathematics scale. This is in relation to the white students, who scored 16% on top of the scale (NC Reports, 2020). This data was used instead of more recent test results as this is the last data prior to the Covid-19 outbreak. This continued disparity in performance comes from a year that showed above-average growth for the district.

The researcher was a member of the School Improvement Team and Data Team. Both positions provided the opportunity to share the research outcomes and impact instructional practices and professional development in the school. This third-grade teacher also served as a mentor and facilitator for the grade level. This position provided the opportunity to influence instructional practices across the entire grade, specifically for beginning teachers assigned to her.
Overview of Methodology

This was a mixed-methods action research study. Action research is heavy with the purpose of problem-solving (Herr & Anderson, 2015). It exists so that insider practitioners can study and address issues, problems, or practices and improve them (Herr & Anderson, 2015). It was considered action research because it was a structured investigation designed to determine how teaching impacts learning (Mertler, 2017) and qualitative because it is focused on how learning is formed (Merriam & Tisdell, 2016). This researcher employed the triangulation design as all data, both qualitative and quantitative, was collected simultaneously, and both were given equal weight (Mertler, 2017). The teacher-researcher conducted the study in a third-grade classroom of approximately 36 students in the spring of 2023 over a six-week period of time. The intervention was a unit in math based on problem-based learning. Students were introduced to and practiced math skills through problem-based scenarios. It consisted of several data collection opportunities. Likert scale surveys were administered pre- and post-intervention in order to assist students in determining the sense of confidence they possess regarding math. The researcher took detailed observer field notes during the intervention to demonstrate examples of critical thinking skills and student proficiency. Academic behaviors relating to attitudes and critical thinking were evaluated using behavior checklists generated by the teacher-researcher. These were utilized throughout the intervention to show changes in critical thinking skills and mathematical reasoning. The researcher also interviewed students to identify the impact of the intervention on student confidence.
Dissertation Organization

This dissertation is organized into five distinct chapters. Chapter One situates the study with the problem of practice, research questions, and the study’s significance. Chapter Two examines the existing literature and research relevant to the study. In Chapter Three, the methodology of research is explained, along with the means of data collection and analysis. The results of the study are enumerated in Chapter Four. Finally, Chapter Five provides the follow-up on data analysis and future impact on teaching and learning in mathematics.

Definition of Terms

The following terms are used throughout this dissertation and relate directly to the study conducted.

Achievement/Learning gap: A disparity in scores based on race/ethnicity (Nations Report Card).

Agency: A student’s sense of academic self (Berry, et al., 2014).

Basic skills: The minimum amount of mathematical knowledge necessary (Berry, et al., 2014).

Career and college ready (CCR): A determination by the state Department of Public Instruction signifying comprehension of skills at the mastery level (NC Reports, 2020).

Critical thinking: The ability to think logically in any area (Lefkowitz, 2021).

Culturally relevant pedagogy: A pedagogy developed on the stance of empowerment based on academic success, cultural competence, and challenging the present order of things (Ladson-Billings, 1995).
**Data team:** A committee at the school level to monitor, analyze, and make plans to impact the data from reading, math, and behavioral plans.

**End of Grade (EOG):** The end-of-year standardized assessment developed and administered by the state Department of Public Instruction. This assessment is used to determine student, teacher, school, and district achievement (NC Reports, 2020).

**National Assessment for Educational Progress (NAEP):** A national assessment in math that is mandated by the United States Congress and overseen by the United States Department of Education (Nations Report Card).

**Problem-based learning (PBL):** A manner of teaching that presents skills within the context of a real-world problem and requires collaboration and problem-solving to develop a solution (Nariman & Chrispeels, 2016).

**Proficiency:** Having shown a solid understanding of the material presented (Nations Report Card).

**School Improvement Team (SIT):** A school-level committee chosen by peers to develop to implement instructional and operational plans and support grade-level needs.
CHAPTER TWO

LITERATURE REVIEW

Introduction

Each day in the classroom is a new opportunity to connect and inspire. Each day allows students to find hope and promise of a different tomorrow. Every student needs this. Not every student, however, receives it. Within schools, there exists a perpetual gap, one that has created children whose success depends on the quality of instruction they receive each year (Hammond, 2015). This is a gap that continues to highlight that the children are "not well" (Boutte, 2016, p. 2). This chapter revisits the problem of practice from chapter one. It also explains the theoretical framework of constructivism and culturally relevant pedagogy that support this study. Included in this chapter, as well, are research-based studies focused on problem-based learning as an intervention to this academic gap.

Problem of Practice

In examining data, it is clear that a significant number of students are not demonstrating proficiency in mathematics. An even deeper dive shows that, specifically, African American students are underperforming, even below that of other demographics (NC School Report Cards, 2020). This data points to a lack of culturally relevant and high-quality instruction, leading to this underdeveloped proficiency.
According to recent reports from the North Carolina Department of Public Instruction, less than half of the African American students in grades 3-5 are testing proficient in math (NC School Report Cards, 2020). Meanwhile, 54% of white students in Grades 3-5 tested proficient (NC Reports, 2020). This data makes it clear that all students struggle to demonstrate proficiency in mathematics, and African American students struggle at a greater rate. This study examined the reasons for this disparity and the impact of culturally relevant pedagogies and problem-based learning on this problem.

Students who struggle academically are frequently disengaged from school and view it separate from their lives (Berry, et al. 2013; Matthews, 2018). School is where they are made to feel different, less than others, incapable, and not smart. School is where people who, too frequently, do not look like them set the parameters of what is deemed successful (Boutte, 2016; Delpit, 2012). It is an extension of the wider world that tells them lighter skin, hair, and eyes are prettier; getting A's means the student is successful and smart; one needs to act, talk, and think a certain way to be accepted (Boutte, 2016). School also presents students with a context for themselves that differs from their innate version of who and what they are (Emdin, 2016; Gay, 2002).

This study focused on the need to engage and instruct all students, especially African American students, in a way that respected and reflected their culture and enabled them to develop critical thinking skills. All too often, students struggle to find the purpose of school when school does not mirror the structure of their lives outside the classroom (Delpit, 2012; Ladson-Billings, 1995; Matthews, 2018). Schools, especially high-poverty ones, are often staffed with teachers who lack the proper training to provide effective instruction (Reddy et al., 2020). The curriculum and teacher focus on low-level
skills, preventing children from developing the higher-order thinking skills needed to close the achievement gaps (Berry, et al. 2013; Delpit, 2012; Harper, 2021; Williams, et al. 2019).

Purpose of Study

This study aimed to determine the effectiveness of problem-based learning (PBL) and the use of culturally relevant pedagogy (CRP) on the attitudes, critical thinking, and achievement of African American third-grade students in a mathematics class. This study explored the use of PBL to provide a backdrop for the content taught in elementary school; to show students the connection between what is taught in school and what they live in their daily lives. PBL provides teachers with the ability to engage students in critical thinking exercises while teaching key concepts in a way that is meaningful to students' lives. CRP was also employed in this study to examine the increase in student sense of self when connected to the content via culture.

In order to achieve academic proficiency, a student must believe they are capable (Berry et al. 2014; Diemer et al. 2016; Zilanawala et al. 2018). How a student thinks about their ability to achieve greatly impacts their actual achievement. Confidence is developed over time by comparing others on commonly held ideas of achievement (Diemer, et al. 2016). Palmer & Weymeyer (2003) determined that when taught concepts in relation to self-efficacy, students could set and achieve academic goals. This ability to believe in and accomplish academic tasks at an advanced level is suggested by Zilanawala, et al. (2018) as the primary way to increase mathematics proficiency in African American male students. Critical thinking skills are an important component of mathematics proficiency. As our technology develops, mathematical calculations can be
and are being completed by machines (Gravemeijer, et al. 2017). This leaves critical thinking and problem solving as the mathematical-specific skills to be taught in order for students to reach proficiency (Gravemeijer, et al. 2017). In a review of relevant literature, Erikson & Erikson (2019) determined critical thinking to be the ability to analyze and judge a situation. Critical thinking skills enable a learner to think rationally about any concept in all fields (Lefkowitz, 2021). This takes learning beyond basic fact fluency or solving for an unknown in a contrived situation. Developing an understanding of how mathematics works, in general, cannot be found in more typical word problems. Instead, replacing these word problems with real-world situations hone's critical thinking skills and their application (Gravemeijer, et al. 2017). Providing students with the opportunity to amplify critical thinking skills can improve academic proficiency, according to Gallagher & Gallagher (2013). These skills can be seen in tackling real-world situations that employ academic concepts (Gallagher & Gallagher, 2013; Gravemeijer et al. 2017; Zilanawala et al. 2018).

**Figure 2.1** *Constructs for mathematics*

These constructs come together to develop proficiency in mathematics. Proficiency is defined in a variety of ways, dependent upon the assessment tool used to
determine it. For example, NAEP (Nations Report Card, 2019) defines *proficiency* in mathematics as engaging in problem-solving strategies and demonstrating a conceptual understanding of rational numbers. North Carolina Department of Public Instruction (North Carolina Department of Public Instruction, 2019) defines *mathematical proficiency* as having a solid comprehension of grade level standards and showing readiness for the next steps, such as college or career.

CRP situates mathematics for students (Delpit, 2012; Gay, 2018, Ladson-Billings, 2021). Rather than mathematics being something other than their real lives, CRP grounded the content in a student's reality and made it meaningful, and provided the opportunity for students to see themselves in the content (Ladson-Billings, 2021). This research site has almost two-thirds of the student population as African American, Hispanic, or multiracial. These cultures approach problem-solving contextually; they value group-ness and collaboration (Gay, 2018). By implementing mathematics through a collaborative problem-solving model, students' cultural socialization is activated, and learning becomes more relevant (Gay, 2018). Mathematics instruction has historically focused on repetition, procedures, and convergent thinking (Ladson-Billings, 2021). Applying CRP to mathematics instruction allowed students to think outside the box, challenge known ideas, and tap into the African American culture, rich with rhythm and patterns (Ladson-Billings, 2021). It provided the opportunity to engage the cultures of two-thirds of the students in a novel way and offer collaborative group work that allowed for stage-setting and discourse (Gay, 2018). Through collaborative problem-solving tasks, students were pushed beyond the typical mathematics tasks of curriculum and
worksheets. They were engaged in meaningful mathematics tasks involving their communities and their own ideas.

This study sought to determine if utilizing PBL and CRP would improve African American students' attitudes, critical thinking, and mathematical achievement. This mixed-methods action research study investigates the following:

1. How will culturally relevant pedagogy and problem based learning impact the attitudes of African American third graders as it relates to mathematics achievement?

2. How will culturally relevant pedagogy and problem based learning impact the critical thinking skills of African American third graders as it relates to mathematics achievement?

3. How will culturally relevant pedagogy and problem based learning impact the overall proficiency in mathematics of African American third graders?

**Literature Review Methodology**

For this study, the University Libraries at the University of South Carolina was used to search peer-reviewed journals on databases such as ERIC and JSTOR. In addition, several published books by authors considered experts in the theoretical framework of culturally relevant pedagogy were also used to support this dissertation.

This chapter discusses, in-depth, the theoretical frameworks and interventions presented in Chapter One. The literature review consists of five sections. First, the historical perspectives frame this study in the history of oppression that is the foundation for the disparities inherent in the instruction and performance of African American students. The theoretical framework examines the constructs of constructivism and
culturally relevant pedagogy, their underpinnings, and their relation to the study conducted as part of this dissertation. The third section examines mathematical achievement and the historical trends of math achievement in our country. The fourth section of this chapter explains problem-based learning and its connections to culturally relevant pedagogies. The final section examines four studies relevant to this work.

**Historical Perspectives**

Oppression in the forms of racism and classism has existed since well before the dawn of this nation and has permeated the very fabric of our politics and society (Bell, 2016). It is found in our constitution, history books, and daily lives (Bell, 2016). Its existence is so interwoven in our society that the need for a diaspora literacy (Boutte, 2016) is crucial. Counter-narratives are much more about the "them" or separateness of white views of African Americans than of African American views of themselves. These counter-narratives are specific and well-planned efforts in opposition to the hegemonic ideologies about the abilities of African Americans (Boutte, 2016).

As African Americans and other children of color become more "bicultural" (Boutte, 2016, p. 24), the need to demonstrate the dissimilarity of the cultural and linguistic norms of their familial units with the ones of the society at large. This contrastive information comes in many forms, best exemplified by specific communication styles (Gay, 2002). Various groups communicate in different ways (Gay, 2002; Ladson-Billings, 1995). These ways must be understood and celebrated. Using these various communication styles helps students feel they have a voice (Gay, 2002). There has been progress over time in the oppression of racism and classism. However, it still exists in every facet of our society (Bell, 2016). Through these culturally relevant
concepts, we enable our children to gain skills and succeed beyond just their time in the classroom. This is a promise to the communities these children come from for a better today and an improved tomorrow (Ladson-Billings, 2006).

**Theoretical Framework**

As is demonstrated in Chapter One, this study is supported by the theoretical framework of constructivism and culturally relevant pedagogy (CRP). Grant & Osanloo (2014) identify the theoretical framework as a key dissertation feature. The theoretical framework is likened to the foundation of a house (Grant & Osanloo, 2014). It is the basis for the study. It grounds the study in exigent knowledge and frames the significance of the work (Grant & Osanloo, 2014).

**Constructivism**

Constructivism is a learning theory described by Dimock & Boethel (1999) as one that has developed via multiple disciplines and is rooted in the belief that the learner constructs knowledge. Students are not a tabula rasa, blank slates, upon which new knowledge is written. Rather, they actively participate in activities that develop learning based on situations and experiences (Bada, 2015; Dimmock & Boethel, 1999). Two primary tenets of constructivism are that learning is adaptive and that social interactions are key to creating knowledge (Boethel & Dimmock, 1999). Learning does not occur in a vacuum; it is situated with experiences, and prior knowledge is used to build new information (Bada, 2015; Dimmock & Boethel, 1999). Learning is an active undertaking (Dimmock & Boethel, 1999), and the learner uses old information to make sense of new situations. The learner is creating knowledge based on context and dialogue. This
interaction of learners with concepts enables learners to develop transferable skills for novel situations (Bada, 2015).

**Classroom Implications of Constructivism**

The focus on learning being active and situated in the experiences has a profound impact on the manner in which a classroom is run. Constructivist classrooms are learner-focused rather than teacher-focused (Bada, 2015). These classrooms have teachers whose purpose is not dispensing knowledge but rather to act as a coach or facilitators. The teacher is not the owner of the knowledge they will impart to the learner but the developer of the experiences that enable the learner to construct their knowledge (Bada, 2015).

**Culturally Relevant Pedagogy**

The framework of culturally relevant pedagogy (CRP) supports the concepts put forth by constructivism. Developed by Dr. Gloria Ladson-Billings in the early 1990s, this theory asserts that education focuses much more on the empowerment and improvement of the whole rather than the individual (Ladson-Billings, 1995). Culturally relevant classrooms contain three touchstones: academic success, cultural competence, and critical consciousness. First, students must attain academic success. Cultural competence is important because it ensures that students can be successful academically without dismissing their culture or social standings (Ladson-Billings, 1995; 2021). Within this aspect of CRP lies the heart of cultural relevancy – culture is used as an instrument for learning. Students can develop knowledge in content areas through the authentic appreciation and affirmation of culture.
CRP goes beyond multiculturalism (Gay, 2002). It is the development of a deep understanding of culture and how that culture impacts learning (Gay, 2002; Gay & Howard, 2000). For example, many cultures emphasize community and storytelling (Gay, 2002; Hammond, 2015). Having that appreciation for a student's culture enables teachers to develop lessons with a topic-chaining structure (Gay, 2002, Harris, et al. 2016). This structure mimics storytelling that "helps develop … a blend of curiosity, imagination, and wonder" (Harris, et al. 2016, p. 64). This demonstrates a deeper understanding of cultural aspects and authenticity to engage students in meaningful ways.

CRP emphasizes three aspects of student development: "academic achievement, cultural competence, and sociopolitical consciousness" (Boutte, 2016, p. 137). To turn CRP into culturally relevant teaching, teachers must prioritize what they think rather than what they do (Ladson-Billings, 2006). Teachers must approach students with the concept of all they are capable of accomplishing rather than all the students do not have. Teachers do not look at their more privileged students and see the skills or advantages that are lacking, and they see all the potential that is there (Boutte, 2016; Delpit, 2012; Ladson-Billings, 2006).

This difference is the crux of oppression that works against African American students. Oppression is the "interlocking forces that create and sustain injustice (Bell, 2016, p. 5). It permeates every aspect of life and is so deeply embedded in our social fabric that it cannot be easily separated. From this framework, we will focus on two forms of oppression: societal/cultural and academic/school.

Societal/Cultural Inequities
Societal inequities present themselves in the myriad ways we present ourselves and judge others. It is based on standards of beauty, specifically thinness or lightness can be emphasized, devaluing Black students with natural hair and darker skin (Boutte, 2016; Ladson-Billings, 2006). Inequities are also based on languages such as English and normalized grammar and speaking patterns. This can denigrate those who use African American Vernacular English in everyday speaking. Gay (2002) examines the importance of communication style as an integral part of culture. This communication variation can include dialect, language, and how people speak. Some cultures are more interactive in speech, such as the call-response of African Americans (Gay, 2002; Emdin, 2016); by identifying the appropriateness of a language based on circumstance rather than correctness, social/cultural inequities can be righted (Gay, 2018).

Racism is deeply embedded in our society. Our nation has a long-standing history of racism and bigotry. From its inception, our nation has been built on the enslavement of Africans and the refusal to see Blacks and indigenous peoples as equals to white settlers (Bell, 2016). While much has been done to improve that, racism still exists. There is still the perception that African American students, especially those from poverty, are less capable, more aggressive, and less likely to succeed (Boutte, 2016).

Classism is as equally pervasive and immutable as racism. There persists, in our society, the sense that those who live in poverty deserve it. People are poor because of the choices they have made in life (Adams et al. 2016). This is played out on reality TV, in our political machinations, and in the disproportionate numbers of Black and brown people who are struggling during this global pandemic (Henning-Smith et al. 2021). Those who live in poverty, especially those who are African American and live in
poverty, are least likely to receive needed support and most likely to experience oppression daily (Bell, 2016).

**Academic Inequities**

These societal inequities filter down to the institutional school level. When teachers believe that students are capable and provide these students with support, students are successful (Boutte, 2016). Children who come to school ready to learn are seen as such by their teachers. Whether the teacher intends to or not, they communicate that belief to students (Delpit, 2012). Teachers who feel sorry for students engage in the negative mindset of "informed empathy" (Ladson-Billings, 2006, p. 31). They then tend to lower expectations. This deficit thinking keeps students from academic success (Ladson-Billings, 2006; Hammond, 2015). These students need more from their teachers, not less. Children who are entering school without the benefit of preschool experience or other preparatory factors now rely upon the quality of education they receive to become academically successful (Boutte, 2016; Ladson-Billings, 2006). Delpit (2012) explained this as students being school dependent. Students who enter school with foundational advantages will find success on standardized tests and school in general, even if they have ineffectual teachers. School-dependent students, however, need effective teachers to teach them. Inadequate teachers will only keep students at their current level (Ladson-Billings, 2006).

In addition to the necessity of teachers to believe in the students' abilities, they must also be mindful of cultural and language barriers. Culture varies greatly between and within racial and ethnic groups. Teachers must recognize the cultural norms and use those as starting points rather than barriers to education. Too often, African American
children are penalized for their culture (Boutte, 2016). Teachers view them as loud or aggressive when their culture is full of movement and collectiveness. Black culture is robust in many ways (Boutte, 2016). However, it does not mean that it is a deficit because the culture varies from white or middle-class standards. Schmeichel (2012) stated that cultural differences are "valuable resources that can be accessed to help children of colour to become successful..." (Schmeichel, 2012, p. 223).

Knowing a student's culture, the teacher can use that information to elevate a child rather than focus on differences. In that elevation, the teacher can begin to erase any deficits in knowledge on the student's part and bias on the teacher's part. This leads the way to that student's academic success. It is also important to note that culture and response to oppression differ greatly. Delpit (2012) works to clarify this concept in chapter one of her book, *Multiplication is for white people: Raising Expectations for other people's Children*. She states that behaviors are the response to suppression and poverty and not manifestations of culture. She makes it clear the damage that can be wrought by confusing the two things. Response to oppression does not make a person or a group. Rather it is a symptom of a larger issue to be addressed (Delpit, 2012).

The same can be said for differences in language. Whether a child speaks a language other than English or a dialect such as African American Vernacular English (AAVE), this can play into a student's academic success. There is a negative stereotype connected to not speaking 'standard English.' Many hear a language other than English or a dialect such as AAVE and assume a lack of education, knowledge, or ability (Boutte, 2016). Schools often view students who do not speak standardized English as having a hindrance to learning (Valenzuela, 2017). Students are viewed as being deficit or limited
in proficiency rather than being seen as bilingual or having multiple languages and dialects. The ability to shift between these languages and dialects demonstrates student ability rather than disability (Emdin, 2016). Understanding a culture enables teachers to structure classrooms to support a variety of dialects and languages and make them valid (Gay, 2002).

**Classroom Implications of CRP**

Culturally relevant pedagogy has multiple classroom implications. Teachers must understand the background of each of their students. They must appreciate the differences in culture and language. To do this, teachers must develop meaningful relationships with students. They must earn the respect of their students and believe in their abilities to succeed (Delpit, 2012). Sympathy for students' circumstances cannot hinder becoming a warm demander (Delpit, 2012; Hammond, 2015; Ladson-Billings, 2009). A warm demander is a teacher who uses their rapport with students to scaffold, support, and push. Hammond (2015) describes a warm demander as one who is warm and supportive but holds high standards for student learning. Tough love is a descriptor given to these warm demanders by students (Delpit, 2012; Gay, 2002; Hammond, 2015). These warm demanders have built real relationships with students and have demonstrated that they care for their students and have developed competence as an educator. Students respect these teachers and will work for them because these teachers have shown that they are there for the students. Teachers have a huge impact on students. Those warm demanders let their students know their achievements have no boundaries. Warm demanders work hard for their students, and their students work hard for them.
Relationships construct the foundation of warm demanders and CRP in general. Relationships are formed by understanding and valuing the differences between and amongst ourselves and our students. When teachers take the time to teach in a culturally responsive manner, it positively impacts the interaction between student and teacher (Byrd, 2016). Students are aware when teachers appreciate their culture and differences. It makes the divide smaller and makes students believe in and want to work for teachers. When teachers take the time to learn about, appreciate, and integrate student culture into classroom practice, it improves the atmosphere in the classroom (Byrd, 2016; Hammond, 2015).

There is much to glean from the practices of other cultures. Emdin (2016) likens the call and response of preacher and congregation to the pedagogy of classroom call and response. In his book, *For White Folks Who Teach in the Hood... and the Rest of Y'all Too*, Emdin (2016) equates a skilled teacher to a Pentecostal preacher who knows how to keep the listeners engaged using inflection, tone, and carefully positioned call and responses. Calls to the altar causing quiet, reflective moments in a congregation can be replicated in a classroom by using tone and music to guide students (Gay, 2002; Emdin, 2016). Hip-hop culture (which, it should be cautioned, is not the only lens through which to view Black culture) lends itself to the classroom to develop relationships and promote academic achievement (Emdin, 2016). In rap videos and battles, MCs use call and response to engage the crowd. The subtle variations MCs use to tell the audience to do something versus asking them to do something is an emotional shift that classroom teachers can also employ. The rules of a rap cipher can also be engaged in classroom discussions to develop relationships with students. Using similar routines, a teacher can
allow their students' voices to be heard in classroom decision-making. This develops a sense of shared load between the students and the teacher. An all-inclusive shared classroom culture opens doors to the teacher being that warm demander. It makes students want to work for the teacher (Hammond, 2015; Harper, 2010).

This willingness to work for a teacher creates a liturgy of hope (Williams et al. 2019). High academic goals are seen as attainable through the development of relationships and shared respect. Students develop a sense of agency (Williams, et al. 2019). They have skillsets and academic confidence. It is as if they are now willing to take academic risks because they believe in the safety net. This safety net is derived from the instruction teachers provide in the form of higher-order thinking skills, creativity, and critical thinking (Byrd, 2016; Harris, et al. 2016). When teachers have developed an increased cognitive capacity, students can employ strategies to get themselves unstuck from an academic problem (Hammond, 2015).

Beyond the classroom, CRP is about building relationships with families and whole communities. It is about doing the real work of getting to know students at their most basic family levels. When we include families and even whole communities in the educational process, the likelihood that the students have a greater success rate increase (Boutte, 2016). Mapp (2003) examined an urban school that successfully created a school environment that was welcoming and authentic to families. This, in turn, had a positive impact on students. This school demonstrated academic success, which was credited to the impact of family involvement (Mapp, 2003). Creating students who want to learn and who develop autonomy in work completion is paramount to the overall success of students. Including the family in the process of developing students is important
Grijalva-Quinonez et al. (2020) examined the success rate of students whose parents actively supported homework. These students, whose parents were actively supportive, demonstrated higher academic functionality.

As we understand our student's family and community culture, we must reflect that in the classroom setting. Classrooms can feel like the child's community and look like it in many ways (Boutte, 2016). Representation is important; key community figures can be represented in the classroom in pictures and posters. Words and phrases from the community (church, ball fields, for example) can be displayed on the classroom walls as motivational quotes. Strong community-school relationships are necessary for all students to feel included and important. Culturally relevant pedagogy requires that we view our families in a way that highlights the "beauty, wisdom, and humanity" (Boutte, 2016, p. 201) inherent in them.

**Mathematical Achievement**

Mathematical performance has been monitored yearly since 1969 (Nations Report Card, 2019). This math assessment is given every two years to 4th, 8th, and 12th-grade students nationwide (Nations Report Card, 2019). Over time, the framework for this assessment has been adjusted to support new knowledge and needs in math instruction and performance. For example, in 2009, the shift highlighted the need to demonstrate mathematical reasoning (Nations Report Card, 2019). As technology advances, the focus on calculations has declined (Gravemeijer, et al. 2016; Lefkowitz, 2021). As early as 1980, the National Council of Teachers of Mathematics began to focus on the theoretical application of math rather than specific skills to be taught (Gravemeijer, et al. 2016). Emphasis on this higher-level thinking in mathematics has impacted student performance
and understanding. Direct instruction can develop critical thinking skills (Arisoy & Aybek, 2021). This demonstrates a clear need for specific instruction on critical thinking and problem-solving in mathematics.

**Problem-Based Learning**

Culturally relevant pedagogy lays the foundation for negating the effects of oppression on academic success. CRP shares many aspects of problem-based learning (PBL). PBL marries the tenets of constructivism with CRP to veer from the typical instructional model in many ways (Nariman & Chrispeels, 2016). It requires the focus to move from the teacher to the student (Dole, et al., 2017). This change necessitates the development of new skills for both the teacher and the student, which presents challenges in its implementation.

**What is PBL?**

Problem-based learning is different from traditional instructional models. Developed in the late 1950s, PBL was first utilized in the medical field as an application-based approach to training. It is learner-centered (Savery, 2006) and utilizes problems to stimulate learning (Nariman & Chrispeels, 2016). PBL provides a more personalized educational experience (Dole et al. 2017), and it allows students to collaborate with peers (Nariman & Chrispeels, 2016). This model of instructional delivery integrates content information with higher-order thinking skills and provides students the opportunities to solve problems effectively (Savery, 2006; Suastra et al. 2019). Furthermore, instruction delivered via PBL motivates and engages students, especially at-risk students (Gallagher & Gallagher, 2013). A review of literature conducted by Dole et al. (2017) highlighted the benefits of PBL instruction on upper elementary to high school students:
• strengthens student understanding
• enables organization of notes/notetaking by students
• improves higher-order thinking skills and the desire to complete higher-order tasks
• increases student self-efficacy
• increases intrinsic motivation of students
• improves collaborative skills (Dole et al. 2017)

PBL is not teacher-centered. This takes the teacher out of the role of the deliverer of information and more into the realm of facilitator (Dole et al. 2017). Instead, the focus is on the student as a problem solver. While students complete scenarios in collaborative teams, it is also not a traditional group project. PBL requires a well-thought-out problem and a structure that provides students with the collaborative skills to be successful. It is also not a situation that has clear right or wrong solutions. Instead, PBL presents students with intricate situations that might have multiple solutions (Savery, 2006).

Student autonomy is at the heart of PBL. Problems are presented to students who take on the role of stakeholders within that problem and are then required to lead their analysis (Gallagher & Gallagher, 2013). While the teacher provides scaffolding to ensure that the problem is accessible to all, the students develop the lines of inquiry and advance solutions to the problem presented. Teachers are facilitators in this model of instruction. In a traditional classroom, the teacher guides student thinking and shows them how to solve problems. Traditional models also have teachers determining the accuracy or correctness of a student response to a problem. PBL affords students greater latitude in decision-making and determining the best solution to a problem (Suastra et al. 2019).
Because these scenarios frequently have many possible solutions, students must develop evaluative criteria to determine if the solution is indeed the best one to solve the problem presented. The need for rubrics and other assessment tools is paramount. PBLs cannot be gauged by a typical multiple-choice assessment (Chian et al. 2019).

An aspect of the pedagogy of poverty is keeping students under control through quiet, independent seatwork (Delpit, 2012). Low-level activities are often provided to at-risk students because they demonstrate poor academic performance, recall basic information, or lack critical thinking skills (Jensen, 2013). These low-level activities keep at-risk students from achieving (Gallagher & Gallagher, 2013). PBL emphasizes conceptual knowledge rather than procedural. Instead of students spending mathematics class completing a worksheet of problems on area and perimeter, for example, they are instead developing a plan to turn a vacant neighborhood lot into a park. They calculate the amount of mulch or fencing needed to complete the project. This problem affords students the ability to see how the mathematical procedures fit into real-life scenarios. Seeing the connection between what they are learning in school and how it impacts daily life is imperative for students to own the knowledge and apply it in a variety of situations (Ladson-Billings, 2009). PBL provides students with the opportunity to see problems from a variety of subjects.

Through PBL, students can access information from different sources and use ideas from other disciplines to generate vigorous solutions (Savery, 2006). PBL cycles contain four primary steps that students follow to achieve the desired outcome:

1. explore and generate ideas,
2. research the ideas,
3. review the problem and synthesize new knowledge gained from research,

4. prepare final solution (Chian et al., 2019).

These steps require time for students to complete and time for the teacher to scaffold and support learning teams.

In reviewing the literature, however, Dole et al. (2017) point out that students cannot discover everything they need to know from disciplines on their own. There is still the need for direct instruction. This is where the scaffolding from teachers must come into play (Savery, 2006). Students, especially elementary students, often lack the prerequisite skills needed to manage the conceptual thinking needed by PBL.

Another aspect of PBL is collaborative teamwork. Problems are presented to teams of students who must work together to develop solutions (Nariman & Chrispeels, 2016). This collaborative aspect of PBL allows students to develop academic language, which many at-risk students lack, and to share new ideas (Zhang et al. 2021). This key component of PBL enables students to develop skills that will serve them throughout their lives. Most adults will use these skills in their jobs and daily lives. Collaborating with others will serve students well throughout their life beyond school (Savery, 2006).

There is some concern, as noted by Nariman & Chrispeels (2016), that collaborative groups are not always successful. The teacher must ensure equal distribution of the workload, clear team goals, and an appropriate level of group leadership and success.

A final component of PBL that is key to reaching at-risk students is the improvement of overall engagement. Students who struggle academically or have low self-efficacy often disengage from challenging tasks (Delpit, 2012). PBL improves the engagement of students. PBL tasks are real-world and provide students with the
opportunity to develop their ideas and work with others. Despite potentially weak procedural knowledge, these tenets yield student motivation to delve into challenging tasks. PBL captures the attention of students because they are solving problems that are meaningful to their lives and to their communities. It makes them feel as though they are making a real difference (Dole et al. 2017). By giving students the free reign to develop questions and solutions to unique problems, students are invested in the solution. This investment enables the development of intrinsic rather than reliance on extrinsic motivation (Warren et al. 2008).

Classroom Shifts

The implementation of PBL requires multiple classroom shifts. Teachers have to reposition themselves more as coaches or facilitators and less the purveyors of knowledge (Nariman & Chrispeels, 2016). For PBL to be successful, students must be the focus of the learning process. Utilizing relationship-centered practices and allowing students the latitude to develop their ideas and questions is paramount (Zhang et al. 2021). Students have to become active participants in every aspect of the learning process. Student choice and voice for timelines, outcomes, and rubrics are instrumental in the success of PBL in the classroom (Dole et al. 2017).

For students to feel empowered in this way requires implementing culturally responsive teaching layered on the PBL learning model. Culturally responsive teaching utilizes culturally responsive pedagogy and focuses on developing relationships that promote mutual respect and support between the teacher and the learner (Gay, 2002; Ladson-Billings, 1995). Students need to know that the classroom is a safe place to take risks and that their voice matters. This is developed through class talk that is authentic
and not teacher-driven (Emdin, 2016; Gay, 2002; Hammond, 2015). Talk structures such as think-pair-share or other turn-and-talk routines provide students with the underpinnings of safe talk structures, which enable them to collaborate successfully on complex problems (Hammond, 2015). By developing the ideas of a safe space and genuine voice, students are empowered to share their ideas, even when it comes to challenging academic tasks (Emdin, 2016). While teachers take on the role of facilitators, they must be intentional in the way they establish relationships and manage successes and failures within the classroom. Employing CRT as a part of the PBL process can help students feel their voices are valuable, and they will be willing to take academic risks in ways they might not have before (Gay, 2002).

Implementing PBL successfully also requires a mindset shift on the part of students. Students must be able to engage in growth academic mindsets. For many students, this is not something they have naturally. Years of academic struggle or lack of appropriate support have created dependent learners who do not believe themselves capable (Delpit, 2012; Diemer, et al. 2016; Matthews, 2018; Zilanawala, et al. 2018). Teachers must develop this mindset in students in order for them to be successful (Hammond, 2015). Academic mindset is made by the adults in a child's life. The power of the productive struggle is a compelling tool teachers utilize to help students develop a more flexible mindset toward problem-solving (Boaler, 2016). Teaching students how to fail forward helps them understand that even mistakes cause learning and opens them up to more creative problem-solving (Boaler, 2016; Hammond, 2015).

Establishing authentic relationships and employing CRT strategies can assist students in developing the skills they need to be successful in PBL. For students to work
collaboratively to problem solve, they must first be able to think (Dole et al., 2017). Unfortunately, critical thinking is not often developed in low-income students of color (Delpit, 2012). Frequently, these students are not challenged in school and learn to go with the flow without challenging how things are. In her book, "Multiplication is for White People": Raising Expectations for Other People's Children, Delpit (2012) recounts the story of a Native Alaskan teacher using a broom on the floor to teach this notion of thinking for themself. The broom lay in the doorway. Each student who entered the classroom had to step over it. No one picked it up because it was seen as an obstacle to get over. Not one student thought to remove the obstacle. According to Delpit (2012), this is a metaphor for how our low-income students of color view the obstacle of school. PBL will provide students with critical thinking and creative problem-solving skills only if the teacher establishes an environment that lets them flourish.

Students need a healthy sense of self-efficacy to tackle real-world problems creatively and critically (Karatas & Baki, 2013). Employing CRP in the classroom does improve student desire to work and their persistence in complex tasks, according to research conducted by Gamlen et al. (2019). It is a commonly held belief that students work for teachers they like and who believe in them. When students are engaged in activities that are meaningful to their lives and supported by a warm demander of a facilitator, they are more likely to believe in their ability to be successful (Suastra et al., 2019).

**Challenges to Implementation**

Problem-based learning, in conjunction with culturally responsive teaching, has a wide range of positive implications for the classroom setting. However, it presents some
unique challenges as well. Teachers must scaffold procedural skills to support the conceptual problems and provide students with the collaborative tools and self-efficacy to solve successfully complicated, real-world problems (Gallagher, & Gallagher, 2013; Savery, 2006; Suastra, et al. 2019). Teachers must also contend with the time constraints inherent in the schedules of classrooms (Nariman & Chrispeels, 2015; Savery, 2006).

PBL is a learner-centered instructional approach that requires teachers to present ill-formed scenarios to students to solve (Savery, 2006). The time required to develop these scenarios can be an obstacle to implementation. In addition, teachers are frequently overtasked with paperwork, committees, and the daily running of a classroom in a high-accountability environment. Learning how to implement student-centered practices is another challenge to implementation. According to Zhang, et al. (2021), most professional development is still offered in an isolated approach. Teachers sit through sessions that are not in-depth or do not provide the information they need and are then expected to go into the classroom to implement without additional support (Zhang et al. 2021).

An additional impediment to implementation is the development of valid assessment pieces for each scenario (Chian, et al. 2019). Because the emphasis in most public schools is proficiency on state standards due to NCLB and Race to the Top initiatives, students must demonstrate grade-level proficiency on the standards put forth by the local school district. Aligning the PBL scenario to learning outcomes requires determining and developing appropriate assessment tools (Chian et al. 2019). The requirement to follow a curriculum and the ever-present high-stakes testing presents another challenge to the implementation of PBL in classrooms (Nariman & Chrispeels,
2016). Problem scenarios must match the curriculum and pacing guides of the local and state districts. PBL requires the use of real and relevant problems. Teachers must develop a framework that will match both the required content and the need for meaningful and authentic situations for the students to solve (Nariman & Chrispeels, 2016). The requirement by many districts to spend time on test prep programs takes away from the time needed to implement PBL in the classroom (Nariman & Chrispeels, 2016; Savery, 2006). A true PBL scenario would encompass large chunks of instructional time, as it flows across multiple subjects and requires student collaboration time. High-stakes testing and the programs often required of teachers limit the amount of flexible classroom time to devote to such critical thinking situations (Savery, 2006).

**Related Research**

Utilizing CRP as the framework to underpin PBL in the elementary classroom provides the missing pieces of student self-efficacy and cultural support. The literature reviewed in this chapter shows links between the two concepts. This chapter will present four studies that examine the impact of PBL and CRP on student learning.

Pi-Hsia Hung et al. (2014) conducted a study to investigate the effect of problem-based learning on the ability of students to generate questions in inquiry-based subjects such as science. This study was conducted on 43 fifth and sixth-grade students over a period of seven months. This quantitative study examined the ability of students to develop critical-thinking questions before and after the PBL opportunity. The researchers differentiated between students with little experience in PBL or developing advanced questions and those who were more knowledgeable. This study also looked at the impact of students' collaborative learning skills. After students completed the inquiry-based
activities, their results were examined using the Hierarchal Linear Model. The researchers concluded, via a rubric, that all students’ questioning abilities improved due to PBL participation. The sixth graders were determined to improve their questioning skills more than the less experienced fifth graders. These researchers concluded that while all students displayed growth, those with more experience in inquiry-based learning showed greater gains. This observation led the researchers to conclude that the less-experienced students need more scaffolding from the teacher to demonstrate a high growth rate from inquiry-based lessons.

Amrullah & Suwarjo (2018) conducted a similar research study to determine the effect of PBL on fifth graders’ critical thinking and interpersonal skills. They set out to address the weaknesses students demonstrated in natural science classes. Student performances lacked problem-solving, critical thinking, and interpersonal skills. These skills were deemed essential for 21st-century success. This quantitative study was a quasi-experiment, utilizing a pretest and post-test control group design. The intervention used to improve critical thinking and interpersonal skills was problem-based cooperative learning. After conducting this two-month study, the results of the pre and post-tests were compared. Initially, students demonstrated an average critical thinking score of 4.36. After the intervention, students showed an average critical thinking score of 13.82. Similar findings occurred for interpersonal intelligence as well. The results of this study determined that PBL significantly improved the critical thinking and interpersonal intelligence of the fifth graders included in the study.

A third study relevant to this literature review is conducted by Brown et al. (2019). This qualitative study was developed to determine the potential of implementing
culturally relevant education (CRE) in science, technology, engineering, and math (STEM) studies. This study focused on the knowledge base of STEM teachers regarding culturally relevant education and how it correlates to STEM instruction. These researchers used this study to delve into the correlation between CRE and cognitive apprenticeship. The supposition proposed by this study was that CRE could support cognitive apprenticeship, and the two could enable students to understand the interrelatedness of school work and their community at large. This study determined that teachers needed support in implementing CRE into their STEM activities. Once teachers had full training on CRE, the ability to apply it to STEM lessons was clear.

A final study is the one conducted by Brown et al. in 2020. This qualitative study examined the effects of CRP on learning via virtual reality (VR). The study took a group of fifth graders in northern California to determine how virtual reality learning and CRP can help students find interrelatedness between science and their own lives. The argument made by this study for the co-joining of CRP and VR is that CRP contextualizes learning. By anchoring learning in terms of student communities and real-world situations, school subjects become more meaningful for students. This study concluded that using VR improved student engagement and understanding of science concepts. In addition, the coupling of CRP and VR provided students with the means to develop connections across subjects, their lives, and each other.

These four studies support the effectiveness of employing CRP and PBL in elementary classrooms, separately or together. In addition, the results of these studies demonstrate that through these frameworks, students can develop skills that cross content areas and the divide between school and the real world.
Summary

As stated in the Problem of Practice, academically at-risk students are frequently disengaged from school. There is a real need to make the school business relevant to their personal lives. This literature review demonstrates that when teachers work to develop authentic relationships with their students and engage in their students' culture, students are more engaged in school and perform better overall. When schools develop culturally responsive relationships with students and engage the family, students are more firmly connected to the school and the business of formal education.

Culturally relevant teaching enables this process by addressing the racial and ethnic diversity of our students. It also highlights these differences, something to be celebrated. Students who share a classroom with others with the same racial or ethnic background as their own or who have a classroom culture that acknowledges and celebrates these backgrounds are more academically successful (Brenner & Crosnoe, 2011).

This review of the literature shows schools must generate a culture of hope that provides students with the tools and the belief that they can and will be successful. Academic engagement and motivation become "contingent on the beliefs about what is possible" (Williams et al., 2018, p. 230). This focus on what is right with students and classrooms where they succeed is the basis for this study and lays the foundation for those to come.
CHAPTER THREE

METHODOLOGY

Introduction

Mathematics is a key component of our society and development, and yet it is often a subject students dislike or say they cannot do (Gravemeijer, et al. 2016; Matthews, 2018). Mathematical proficiency imparts the ability to seek out patterns, understand data, solve problems and think critically (Lefkowitz, 2021). Without Math, we cannot support our societal infrastructure or function in our daily lives (Gravemeijer, et al., 2016). In spite of these realities, a large portion of our student population is not achieving proficiency in mathematics. Data shows African American students are not demonstrating proficiency in mathematics at a high level. According to statistical data for the state of North Carolina, the percentage of African American students performing at a high level in mathematics is significantly lower than that of white students (NC School Report Cards, 2020). This is coupled with national data showing that African American students are more likely to be in remedial classes (Berry, et al. 2014; Gibson, 2022; Harper, 2021), are overrepresented in special education (Berry, et al. 2014; Gibson, 2022; Harper, 2021), and have a higher rate of suspensions from school (Berry, et al. 2014; Gibson, 2022; Harper, 2021; United States Department of Public Education, 2023). All of
this is evidence that African American students are not receiving the education they need to be successful in math. (Berry, et al. 2014; Gibson, 2022; Harper, 2021).

In this researcher’s school district, currently 40% of African American students in grades 3-5 are testing proficient in math (NC Reports, 2020). Less than 5% of those students scored at the highest level of achievement (NC Reports, 2020). Conversely, 54% of white students in grades 3-5 tested proficient with 16% at the highest level of achievement (NC Reports, 2020). As a classroom teacher in this school district, this researcher’s students and instructional practices contribute to this data. Also, as a mentor to beginning teachers and grade facilitator, it is of consequence because this researcher has the opportunity to impact the instructional practices of peers. The above data demonstrates that while all students lack mathematical proficiency, African American students perform at a lower level than white students. This study was conducted to address the problem of practice related to African American students needing engaging instruction that reflects their culture and enables them to develop critical thinking skills and mathematical proficiency. This researcher was focused on determining the impact of changing the structure of mathematics instruction on the developing sense of confidence for students as well as their mathematical competence.

**Research Questions**

This study was framed by the focus on how culturally relevant pedagogy and problem based learning can improve the attitudes, critical thinking and mathematical proficiency of students in a third grade classroom. This study aims to measure in the following ways:
1. How will culturally relevant pedagogy and problem based learning impact the attitudes of African American third graders as it relates to mathematics achievement?

2. How will culturally relevant pedagogy and problem based learning impact the critical thinking skills of African American third graders as it relates to mathematics achievement?

3. How will culturally relevant pedagogy and problem based learning impact the overall mathematics proficiency of African American third graders?

**Research Design and Rationale**

This research study utilized an action research design. Action research is a systematic research process that is undertaken by a practitioner to understand and ameliorate current practices (Efron & Ravid, 2020). It is steeped in constructivism because it enables the practitioner to test ideas and put what is learned from those investigations into practice (Bada, 2015). Action research provides the researcher-practitioner the opportunity to evaluate their own practices and participatory action research provided this practitioner the opportunity to study a problem that prevents a group of students from achieving in their academic setting (Efron & Ravid, 2020, Herr & Anderson, 2015). Action research must be systematic (Efron & Ravid, 2020). This necessitates that it must follow a prescribed investigative perspective. Mertler (2017) identified four steps in the action research process:

1. planning

2. acting
3. developing

4. reflecting

Action research is cyclical in nature. Reflection on results frequently leads to another cycle of inquiry (Mertler, 2017). This study was designed as a single cycle, as no further study occurred after the completion of the intervention and analysis of data.

There are primarily three interpretations of action research: quantitative, qualitative, and mixed-methods (Efron & Ravid, 2020). Mixed-methods blends both quantitative and qualitative procedures together into one paradigm (Efron & Ravid, 2020). Because of its ability to examine multiple data forms, and improve knowledge learned, this study utilized mixed-methods design.

The benefit of a mixed-methods approach is that it allows the researcher to merge the strengths of quantitative and qualitative data. It can improve both the overall knowledge gained as well as the integrity of the study (Mertler, 2017). The design was appropriate for this study because more discernment into the problem of practice could be achieved through the combining of qualitative and quantitative data (Creswell & Creswell, 2018). There is value to both qualitative and quantitative design. By mixing them both, information can be augmented to generate a more extensive understanding of data collected (Merriam & Tisdell, 2016).

**Intervention**

Problem-based learning (PBL) and culturally relevant pedagogy (CRP) were implemented over a 6-week period of time in a third-grade mathematics classroom. PBL was incorporated into the daily instruction as a real-world problem posed to students to
solve. Through this intervention, students embarked on an experience that incorporated student choice, high expectations, and a focus on social inequities.

Problem based learning (PBL) was chosen because it offered opportunities to address the constructs of confidence, critical thinking skills, and mathematical proficiency in a cohesive manner. It is an instructional model that uses real-world situations to initiate learning (Nariman & Chrispeels, 2016). PBL combines critical thinking and problem solving with subject-area content (Savery, 2006, Suastra, et al. 2019). This intervention also provided students with the latitude to work together with peers to solve problems. This collaborative problem-solving model was designed to advance a student’s sense of confidence. PBL also provided support to enable students to improve critical thinking skills and to build their capacity to persevere through difficult tasks (Nariman & Chrispeels, 2016, Suastra, et al. 2019). PBL further enables students to develop proficiency in academic content as well as problem solving (Karatas & Baki, 2013). Over time, this increased proficiency improves attitudes as students begin to feel more confident Dole, et al. 2017; Suastra, et al. 2019).

Culturally relevant pedagogy (CRP) was included in this study because it promotes academic achievement, as well as develops a strong sense of cultural competence, social consciousness, and a critique of the wider world (Gay, 2018). Utilizing CRP in the classroom enables students to develop a sense of competence and allows for students to grow from where they are (Ladson-Billings, 2021). This emphasizes the strengths students come to school with and provides the framework for growing student knowledge through scaffolding and cultural competence (Delpit, 2012; Ladson-Billings, 2021). Through the use of CRP in the classroom, students develop a
sense of confidence and worth because of their culture and prior knowledge and not in spite of them.

The intervention began with a slideshow and discussion about diverse people who make an impact in their communities. The researcher showed a slide deck containing six examples of community change agents (See Appendix F). Students engaged in a review of a previous unit in Social Studies regarding culture and how we help others in their community. A review of the unit on culture and values focused on revisiting the values, beliefs, and culture activities we completed earlier in the year (Appendix E). Students had an opportunity to brainstorm issues in the community they felt could be addressed. Figure 3.1 indicates the questions utilized by the researcher to support student participation in the brainstorming session.

- Do you think you or someone else has ever been treated unfairly because of their skin color, religion, or beliefs?
- What are some examples of this you have seen in school or in your community?
- Do you think you or other people are treated better when they are working with people who look like you (or they) do?
- Do you hear people talking about Black or Hispanic culture in your home? In your community? At school?
- Do you think people get to know you (or others) before they decide things about you?
- What are some assumptions people have made about you that has caused problems?

**Figure 3.1 Questions to guide brainstorming session**

These issues were then the springboard for the organization each group would create to address the community problem. This intervention also provided students with the latitude to work together with peers to solve problems.
Students worked cooperatively in small groups to complete the assigned tasks. Direct instruction was provided when necessary to fill in knowledge gaps and scaffold for students who struggled with task completion. Students were tasked with developing a plan to address a specific community need. These needs included assisting children with food insecurities, children whose parents could not afford child care, the homeless, and those with disabilities. Student groups met each week to plan their solution and use mathematics skills to make that happen. Students had to work collaboratively to develop their ideas and use mathematics skills to work through each task provided. Table 3.1 outlines the mathematical group tasks and their alignment with PBL and CRP.

**Table 3.1 Task Alignment with PBL and CRP**

<table>
<thead>
<tr>
<th>Task</th>
<th>Required Activities</th>
<th>Alignment with PBL</th>
<th>Alignment with CRP</th>
</tr>
</thead>
</table>
| Task 1 | • brainstorm community problems  
• develop teams based on interest  
• develop solution to the problem | • examine problem  
• generate ideas  
• collaborate | • identify community inequity and need  
• social mirroring using examples of others who support community |
| Task 2 | • examine solution to problem  
• develop resources list to create solution and make budget | • real-world connections  
• collaboration  
• examine resources | • examine equal access to resources  
• social constructs  
• address community need |
| Task 3 | • design an event to showcase problem and solution | • student-led research  
• identifying use of skills  
• apply new knowledge | • identify cultural aspects to present  
• create inclusive space  
• justify use of space to meet community needs  
• impact of project on community  
• evaluate project’s impact on inequality |
| Task 4 | • share final projects | • demonstrate knowledge and understanding of community problem and math skills | |
Research Setting and Context of Study

B Elementary School (pseudonym) is situated in central North Carolina in a small school district. Each spring the North Carolina End of Grade (EOG) test in mathematics is administered to all students in grades 3-5. The EOG is a state-derived standardized assessment used to determine the proficiency of all students across the state. Students score on a scale of 1-5. Scores 1 and 2 denote performance well below grade level and below grade level respectively. A score of a 3 is considered passing but not demonstrating career and college readiness (CCR). Scores of 4 and 5 signify the student has mastered grade level content in a manner that ensures success in subsequent grades (NCDPI, 2019). The following data was used as it was the last pre-Covid data available.

B Elementary had a diverse population in 2019. The school was classified as highly diverse, with 38% of the student population identifying as Hispanic, 26% African American, 31% white, with 4% multiracial, and 1% Asian/Pacific Islander (Public Schools Review, 2019). This diverse population was in line with the district demographics. Testing data for 2019 shows that in this researcher’s district, currently 40% of African American students in grades 3-5 are testing proficient in mathematics. Less than 5% of those students scored at CCR, the highest level of achievement. Conversely, 54% of white students in grades 3-5 tested proficient, with 16% at the highest level of achievement. In the researcher’s school building, 50% the African American students in grades 3-5 tested proficient with 30% performing at the highest achievement level. 59% of Hispanic students scored proficient with 45% scoring CCR. In
contrast, 64% of the white students performed at the proficient level, with 50% performing at the highest level of achievement (NC Reports, 2020). B Elementary’s standardized test data in mathematics supports the assertion put forth by Diemer, et al. (2016) that African American students are demonstrating less success in mathematics than other populations. The data clearly shows that while all the demographical groups are at risk for not developing the needed mathematical understandings to be successful in the future, African American students are at a greater risk of lacking the necessary mathematical thinking and skills. As this study was focused on how students learn and how to impact those learning behaviors, the context occurred at the micro level (Kivunga, 2018).

**Role of the Researcher**

Herr & Anderson (2015) defined action research as that which is conducted “by or with insiders” (p. 3). It is the crux of action research; in that it is undertaken by an insider for the purpose of improving practice or results within the professional setting. This study was considered insider research as the researcher conducted this study in her classroom with her own third-grade students. Being an insider was advantageous as this researcher had relationships with these students and knew them well. This enabled the researcher to observe student behaviors organically, without concern that her presence would disrupt their typical behaviors (Merriam & Tisdell, 2016).

**Participants**

This mixed methods action research study focused on third grade students. Typical purposeful sampling (Merriam & Tisdell, 2016) was employed in this study as this researcher used the third-graders that are assigned to her class. As classes in this
school are heterogeneously populated, the students represented a sampling of typical
students for the setting. There existed a diversity in race/ethnicity, gender, as well as
historical academic performance.

The third graders assigned to this class were the participants. There were 36
students in this sampling, from the researcher’s homeroom class and scaffolded math
class. Of these 36 students, there were 16 males and 20 females. Fourteen students were
white, ten were African American, and twelve were Hispanic. Six students were served
by the Exceptional Children’s program, two students have a 504 Plan, five students were
identified Academically Gifted. This school setting has a history of transiency in its
population. The typical percentage of movement each year ranges approximately from
20-24% according to records from the school data manager (J. Stephenson, personal
communication, ). Table 3.2 is a list of students in the sampling along with their
demographic information. This table also shows the students the researcher included in
the study.

Table 3.2 Demographic Information and Identification of Participants

<table>
<thead>
<tr>
<th>Student</th>
<th>Race/Ethnicity</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student 1</td>
<td>White</td>
<td>F</td>
</tr>
<tr>
<td>Student 2</td>
<td>White</td>
<td>F</td>
</tr>
<tr>
<td>Student 3</td>
<td>White</td>
<td>F</td>
</tr>
<tr>
<td>Student 4</td>
<td>White</td>
<td>F</td>
</tr>
<tr>
<td>Student 5</td>
<td>White</td>
<td>M</td>
</tr>
<tr>
<td>Student 6</td>
<td>African American</td>
<td>M</td>
</tr>
<tr>
<td>Student 7</td>
<td>White</td>
<td>F</td>
</tr>
<tr>
<td>Student</td>
<td>Race</td>
<td>Gender</td>
</tr>
<tr>
<td>---------</td>
<td>------------</td>
<td>--------</td>
</tr>
<tr>
<td>8</td>
<td>African American</td>
<td>F</td>
</tr>
<tr>
<td>9</td>
<td>White</td>
<td>F</td>
</tr>
<tr>
<td>10</td>
<td>White</td>
<td>M</td>
</tr>
<tr>
<td>11</td>
<td>African American</td>
<td>F</td>
</tr>
<tr>
<td>12</td>
<td>White</td>
<td>M</td>
</tr>
<tr>
<td>13</td>
<td>African American</td>
<td>M</td>
</tr>
<tr>
<td>14</td>
<td>African American</td>
<td>F</td>
</tr>
<tr>
<td>15</td>
<td>White</td>
<td>M</td>
</tr>
<tr>
<td>16</td>
<td>African American</td>
<td>M</td>
</tr>
<tr>
<td>17</td>
<td>White</td>
<td>M</td>
</tr>
<tr>
<td>18</td>
<td>Hispanic</td>
<td>M</td>
</tr>
<tr>
<td>19</td>
<td>African American</td>
<td>F</td>
</tr>
<tr>
<td>20</td>
<td>Hispanic</td>
<td>F</td>
</tr>
<tr>
<td>21</td>
<td>African American</td>
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</tr>
<tr>
<td>22</td>
<td>White</td>
<td>F</td>
</tr>
<tr>
<td>23</td>
<td>Hispanic</td>
<td>F</td>
</tr>
<tr>
<td>24</td>
<td>Hispanic</td>
<td>F</td>
</tr>
<tr>
<td>25</td>
<td>Hispanic</td>
<td>F</td>
</tr>
<tr>
<td>26</td>
<td>Hispanic</td>
<td>F</td>
</tr>
<tr>
<td>27</td>
<td>Hispanic</td>
<td>M</td>
</tr>
<tr>
<td>28</td>
<td>African American</td>
<td>M</td>
</tr>
<tr>
<td>29</td>
<td>Hispanic</td>
<td>M</td>
</tr>
<tr>
<td>30</td>
<td>Hispanic</td>
<td>M</td>
</tr>
</tbody>
</table>
Data Collection Instruments

To analyze the impact of PBL and CRP on students in mathematics, the researcher utilized pre- and post-questionnaires to express students’ sense of ability in math and problem solving. The researcher also used semi-structured observations with a behavioral checklist and interviews to gain more information about how PBL and CRP affected students’ competencies and critical thinking abilities. This section explains the various instruments used to collect data during this action research study and the means to maintain their reliability and the validity of the data they generate.

Pre- and Post-Student Survey

A student survey was developed which utilized a Likert rating scale to give the student-participants a place to share their thoughts on attitudes and how they viewed themselves as a mathematics student. This survey was employed at the start and the end of the research study to determine what, if any, changes occur in students’ attitudes as a result of this investigation. Administering this survey at the start and completion of this study focused on the students’ change in their concept of attitudes over the course of this study (Dana & Yendol-Hoppey, 2020). By examining the changes in student responses
from start to finish, the researcher was able to determine the impact the intervention had on this construct. This was a new tool developed by the research-practitioner and was based on the appropriateness for third graders. The rating scale on self-efficacy was a Likert scale of 1-5 (1 being strongly disagree – 5 being strongly agree) to show their sense of confidence.

**Table 3.3 Pre- and Post- Student Survey**

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>I don’t know</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I am a good student.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. I am good at math.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. I like to learn new things.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. I learn new things easily.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. I am able to keep working, even when tasks are hard.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

**Observations**

Structured observational protocols (Mertler, 2017) were used in conjunction with field notes (Dana & Yendol-Hoppey, 2020) to collect data on how students demonstrated critical thinking skills during PBL work sessions. Ahmadpour & Khaasteh (2017) expressed critical thinking skills as those which enable the learner to move beyond rote memorization and apply knowledge in deep and meaningful ways. The general field notes were accompanied by a behavioral rating scale to mark the critical thinking behaviors observed. This rating scale was developed by the researcher-practitioner and
was based on the appropriateness for third graders. This tool included a list of behaviors that demonstrate critical thinking. These behaviors are:

- able to explain the problem/situation
- develop steps to solve the problem/situation
- explain if answer is reasonable

Behaviors were rated on a scale of 1-3: 1 being not demonstrated, 2 being demonstrated inconsistently, and 3 being demonstrated consistently. These observations occurred throughout the study, in each problem-based learning session. Field notes were taken by the researcher during these observations.

In addition to seeking out critical thinking behaviors, this behavioral rating scale also identified two more behaviors that are frequently associated with academic success: leadership, and perseverance. Leadership behaviors were defined, for the purpose of this study, as behaviors where students take a leading role in group tasks. They assisted in organization of work and support their peers, both behaviorally and academically. These leadership behaviors were noteworthy as they related to a sense of attitude towards mathematics. Students who are engaged in tasks and feel capable of completing them have a far greater likelihood of academic competence (Gahlen, et al. 2019; Gravemeijer, et al. 2017; Zilanwala, et al. 2018). Students who are engaged in meaningful ways with their peers feel more connected to school and academic outcomes (Williams, et al. 2019).

Perseverance behaviors are those that show a student can maintain engagement with a task, even when it is challenging. These behaviors were noteworthy for this study because the presence of perseverance behaviors demonstrated that students believed they
could complete tasks. This belief can be tied to academic achievement (Williams, et al. 2019).

The final behavior addressed by the behavior observation rating scale was task avoidance. Task avoidance is the counterpart to perseverance. When students lack perseverance and a sense of self-efficacy, they often disengage from tasks (Gamlen, et al. 2019; Gravemeijer, et al. 2017; Williams, et al. 2019; Zilanwala, et al. 2018). Noting task avoidance behaviors during this study was important as it highlighted the students who lacked academic skills and a sense of confidence.

This behavioral rating scale collected data regarding critical thinking, leadership, perseverance, and task avoidance behaviors. This data collection tool utilized a Likert-like scale to identify the frequency of the observed behaviors. Students were observed during the hour-long sessions and the researcher noted the prevalence of behaviors for participants through the use of tally marks to show frequency of behaviors.

Table 3.4 Behavioral Observation Rating Scale

<table>
<thead>
<tr>
<th></th>
<th>Not Demonstrated</th>
<th>Inconsistently Demonstrated</th>
<th>Consistently Demonstrated</th>
</tr>
</thead>
<tbody>
<tr>
<td>able to explain the problem/situation</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>develop steps to solve the problem/situation</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>explain if answer is reasonable</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>leadership behaviors</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>perseverance behaviors</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>task avoidance behaviors</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
Student Interviews

In order to develop a deeper understanding of the effect of PBL and CRP on student efficacy and approach to math, semi-structured interviews were conducted. Students were asked to reflect on the interventions and how or if PBL and CRP impacted their sense of abilities or understanding of the math concepts. Semi-structured formatting was used so the researcher was able to follow up on student responses if need be (Mertler, 2017). Table 3.4 shows the interview questions and follow up options used by the researcher.

Table 3.5 Interview Questions – follow up questions are italicized

<table>
<thead>
<tr>
<th>Interview Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did you enjoy learning math through these problem situations?</td>
</tr>
<tr>
<td><em>How do you think they helped you understand the math concepts?</em></td>
</tr>
<tr>
<td>What did you like best about learning math through these problem situations?</td>
</tr>
<tr>
<td><em>Why is that?</em></td>
</tr>
<tr>
<td><em>Is there anything you did not like?</em></td>
</tr>
<tr>
<td><em>Can you tell me why you did not like that?</em></td>
</tr>
<tr>
<td>Do you think learning math this way helped you be a better student?</td>
</tr>
<tr>
<td><em>In what ways? Or why not?</em></td>
</tr>
<tr>
<td>Do you think it was helpful to see community leaders who look like you making changes?</td>
</tr>
<tr>
<td>Do you think having the opportunity to work in groups helped you to understand math better?</td>
</tr>
</tbody>
</table>
Do you think these problem situations have helped you to express yourself better?

Rating scales, checklists, assessments were developed utilizing best practices. These tools contained grade/age-appropriate language and skills and concepts. They were administered in a setting comfortable to students, where student responses were kept private through the use of pseudonyms.

**Research Procedures**

Research study began with administration of pre-questionnaire to determine participant self-efficacy. CRP and PBL was implemented slowly and deliberately, ensuring scaffolding for prerequisite skills (academic content as well as collaboration, thinking, questioning, problem solving, perseverance through challenges). Observations were conducted throughout the six-week study to seek out examples of critical thinking skills and content knowledge. At the end of the six-week study, the pre-survey was readministered serving as the post-survey. The data from these tools, in conjunction with the behavioral checklists and observations were triangulated to determine effects of PBL and CRP on student attitudes, critical thinking, and mathematical performance.

Students were assigned a number at the start of this study. All work samples and responses were recorded corresponding to that assigned number. The number-name assignments were kept on a document that was printed and kept locked in the practitioner’s file cabinet. Participants were referred to only as their assigned number in the study results. This assigned numerical pseudonym was utilized throughout the study to protect the identity of both participants and setting.
Surveys and document analysis were completed in writing. These were readily available for viewing. Observation notes were writing on pre-made behavioral observation forms. Other observations were in the form of field notes that the practitioner took during activities in the classroom. Two PBL activity sessions (first and last) were recorded, as well as the student interviews. These video recordings were transcribed later verbatim.

**Week One**

During week one, students were introduced to the pre-survey. The initial student survey was handed out and students were guided to respond to each prompt. The researcher then showed students a series of slides that contained people who identified an inequity or need in their community and developed a plan to address it. Students were introduced to adults and children through this slide deck that worked to make things better for people in their community. Afterwards, students were allowed to reflect on that slide deck and think about their own communities. Students brainstormed a list of problems in their community that needed addressing and why. Student submissions included providing support for those experiencing homelessness, helping students who face food insecurities, and children who are alone because parent(s) must work and cannot afford daycare. After a lengthy discussion on each brainstormed item, students choose learning teams and an issue they wished to address. Learning teams convened to develop a solution to the problem and began creation of a plan to implement. The focus this first week was in developing learning teams and setting the stage for collaborative efforts to come.
Week Two

Students continued to work on the development of their solution to the community problem they identified in week one. Student teams developed a solution to address their problem. They then created a potential list of necessary resources needed to implement their solution. Collaboratively, they began to develop a budget based on the list of necessary resources. This budget development required the use of multiple mathematical skills, such as estimation, adding, subtracting, and multiplying. Students also had to use reasoning skills to determine if their calculations were accurate. An additional mathematical process used was comparisons. Students had to find the best cost for each item. This meant utilizing multiple websites and determining cost comparisons for items.

The researchers provided a great deal of scaffolding for several groups during this week. Because of a lack of experience, academic vocabulary, and other issues, a few groups really struggled this week. The researcher had to work with each group individually to guide them through this budget process. Additional supports and practice in estimation and problem solving were provided. The first round of behavioral observations occurred this week utilizing the behavioral rating scale.

During this week, the researcher also calculated the pre-survey results on attitudes towards mathematics. This data was used to create a list of students to focus on for interviews. The list contained students who had lowest attitudes scores.
**Week Three**

During this week, students were asked to complete a different task relating to their solution to the community problem. They were asked to design an event introducing their project to the community. Students had to create a space and identify the components of the event. Through their knowledge of area, they designed their event to fit the space provided. In their groups, they also had to account for accessibility and meeting the needs of their audience. As students designed their event, they were tasked with examining how this event can be inclusive and support those who might struggle to get to the event, or get around during it. Student groups were also tasked with thinking about activities, music, etc. that appealed to a wide variety of people. They were asked to consider how making everyone feel welcomes could happen and what steps they would need to take in order for that to be true.

**Week Four**

Students worked in their cooperative groups continuing to add to their project design. This week they used their measurement skills to refined their event space. They measured the spaces they designed for their event using standard units of length measurement, inch, feet, yard, mile. During this week, the researcher conducted behavioral observations to examine critical thinking and problem-solving skills.

**Week Five**

This week students used elapsed time to finalize their event plans. They created timelines of events and how long activities would require. Interviews were also conducted this week. The researcher interviewed students in a private corner of the classroom, while groups were meeting to work on elapsed time activities. Interviews
were recorded using QuickTime audio and transcriptions were prepared using the app, otter.ai.

**Week Six**

During this final week, students completed the post-survey. They also shared their project and discussed how the project had the capacity to impact the community. Student groups presented to the class and discussed how their project addressed an inequity in their community. This study was conducted over a six-week period. Weekly tasks are shown in table 3.6.

**Table 3.6 Weekly Research Procedures**

<table>
<thead>
<tr>
<th>Timeline</th>
<th>Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior to the study</td>
<td>Consent to begin study acquired from school and district</td>
</tr>
<tr>
<td>Week One</td>
<td>• Pre-survey given to students.</td>
</tr>
<tr>
<td></td>
<td>• Research explained to students.</td>
</tr>
<tr>
<td></td>
<td>• Introduced idea using slides showing community leaders improving their community.</td>
</tr>
<tr>
<td></td>
<td>• Student brainstorming session to identify community need and develop project ideas.</td>
</tr>
<tr>
<td></td>
<td>• Scaffolding collaborative work with students to help them understand how to work together to create their projects.</td>
</tr>
<tr>
<td>Week Two</td>
<td>• Students begin developing project ideas.</td>
</tr>
</tbody>
</table>
• Budgets were created using budget sheets. Students had to use operational skills to develop working budgets.

• The researcher observed students working collaboratively and noted leadership and working behaviors.

Week Three
• Students designed an event to introduce their project to the community.

• Students utilized knowledge of area to plan space.

• Students identified ways to make their event inclusive to all.

Week Four
• Students continued to work on event space. They utilized measurement and problem-solving skills to finalize their space and ensure inclusivity.

• The researcher observed students working collaboratively and noted leadership and working behaviors.

Week Five
• Students utilized elapsed time skills to finalize their events introducing their project to the community.

• The researcher interviewed students.

Week Six
• Students shared their project ideas with the class.
The researcher gave students their post-survey

**Data Analysis**

Analysis of data begins as soon as collection commences (Merriam & Tisdell, 2016). The data was managed as it was collected and by procedures that best identified the trends inherent in it. The quantitative data was collected through the use of pre- and post-questionnaires. The information from which was analyzed using both descriptive and inferential statistics. Descriptive statistics organize and summarize large amounts of numerical data (Mertler, 2017). Inferential statistics serves to determine the likelihood of a result for a larger population based on the data of a sample (Mertler, 2017). Qualitative data was collected from observations and the behavioral checklist. Inductive analysis was utilized to reduce the amount of information collected and organize into patterns and themes (Mertler, 2017).

**Pre- and Post-Student Survey**

Surveys using a Likert rating scale were given to students at the start of this intervention. Multiple conversations were had with students to help them understand how to use this Likert scale. This ensured that the initial data from these surveys were accurate representations of student attitudes, without including any confusion students may have had due to an unfamiliar tool. This same survey was administered after the intervention period. When utilizing Likert scales to understand results, it is most effective to view the data in terms of median responses (Mertler, 2017). By focusing on the median score, the researcher was able to interpret results and show impact of intervention on student sense of attitude toward mathematics. Initial data from survey administered prior to start of
study was compared to the data from surveys administered after study is conducted. The results of this tool were tabulated at each administration using. The results were compared to determine what, if any, changes occurred as a result of the PBL study.

**Structured observations** The results of the structured observations were recorded as a behavioral scale (Appendix B) towards critical thinking skills. Critical thinking is defined as the ability to reason, induce, and evaluate knowledge and situations (Erikson & Erikson, 2019; Ghanizadeh, 2017). The following skills are integral parts of solving problems critically and were included in the rating scale:

1. able to explain the problem/situation
2. develop steps to solve the problem/situation
3. explain if answer is reasonable

Skills were rated on a scale of 1-3, 1 being not demonstrated, 2 being demonstrated without consistency, 3 being consistently demonstrated. Each observation ended in the analysis of these scale occurrences. Frequency of each rating occurring in the whole group, racial/ethnic, and individual participants at each observation as well as looking over the course of the study to determine changes as the study progresses.

Additional behavioral observations included the following:

1. leadership behaviors
2. perseverance behaviors
3. task avoidance behaviors

These behaviors could impact the analysis of the study as these behaviors often accompany self-efficacy or a lack thereof.
**Student Interviews** These were conducted near the end of the six-week intervention period. The researcher utilized coding to examine recurring themes. Inductive analysis was utilized as the overarching approaching to coding (Mertler, 2017). Interviews were read and reread seeking themes and commonalities. This open coding (Merriam & Tisdell, 2016) allowed for the development of axial coding, which was developed based on the deliberation of the meaning of the data collected (Merriam & Tisdell, 2016).

Validity and reliability was ensured through the triangulation of data from multiple sources. The information from all strategies was viewed as a whole to interpret study results. Merriam & Tisdell (2016) explain triangulation of data as a means to ensure credibility as using three different manners of data collection and comparing those results to one another. Both qualitative and quantitative data were collected simultaneously and with equal impact. This ensured that the results are comparable and lent greater credence to the data collected (Mertler, 2017). Detailed field notes were developed from observations and the checklist data was included in the final results.

**Summary**

A mixed-methods study was administered to a classroom of third graders to determine the potency of PBL and CRP on attitudes, critical thinking, and diminishing the current performance gap of African American students in mathematics. This study was structured based on Mertler’s (2017) action research process of planning, acting, developing, and reflecting. Stage one of the study involved the examination of data and recognizing the problem of practice. These actions led to the creation of the overall study plan. Stage two led to the implementation of the intervention and collection of data
created from that intervention, including the use of rating scales, semi-structured observations and interviews, as well as the analysis of student work to determine the impact of the intervention on student achievement in mathematics. Stage three involved examining the results and identifying improvements and implications for future instructional use. Finally, stage four brought the opportunities to share the results of this study and review the process and knowledge gained from it. The results of this study are further examined in Chapter Four of this dissertation.
CHAPTER FOUR
PRESENTATION AND DATA ANALYSIS

The achievement disparity continues for traditionally marginalized students, especially for African American students. These students are over represented in special education and behavioral classes (Gibson, 2022; Harper, 2021), and underrepresented in advanced classes (Gravemeijer, et al. 2016; Gibson, 2022; Harper, 2021). When mathematics instruction was presented without including culture and real-world implications, all students, but especially African American students, felt the impact in way that altered their ability for future success (Ladson-Billings, 2021). This action research study explored the development of attitudes, critical thinking skills, and overall mathematical achievement when PBL and CRP was incorporated in mathematics instruction.

The study was guided by three research questions:

1. How will culturally relevant pedagogy and problem based learning impact the attitudes of African American third graders as it relates to mathematics achievement?

2. How will culturally relevant pedagogy and problem based learning impact the critical thinking skills of African American third graders as it relates to mathematics achievement?
3. How will culturally relevant pedagogy and problem-based learning impact the overall mathematics proficiency of African American third graders?

This study utilized a triangulated mixed methods action research design as qualitative and quantitative data were collected simultaneously. The researcher collected data through pre- and post-surveys, behavioral observations, and semi-structured interviews. The researcher analyzed the quantitative data using descriptive statistics such as identifying the measures of central tendency and also inferential statistics through the use of repeated-measures t-test on the pre- and post-survey questions and the behavioral checklist. This researcher also utilized inductive analysis on qualitative data. This chapter examines the intervention employed as well as the general findings and results of the study. Finally, this chapter outlines the analysis of the data collected based on the research questions.

**Study Findings**

**Survey Data**

A pre- and post-survey was utilized as a quantitative collection tool. This survey was given to students at the start and the end of this six-week study. It consisted of five questions designed to illicit information about a student’s attitudes. All 36 students took the pre- and post-survey. This survey was designed with students choosing answers from a Likert scale. The results of this pre- and post-survey were analyzed using descriptive statistics. Descriptive statistics simply, summarize, or organize large amounts of data (Mertler, 2017). This information was analyzed for central tendency, with a focus on the median. When utilizing Likert scales to collect quantitative data, the median is the more
pertinent measure of central tendency (Mertler, 2017). The median score is the score that breaks apart the data into equal halves (Mertler, 2017).

The researcher also utilized inferential statistics to examine the data from the presurvey to the post survey. This was done using a repeated-measures $t$-test. This test compares two sets of data taken on the same participants (Mertler, 2017). This $t$-test enabled the researcher to determine whether the differences between the pre- and post-survey means were statistically significant.

**Pre-survey results.** The researcher calculated the mean (M), median (Mdn), and standard deviation (St Dev) for all questions on the presurvey (Table 4.1). On the presurvey, the median for all students on the attitudes statements was a 4 on a 5-point scale. For African American students, the mean for all attitudes statements is a 4. For Hispanic students, the mean for attitude statements was a 3. A score of 4 on the Likert scale is a selection of “Agree” to the statements in regards to students sense of self as a student, math student, learning things, and being able to persevere through challenges.

**Table 4.1 Measures of Central Tendency for Pre-Survey Statements All students**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Mdn</th>
<th>M</th>
<th>St Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am a good student.</td>
<td>4</td>
<td>3.89</td>
<td>1.26</td>
</tr>
<tr>
<td>I am good at math.</td>
<td>4</td>
<td>3.88</td>
<td>1.18</td>
</tr>
<tr>
<td>I like to learn new things.</td>
<td>4</td>
<td>4.02</td>
<td>1.18</td>
</tr>
<tr>
<td>I learn new things easily.</td>
<td>4</td>
<td>3.34</td>
<td>1.16</td>
</tr>
<tr>
<td>I am able to keep working, even when things are hard.</td>
<td>4</td>
<td>3.71</td>
<td>1.32</td>
</tr>
</tbody>
</table>
Table 4.2 Measures of Central Tendency for Pre-Survey Statements African American (AA) and Hispanic (H) students

<table>
<thead>
<tr>
<th></th>
<th>Mdn AA</th>
<th>M AA</th>
<th>St Dev AA</th>
<th>Mdn H</th>
<th>M H</th>
<th>St Dev H</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am a good student.</td>
<td>4.5</td>
<td>4.25</td>
<td>1.11</td>
<td>4</td>
<td>3.4</td>
<td>1.61</td>
</tr>
<tr>
<td>I am good at math.</td>
<td>4</td>
<td>4</td>
<td>1.35</td>
<td>3.3</td>
<td>4</td>
<td>1.25</td>
</tr>
<tr>
<td>I like to learn new things.</td>
<td>4.5</td>
<td>3.6</td>
<td>1.72</td>
<td>4</td>
<td>4.1</td>
<td>1.07</td>
</tr>
<tr>
<td>I learn new things easily.</td>
<td>3.1</td>
<td>3.34</td>
<td>1.29</td>
<td>3</td>
<td>3.2</td>
<td>1.24</td>
</tr>
<tr>
<td>I am able to keep working, even when things are hard.</td>
<td>5</td>
<td>4</td>
<td>1.68</td>
<td>4</td>
<td>3.4</td>
<td>1.45</td>
</tr>
</tbody>
</table>

Post-survey results. The statistical analysis of the post-survey data is found in Table 4.3. The researcher calculated the median (Mdn), mean (M), and standard deviation (St Dev) for questions on the post survey. The median score for all students was a 4. For African-American students the post-survey self-efficacy median score was a 4. For Hispanic students, the post-survey attitudes median score was 4.

Table 4.3 Measures of Central Tendency for Post-Survey Statements All students

<table>
<thead>
<tr>
<th></th>
<th>Mdn</th>
<th>M</th>
<th>St Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am a good student.</td>
<td>4</td>
<td>4.43</td>
<td>0.56</td>
</tr>
<tr>
<td>I am good at math.</td>
<td>4</td>
<td>3.89</td>
<td>1.08</td>
</tr>
<tr>
<td>I like to learn new things.</td>
<td>4</td>
<td>4.11</td>
<td>1.08</td>
</tr>
<tr>
<td>I learn new things easily.</td>
<td>4</td>
<td>3.46</td>
<td>1.15</td>
</tr>
<tr>
<td>I am able to keep working, even when tasks are hard.</td>
<td>5</td>
<td>4.51</td>
<td>0.82</td>
</tr>
</tbody>
</table>
### Table 4.4 Measures of Central Tendency for Post-Survey Statements African American (AA) and Hispanic (H) students

<table>
<thead>
<tr>
<th>Statement</th>
<th>Mdn AA</th>
<th>M AA</th>
<th>St Dev AA</th>
<th>Mdn H</th>
<th>M H</th>
<th>St Dev H</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am a good student.</td>
<td>5</td>
<td>4.75</td>
<td>0.46</td>
<td>4</td>
<td>4.08</td>
<td>0.49</td>
</tr>
<tr>
<td>I am good at math.</td>
<td>4</td>
<td>3.88</td>
<td>0.83</td>
<td>4</td>
<td>3.46</td>
<td>1.27</td>
</tr>
<tr>
<td>I like to learn new things.</td>
<td>4.5</td>
<td>4.0</td>
<td>1.31</td>
<td>5</td>
<td>4.31</td>
<td>1.11</td>
</tr>
<tr>
<td>I learn new things easily.</td>
<td>4</td>
<td>3.38</td>
<td>1.19</td>
<td>3.38</td>
<td>4</td>
<td>1.04</td>
</tr>
<tr>
<td>I am able to keep working, even when tasks are hard.</td>
<td>5</td>
<td>4.63</td>
<td>0.52</td>
<td>5</td>
<td>4.54</td>
<td>1.13</td>
</tr>
</tbody>
</table>

The researcher then investigated the individual student participant median scores to ascertain increases and decreases from the presurvey to the postsurvey. For example, Student 36 increased her score from a total of 14 to 25 points from pre- to post-survey. Student 27 doubled his score from 9 points to 18 points from pre- to post-survey. Student 12, conversely, decreased from pre-survey to post with an initial score of 23, dropping in the postsurvey to a score of 20. Figure 4.1 represents the pre- and post-survey scores by student participant.
The median score remained the same from the presurvey to the post survey for all students and for African American students. However, the median score rose for Hispanic students. The researcher then examined the mean scores from the pre- and post-survey results. The individual means and difference of means are shown in Table 4.5. The first statement, “I am a good student.” showed an increase in mean of 0.54. The second statement, “I am good at math.” showed an increase in mean of 0.01. The third statement, “I like to learn new things.” showed an increase in mean of 0.09. The fourth statement, “I learn new things easily.” showed an increase in mean of 0.12. The final statement, “I am able to keep working, even when tasks are hard.” showed the highest increase with a mean of 0.80.
Table 4.5 *Comparison of Attitude Statements for All Students*

<table>
<thead>
<tr>
<th>Attitude statement</th>
<th>Pre Survey</th>
<th>Post Survey</th>
<th>Difference in Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mdn</td>
<td>M</td>
<td>St Dev</td>
</tr>
<tr>
<td>I am a good student.</td>
<td>4</td>
<td>3.89</td>
<td>1.26</td>
</tr>
<tr>
<td>I am good at math.</td>
<td>4</td>
<td>3.88</td>
<td>1.18</td>
</tr>
<tr>
<td>I like to learn new things.</td>
<td>4</td>
<td>4.02</td>
<td>1.18</td>
</tr>
<tr>
<td>I learn new things easily.</td>
<td>4</td>
<td>3.34</td>
<td>1.16</td>
</tr>
<tr>
<td>I am able to keep working, even when tasks are hard.</td>
<td>4</td>
<td>3.71</td>
<td>1.32</td>
</tr>
</tbody>
</table>

After comparing the outcome from each attitude statement from the pre- to post-survey, the researcher determined the median remained the same for all students, but the overall mean score increased from pre- to post-survey 0.31.

Table 4.6 *Comparison of Attitude Statements Presurvey to Post survey for All Students*

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scores from pre survey</td>
<td>3.77</td>
<td>4</td>
</tr>
<tr>
<td>Scores from post survey</td>
<td>4.08</td>
<td>4</td>
</tr>
</tbody>
</table>

The researcher used a repeated-measures t-test to determine if there were statistically significant differences between the means of the pre- and post-surveys.
Based on the statistical analysis of results, $t(6.67) = -1.39$, $p = 0.21$, the difference between student attitudes before and after the intervention period was not significantly different.

As the researcher was seeking to identify the impact of the interventions on specific students, the data was extrapolated to further explore the impact on African American students, as well as Hispanic students. Table 4.7 demonstrates the impact on African American students.

**Table 4.7 Comparison of Attitudes Statements for African American Students**

<table>
<thead>
<tr>
<th>Attitudes Statement</th>
<th>Pre Survey</th>
<th>Post Survey</th>
<th>Difference in Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mdn</td>
<td>M</td>
<td>St Dev</td>
</tr>
<tr>
<td>I am a good student.</td>
<td>4.5</td>
<td>4.25</td>
<td>1.11</td>
</tr>
<tr>
<td>I am good at math.</td>
<td>4</td>
<td>4</td>
<td>1.35</td>
</tr>
<tr>
<td>I like to learn new things.</td>
<td>4.5</td>
<td>3.6</td>
<td>1.72</td>
</tr>
<tr>
<td>I learn new things easily.</td>
<td>4</td>
<td>3.1</td>
<td>1.29</td>
</tr>
<tr>
<td>I am able to keep working, even when tasks are hard.</td>
<td>5</td>
<td>4</td>
<td>1.68</td>
</tr>
</tbody>
</table>

The pre survey mean for African American students in the area of attitudes towards mathematics was 3.79. The post survey mean for African American students in this area was 4.13. This shows an overall increase of +0.34. The researcher ran a repeated measure t-test to determine the statistical significance of the changes in the mean of this data. Based on the statistical analysis results, $t(6.66) = -1.39$, $p = 0.21$ the intervention
proved not to hold a statistically significant improvement for African American students in attitudes towards mathematics.

This study sought to uncover the impact of CRP and PBL on African American students. However, as the impact of CRP is well documented as quality instructional practices for all, this researcher also examined the effect on Hispanic students in the sample as well. Table 4.8 demonstrates the pre survey and post survey data for Hispanic students in this study.

**Table 4.8 Comparison of Attitude Statements for Hispanic Students**

<table>
<thead>
<tr>
<th>Attitude Statement</th>
<th>Pre Survey</th>
<th>Post Survey</th>
<th>Difference in Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median</td>
<td>Mean</td>
<td>St Dev</td>
</tr>
<tr>
<td>I am a good student.</td>
<td>4</td>
<td>3.4</td>
<td>1.61</td>
</tr>
<tr>
<td>I am good at math.</td>
<td>3.3</td>
<td>4</td>
<td>1.25</td>
</tr>
<tr>
<td>I like to learn new things.</td>
<td>4</td>
<td>4.1</td>
<td>1.07</td>
</tr>
<tr>
<td>I learn new things easily.</td>
<td>3</td>
<td>3.2</td>
<td>1.24</td>
</tr>
<tr>
<td>I am able to keep working, even when tasks are hard.</td>
<td>4</td>
<td>3.4</td>
<td>1.45</td>
</tr>
</tbody>
</table>

The pre survey mean for Hispanic students was 3.62. The post survey mean for Hispanic students was 4.08, which was an increase of +0.46. The researcher ran a repeated measure t-test to determine the statistical significance of the changes in the mean of this data. Based on the statistical analysis results, \( t(79.99) = -1.79, p=0.11 \) the intervention proved to not hold a statistically significant improvement for Hispanic students in attitudes. Figure 4.2 shows the differences in changes for each group.
The researcher further probed the statements that showed the highest increase from pre survey to post survey. Statement 1, “I am a good student.” demonstrated a mean increase of +0.54. This statement had a median score of 4, which represented the “Agree” response. Over half of the participants, 18 students, or 51.43% answered “Agree” to this statement. Just less than half, 15 students, or 45.71% of the participants answered with a 5, or “Strongly Agree”. A single participant, or 2.86% answered with a 3, or “neutral response”.

**Figure 4.2 Changes for each data group from pre to post survey**
The statement “I am able to keep working, even when tasks get hard.” increased both median and mean from the pre survey to the post. This statement went from a median score of 4 to a median score of 5. It also showed an increase of +0.85 in the mean responses from pre survey to post survey. Figure 4.4 demonstrates the responses from participants on this survey statement.

Figure 4.3 Post Survey responses for “I am a good student”
Behavioral Observation Data

During the intervention period, an observational rating scale was utilized by the researcher. This tool captured student behaviors during collaborative work time. There were three primary behaviors examined by this tool: mathematical understanding, leadership, and task avoidance behaviors. All students were observed twice during the six-week intervention period using this tool. Data was analyzed using descriptive statistics to determine measures of central tendency. Inferential statistics were also used seeking to determine statistical significance using repeated-measures t test.

**Mathematical Understanding.** The researcher observed students twice using the behavioral observation tool (Appendix B). The first observation occurred during the second week of the intervention period. The first three questions on the observation tool demonstrate mathematical understanding of the tasks performed. The researcher found
the median and mean for each component in this section. This data for the first observation is demonstrated in Table 4.9.

**Table 4.9 Measures of Central Tendency Math Understanding First Observation All Students**

<table>
<thead>
<tr>
<th>Mathematical Understanding Behaviors</th>
<th>Mdn</th>
<th>M</th>
<th>St Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Able to explain the problem/situation</td>
<td>2</td>
<td>2.03</td>
<td>0.66</td>
</tr>
<tr>
<td>Develop steps to solve the problem/situation</td>
<td>2</td>
<td>1.88</td>
<td>0.47</td>
</tr>
<tr>
<td>Explain if the answer is reasonable</td>
<td>2</td>
<td>1.99</td>
<td>0.51</td>
</tr>
</tbody>
</table>

**Table 4.10 Measures of Central Tendency Math Understanding First Observation African American (AA) and Hispanic (H) students**

<table>
<thead>
<tr>
<th>Mathematical Understanding Behaviors</th>
<th>Mdn AA</th>
<th>M AA</th>
<th>St Dev AA</th>
<th>Mdn H</th>
<th>M H</th>
<th>St Dev H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Able to explain the problem/situation</td>
<td>2</td>
<td>2.12</td>
<td>0.64</td>
<td>2</td>
<td>2</td>
<td>0.60</td>
</tr>
<tr>
<td>Develop steps to solve the problem/situation</td>
<td>2</td>
<td>1.88</td>
<td>0.35</td>
<td>2</td>
<td>1.85</td>
<td>0.39</td>
</tr>
<tr>
<td>Explain if the answer is reasonable</td>
<td>2</td>
<td>2</td>
<td>0.53</td>
<td>2</td>
<td>2</td>
<td>0.43</td>
</tr>
</tbody>
</table>
The researcher conducted a second round of behavioral observations during week six of the intervention period. The researcher found the median and mean for each component of this section. The data is shown in Table 4.11.

**Table 4.11 Measures of Central Tendency Math Understanding Second Observation All students**

<table>
<thead>
<tr>
<th>Mathematical Understanding Behaviors</th>
<th>Mdn</th>
<th>M</th>
<th>St Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Able to explain the problem/situation</td>
<td>3</td>
<td>2.46</td>
<td>0.61</td>
</tr>
<tr>
<td>Develop steps to solve the problem/situation</td>
<td>3</td>
<td>2.46</td>
<td>0.69</td>
</tr>
<tr>
<td>Explain if the answer is reasonable</td>
<td>3</td>
<td>2.46</td>
<td>0.69</td>
</tr>
</tbody>
</table>

**Table 4.12 Measures of Central Tendency Math Understanding Second Observation African American (AA) and Hispanic (H) students**

<table>
<thead>
<tr>
<th>Mathematical Understanding Behaviors</th>
<th>Mdn</th>
<th>M</th>
<th>St dev</th>
<th>Mdn</th>
<th>M</th>
<th>St dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Able to explain the problem/situation</td>
<td>2</td>
<td>2.38</td>
<td>0.52</td>
<td>3</td>
<td>2.46</td>
<td>0.66</td>
</tr>
<tr>
<td>Develop steps to solve the problem/situation</td>
<td>2.5</td>
<td>2.38</td>
<td>0.52</td>
<td>3</td>
<td>2.54</td>
<td>0.66</td>
</tr>
<tr>
<td>Explain if the answer is reasonable</td>
<td>2</td>
<td>2.25</td>
<td>0.71</td>
<td>3</td>
<td>2.54</td>
<td>0.66</td>
</tr>
</tbody>
</table>

The overall median score for each aspect of mathematical understanding increased from 2 to 3. The overall mean score for each component increased by +0.49.

For African American students the overall median score stayed the same, and the means
increased from 2 to 2.34. This showed an increase of +0.34. Hispanic students showed an increase in median score from 2 to 3. Their mean score went from 1.95 in the first observation to 2.51 in the second observation. This showed an increase of +0.56. This is demonstrated in Table 4.13.

**Table 4.13 Comparison of Mathematical Understanding**

<table>
<thead>
<tr>
<th></th>
<th>Mdn</th>
<th>M</th>
<th>Mdn</th>
<th>M</th>
<th>Mdn</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All</strong></td>
<td>2</td>
<td>1.97</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1.95</td>
</tr>
<tr>
<td><strong>AA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>H</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scores from first observation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2.46</td>
<td>2</td>
<td>2.34</td>
<td>3</td>
<td>2.51</td>
</tr>
<tr>
<td>Scores from second observation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The researcher used a repeated-measures t-test to determine if there were statistically significant differences between the means of the pre- and post-surveys for all students. All students demonstrated an increase in mathematical understanding of +0.49. African American students demonstrated an increase in mathematical understanding of +0.34. Hispanic students demonstrated an increase in mathematical understanding of +0.56. Based on the statistical analysis of results, $t(2)=-11$, $p=0.01$, the difference between student ability to explain and understand tasks mathematically was not statistically significant. The data also proved to not be statistically significant for either African American students or Hispanic students.

**Leadership Behaviors.** The researcher observed students working collaboratively to identify leadership behaviors exhibited during work sessions. This data was collected
using the behavioral observation tool. It was employed during weeks two and four of the intervention period.

**Table 4.14** Measures of Central Tendency Leadership Behaviors All Students

<table>
<thead>
<tr>
<th>Leadership Behaviors</th>
<th>Mdn</th>
<th>M</th>
<th>St Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>First observation</td>
<td>2</td>
<td>1.83</td>
<td>0.75</td>
</tr>
<tr>
<td>Second observation</td>
<td>2</td>
<td>2.17</td>
<td>0.73</td>
</tr>
</tbody>
</table>

**Table 4.15** Central Measure of Tendency Leadership Behaviors African American (AA) and Hispanic (H) students

<table>
<thead>
<tr>
<th>Leadership Behaviors</th>
<th>Mdn AA</th>
<th>M AA</th>
<th>St Dev AA</th>
<th>Mdn H</th>
<th>M H</th>
<th>St Dev H</th>
</tr>
</thead>
<tbody>
<tr>
<td>First observation</td>
<td>2</td>
<td>1.75</td>
<td>0.71</td>
<td>1</td>
<td>1.54</td>
<td>0.66</td>
</tr>
<tr>
<td>Second observation</td>
<td>2.5</td>
<td>2.25</td>
<td>0.89</td>
<td>2</td>
<td>2</td>
<td>0.91</td>
</tr>
</tbody>
</table>

The median score for each observation remained the same for all students. For African American and Hispanic students, the median increased. The mean increased from 1.83 to 2.17 with a net gain of 0.34 for all students. The researcher utilized the repeated-measures *t* test to determine if this gain was statistically significant. Based on the analysis, *t*(66)=−1.78, *p*=0.08, the data does not demonstrate a statistically significant gain in student leadership behaviors for all students. For African American students, the gain was +0.5. For Hispanic students the gain was slightly smaller at +0.46. Leadership behaviors increased more for African American students than other subgroups, but the
Hispanic subgroup of students also demonstrated an uptick in observable leadership behaviors as a result of this intervention.

**Perseverance Behaviors.** The researcher collected observation data on perseverance behaviors as well. This data was collected via the observation tool. Table 4.16 displays this data.

**Table 4.16 Measures of Central Tendency Perseverance Behaviors All students**

<table>
<thead>
<tr>
<th>Perseverance Behaviors</th>
<th>Mdn</th>
<th>M</th>
<th>St Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>First observation</td>
<td>2</td>
<td>1.97</td>
<td>0.79</td>
</tr>
<tr>
<td>Second observation</td>
<td>3</td>
<td>2.63</td>
<td>0.60</td>
</tr>
</tbody>
</table>

**Table 4.17 Measures of Central Tendency Perseverance Behaviors African American (AA) and Hispanic (H) students**

<table>
<thead>
<tr>
<th>Perseverance Behaviors</th>
<th>Mdn AA</th>
<th>M AA</th>
<th>St Dev AA</th>
<th>Mdn H</th>
<th>M H</th>
<th>St Dev H</th>
</tr>
</thead>
<tbody>
<tr>
<td>First observation</td>
<td>3</td>
<td>2.38</td>
<td>0.92</td>
<td>2</td>
<td>1.77</td>
<td>0.73</td>
</tr>
<tr>
<td>Second observation</td>
<td>3</td>
<td>2.75</td>
<td>0.46</td>
<td>3</td>
<td>2.54</td>
<td>0.66</td>
</tr>
</tbody>
</table>

The median score for this data set increased from the first collection to the second. The mean score also increased 0.66. Using repeated-measures t test, $t(62)=-4.11$, $p=0.0001$, the data does not show a statistically significant change in perseverance behaviors. African American students showed an increase in perseverance behaviors of +0.37. Hispanic participants demonstrated an increase in perseverance behaviors of +0.77.
**Task Avoidance Behaviors.** The researcher also collected observational data on task avoidance behaviors. This data was collected using the behavioral observation tool. The measurement on this data was in reverse of the previous uses of this rating scale. For mathematical understanding and leadership behaviors, the higher the score, the better the student performance. For task avoidance, the higher the score, the more the student engaged in avoidance behaviors during collaborative work sessions. Task avoidance behaviors include off-task behaviors such as talking about other subjects, leaving the room, disengaging from tasks, completing other work/tasks instead of group work tasks. This data is shows in Table 4.18.

**Table 4.18 Measures of Central Tendency Task Avoidance Behaviors All Students**

<table>
<thead>
<tr>
<th>Task Avoidance Behaviors</th>
<th>Mdn</th>
<th>M</th>
<th>St Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>First observation</td>
<td>2</td>
<td>2.09</td>
<td>0.66</td>
</tr>
<tr>
<td>Second observation</td>
<td>2</td>
<td>1.34</td>
<td>0.59</td>
</tr>
</tbody>
</table>

**Table 4.19 Measures of Central Tendency Task Avoidance Behaviors African American (AA) and Hispanic (H) students**

<table>
<thead>
<tr>
<th>Task Avoidance Behaviors</th>
<th>Mdn AA</th>
<th>M AA</th>
<th>St Dev AA</th>
<th>Mdn H</th>
<th>M H</th>
<th>St Dev H</th>
</tr>
</thead>
<tbody>
<tr>
<td>First observation</td>
<td>2</td>
<td>1.88</td>
<td>0.83</td>
<td>2</td>
<td>2.23</td>
<td>0.60</td>
</tr>
<tr>
<td>Second observation</td>
<td>1</td>
<td>1.13</td>
<td>0.35</td>
<td>1</td>
<td>1.38</td>
<td>0.65</td>
</tr>
</tbody>
</table>

The median score for all students remained the same for each observation. The mean, however, dropped from 2.09 to 1.34, for a loss of -0.75. Based on the analysis,
\( t(67) = 4.97, p < 0.0001 \). This does not demonstrate a statistically significant change in task avoidance behaviors from the first observation to the second. For African American and Hispanic students, the median score changed from a 2 to 1, signifying a decrease in task avoidance behaviors. For African American students, the mean changed from the first observation to the second by a score of -0.75. For Hispanic students the change was greater with a change of -0.85.

**Interview Data**

Individual student interviews occurred during week five of the intervention period. The interviews offered additional insight into the impact of PBL and CRP on student attitude and mathematical proficiency. The researcher chose the students who scored the lowest in attitude based on the pre survey administered week one of the intervention period. Table 4.20 Shows students with lowest attitude scores based on pre-survey.

**Table 4.20 Students with the lowest attitude scores out of 25 points**

<table>
<thead>
<tr>
<th>Student</th>
<th>Attitude Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student 27</td>
<td>9</td>
</tr>
<tr>
<td>Student 16</td>
<td>11</td>
</tr>
<tr>
<td>Student 35</td>
<td>14</td>
</tr>
<tr>
<td>Student 36</td>
<td>14</td>
</tr>
<tr>
<td>Student 14</td>
<td>15</td>
</tr>
<tr>
<td>Student 3</td>
<td>16</td>
</tr>
<tr>
<td>Student 11</td>
<td>17</td>
</tr>
<tr>
<td>Student 18</td>
<td>17</td>
</tr>
<tr>
<td>------------</td>
<td>----</td>
</tr>
<tr>
<td>Student 30</td>
<td>17</td>
</tr>
<tr>
<td>Student 34</td>
<td>17</td>
</tr>
</tbody>
</table>

A total of ten participants were interviewed for this part of the study. The qualitative data collected through student interviews were designed to closely examine the impact of CRP on student work.

**Participant 3.** Participant 3 had a 16/25 score on attitude towards mathematics based on the pre survey data. This student, overall, demonstrated a strong sense of mathematics and self, but showed in the pre survey a lack of confidence. She stated during the interview that she struggled with working collaboratively. She also said “Seeing other people, especially kids and girls, make a difference makes me feel stronger”. She stated it made her realize that people were successful at things that others said they couldn’t do. She said that had a big impact on her and made her feel like she could do big things too.

**Participant 11.** Participant 11 had a score of 17/25 on attitude. This student, demonstrated a large degree of difficulty in understanding and explaining math tasks and demonstrated a high level of task avoidance behaviors in the initial behavioral observation. As the intervention period went on, her ability to explain the problem increased and her task avoidance behaviors decreased. She stated that “I got excited to see girls, not just boys making changes.” She also stated “I used to be nervous talking in front of others. Now I feel like I can do it.”
Participant 14. Participant 14 scored 15/25 on the initial attitude survey. This student demonstrated a great deal of competence in explaining and tackling math concepts, but struggled with leadership skills. She stated this intervention helped her understand math because she could talk about it with others. She also stated that seeing kids and people who looked like her helping their community made her feel “like a leader”.

Participant 16. Participant 16 had one of the lowest attitude scores of 11/25. He showed some difficulty in explaining the math problems and developing a viable solution. He said “this helped me understand math in real life.” He stated that knowing how math would be used in real life made it easier to understand and made him want to work harder. He also stated that this intervention helped him because “this showed me how I can help my community”.

Participant 18. Participant 18 had an initial attitude score of 17/25. He is the only participant interviewed whose score decreased (-1) from the beginning to the end. His greatest take away was that he liked doing problems with the group. “You don’t have to do it alone,” he stated. He said listening to the ideas of others help him when he was stuck and made him feel good when he was right. The collaborative support was key to him. He also liked “knowing that everyone had the power to change their world”.

Participant 27. Participant 27 had the lowest attitude score of any participant, 9/25. He said that he really liked everything about this project. He said “I started third grade and I had a hard time in math. Now my grades are getting better”. He stated he feels like he knows how to think about math and how to ask for help when he needs it. He
also stated that knowing his ideas would make life better for someone else made him want to “work harder”.

**Participant 30.** Participant 30 had an initial attitude score of 17/25. He stated that he really liked the project but he said “It was hard to work together in a group”. The groups made it harder but “being able to work with other people sometimes distracted me but I see how it helped me have better ideas”. He also stated that the project did not help him to be a better student, but it helped him to be better at math. He clarified to say that being a good student meant behaving and helping the teacher. He separated being a good student from the academic aspect. He also said the project helped him to share his ideas better.

**Participant 34.** Participant 34 had an attitude score of 17/25. He stated that he really felt like the project helped him because of the group aspect. He said “It helped me know if I’m struggling with something I can ask somebody in my group for help”. He also said knowing that his ideas and work could help others was important to him. “I didn’t realize I could do that until now. I didn’t think I could help anybody”.

**Participant 35.** Participant 35 had an attitude score of 14/25. He said having friends help him helped him understand and make better grades. He said “working together helped me to think of better ideas”. He also stated that this project helped him see how he can make a difference helping others.

**Participant 36.** Participant 36 had an attitude score of 14/25. She said “I like to do math and I like to figure things out”. She said knowing she could be better at math and help make things better for other people made her feel good about herself. She referenced that Blacks and women did not always have the right to vote and being able to
help people in the community made her feel like she had power. “It made me feel happy because girls couldn’t always vote and had no power. I see that girls can have power now and make things better. I like that.”

**Themes from Interviews.** The researcher transcribed the individual interviews with participants. The transcripts were coded to identify emerging themes. After initial open coding and a deeper analysis of data, six themes appeared.

**Figure 4.5 Emerging themes from interview data**

**Theme 1: Increased Confidence.** An initial theme that emerged from the interview data was an increase in confidence. A primary aspect of CRP is the idea that every student is capable of achieving academically, and with the appropriate culturally situated instruction, they can (Gay, 2018). The interview data provided evidence of this impact on students. Without exception, every student interviewed addressed their feelings of confidence. They said things like “I feel stronger.” and “I feel good about myself”. They also expressed being able to help others because of this project. The confidence increase was expressed in relation to mathematics, but also just in school in general.
Participant 11 explained how this project made her feel more confident in expressing her ideas. “I used to feel nervous…talking with the microphone. And now I feel like I actually like it.”

“This helped me to be better at math and also at working together. I thought both of those things were hard at first. And now I think they are easier” stated Participant 30.

Participant 35 shared that he was able to “think better ideas” because of this project.

**Theme 2: Real world connections.** A second theme that emerged from the interviews with participants is their understanding that mathematical connects to the world around them. Every participant interviewed expressed how they now understood how math was in the real world. This connection of the mathematical concepts to the real world gave participants a reason to learn. It showed them why mathematics was important and made them want to learn it because they knew they would have a reason to and not just because they have to for school. It created an environment where students felt invested in the concepts because they understood their power and significance.

Participant 16 shared in his interview “This helped me understand math and see it in real life. It shows me how I can use math to do things…and help my community.”

This idea of being able to use math in the real word and seeing those connections was echoed by Participant 35 as well. “I can see how I can make a difference using math. I didn’t know I could do that before” declared Participant 35.

**Theme 3: Problem solving.** This study enabled participants to see mathematics for more than just operations. The idea of using mathematical concepts to solve a problem was evident during interviews with students. Of the ten students interviewed,
five participants stated that this project helped them to use the mathematics in different ways and to understand problems better. Three participants were able to articulate that understanding how to tackle these types of problems made it easier to do word problems in class. Participant 16 stated “This helped me understand math problems in a lot of different ways.”

Participant 14 also shared that this project helped her see math in different contexts. “I didn’t know math could do that [help others].”

This idea was elaborated on by Participant 36 who stated “I liked doing the math and this helped me to figure things out that I didn’t really get.”

**Theme 4: Collaboration.** Several students addressed the collaborative aspect of this project. Many participants stated that working collaboratively was a struggle at first. However, they all agreed that it helped them complete the tasks.

Participant 3 expressed a lot of struggles in working collaboratively with a group. “Some people don’t want to work or they just want to copy off your paper.” She went on to say that [group work] is not my kind of style… but if I work independently who am I gonna work out problems with?”

Participant 34 said it helped him because “if I am struggling with something I can ask somebody in my group for help.”

Participant 18 said it was helpful to know “you don’t have to do it alone.”

Every participant stated that being able to work with someone else helped them feel more confident and comfortable with the tasks.
Participant 14 said “working in groups is better because I don’t think I can do it by myself. This was a big project. Doing it by myself would be a lot of work. I think everyone needs help sometimes.”

**Theme 5: Separation of behavior and academics.** This theme surprised the researcher. Four participants separated the idea of being a good student from academics. For them, a good student was one who listened to the teacher and helped her. Having good grades or understanding the concepts was not a component of being a good student.

Participant 30 even stated that this project did not help him be a better student but it did help him get better at mathematics. While Participant 27 stated, “This helped me with math, but I was already a good student. I listen and I try hard. I had not good grades and third grade was hard but I don’t get in trouble. I listen.”

**Theme 6: Critical consciousness.** The final theme that emerged from the interview data was that of critical consciousness. Several students stated that this project helped them to realize that there are people and situations that are not right and need to be changed.

Participant 36 referred to the fact that “women couldn’t vote for a long time and lots of people think girls can’t do things. But they can! It makes me feel happy to know I can do good things.”

Several other students addressed that fact that they never see Black and Hispanic people who are making changes, except during Black History Month. Participant 14 explained “You only see Black people and the things they do when we learn about Black History Month. In school, we don’t talk about people like this during the rest of the year.” These participants all shared that they only knew a few people who made big changes in
the world – Martin Luther, King, Jr., Rosa Parks, and Harriet Tubman. This project helped them to see the power in people and the way things that were unfair could be addressed. Participant 27 shared “I didn’t know kids could do things like this. I didn’t think anyone would listen to a Mexican kid before this.”. Participant 36 stated, “This makes me feel good about myself and let’s other people know that being Black is a good thing.”

**Addressing the Research Questions**

This study sought to determine the impact of CRP and PBL on African American third grade students. The researcher examined the impact on three main areas for students: attitudes, critical thinking, and overall mathematical proficiency. A synopsis of the data as it relates to each question follows.

**Research Question 1: How will culturally relevant pedagogy and problem based learning impact the attitudes of African American third graders as it relates to mathematics achievement?**

Attitudes of confidence data was collected using both quantitative and qualitative measures. Quantitatively, the results of the pre- and post-survey do not show a statistically significant increase in attitudes towards mathematics after the implementation of the intervention. The quantitative data was deemed inconclusive due to a lack of statistical significance and a substantial variability in the data. All students showed an increase in attitudes, while African American and Hispanic students showed a larger increase in their sense of attitudes towards mathematics. Qualitatively, students who were interviewed shared they gained confidence from this project and felt better about themselves and their abilities after it was completed.
Research Question 2: How will culturally relevant pedagogy and problem based learning impact the critical thinking skills of African American third graders as it relates to mathematics achievement?

Critical thinking skills are those that move beyond rote memorization and cause students to apply information to novel situations (Ahmadpour & Khaasteh, 2017). Critical thinking skills were examined through the behavioral observation checklists that were administered twice during this intervention period (Appendix B). Students were more able to explain the mathematical problem and develop an appropriate solution to it. This increased ability to develop an appropriate solution and explain the reasonableness of a solution showed a development of critical thinking skills and the ability to reason through a problem. The quantitative data was not conclusive for statistical significance. However, there were improvements and behavioral data demonstrates a positive change.

Research Question 3 How will culturally relevant pedagogy and problem based learning impact the overall proficiency in mathematics of African American third graders?

The behavioral observation checklist data did not demonstrate a statistically significant increase for African American students in the area of mathematical proficiency, however qualitative data did. Throughout this intervention, students gained a stronger ability to explain a mathematical situation, developed a plan to solve it, and demonstrated the ability to justify the reasonableness of the answer. Students were able to have conversations about the mathematics tasks required of them. They discussed their ideas and developed plans to implement, using the mathematical skills. During observations, the researcher saw observable behaviors. This overall mathematical
proficiency improved for African American students. Quantitatively, the behavioral checklist data did not show a statistically significant increase in understanding mathematical concepts. Qualitatively, students stated they felt better as a mathematics student. Participant 27 even stated that his mathematics grade has improved in the quarter this study was conducted.

Summary

This chapter presents the findings of the mixed methods action research study. This study sought to determine the impact of problem-based learning and culturally relevant pedagogies on African American students; specifically, their attitudes, critical thinking skills, and mathematical proficiencies. The quantitative data collected via pre- and post-student surveys and behavior observation checklists did not demonstrate a statistically significant increase in self-efficacy and critical thinking skills for students. This data does suggest that the interventions had a positive impact on student understandings. The mixed methods design of triangulation, along with multiple data collection procedures ensured the reliability and credibility of this study.
CHAPTER FIVE
SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

This chapter will review the action research study conducted by the researcher, to include the problem of practice, the research questions, and purpose of the study. It also provides an overview of the methodology used, as well as a discussion of the findings. Finally, this chapter provides an action plan, recommendations for practice, and implications for future research.

Problem of Practice

Mathematics skills are woven into the fabric of our society. They include not only calculations, but also problem solving, critical thinking, and reasoning as well (Lefkowitz, 2021). And yet a majority of our students are not able to successfully demonstrate these skills. While there has been growth overall, 59% of fourth grade students nationwide were deemed not proficient by the 2019 NAEP (Nations Report Card, 2019). Diving deeper into the national test results is the fact that African American students tested 20% proficient (Nations Report Card, 2019). These data points are mirrored by the researcher’s district that shows only 30% of African American students are College and Career Ready (NC Reports, 2020). This data, coupled with the statistics that show African American students are more like to be placed in special education
classes than advanced classes (Berry, et al. 2014; Gibson, 2022; Harper, 2010) demonstrates a lack of instruction for African American students at a higher level. African American students are more likely to receive remedial instruction than that which offers opportunities to improve critical thinking and problem solving (Delpit, 2012; Gay, 2018; Harper, 2010).

The problem of practice for this study centered around addressing the lack of higher-order and culturally relevant instruction that has created this underdeveloped proficiency. Students need to have instruction provided in a way that supports their cultural learning and shows them relevance to their lives (Gay, 2018; Ladson-Billings, 2021; Zilanawala, et al. 2018). This researcher wanted to determine the impact of culturally relevant pedagogies and problem based learning on the student attitudes, critical thinking skills, and overall math achievement. The school in which the researcher was employed did not have a current model for CRP or implemented within the school.

Research has demonstrated that CRP can support extended learning for African American students (Brown, et al. 2019; Gay, 2018; Ladson-Billings. 2021). PBL and other inquiry-based models have also been shown to improve student thinking and achievement (Arisoy & Aybek, 2021; Chian, et al. 2019; Gallagher & Gallagher, 2013).

**Research Questions**

This study was guided by three research questions.

Research Question 1: How will culturally relevant pedagogy and problem based learning impact the attitudes of African American third graders as it relates to mathematics achievement?
Research Question 2: How will culturally relevant pedagogy and problem based learning impact the critical thinking skills of African American third graders as it relates to mathematics achievement?

Research Question 3: How will culturally relevant pedagogy and problem based learning impact the overall mathematics proficiency of African American third graders?

**Purpose of Study**

The purpose of this mixed-methods action research study was to examine the impact of CRP and PBL on the attitudes, critical thinking, and mathematical achievement of African American third graders. PBL combines real-world situations and problems that include problem solving and collaboration (Nariman & Chrispeels, 2016; Savery, 2006; Suastra, et al., 2019). Successful PBL produces conditions where the self-efficacy of children increase as they find success through these tasks (Dole, et al. 2017; Nariman & Chrispeels, 2016; Suastra, et al. 2019). CRP anchors learning in community and cultural relevance (Gay, 2018; Ladson-Billings, 2009, 2021). It mirrors PBL in the collaborative aspects and adds, for students, a layer of connection to school, which improves student outcomes (Byrd, 2016; Matthews, 2018).

The study was designed to seek the impact of CRP and PBL on students’ attitudes of confidence and critical thinking as they related to mathematics. The desire was that an increase in confidence and critical thinking would show an improvement in overall mathematical achievement. The added layer of CRP was provided to anchor student learning in relevance and offer them a voice in the wider world.
Overview of Methodology

The researcher utilized an action research study with triangulation mixed-methods research design. This was developed so the researcher could collect quantitative and qualitative data simultaneously, which offers the researcher the ability to hold both types of data in equal standing (Mertler, 2017). This research design offers a greater credibility as the two types of data merge to show similar results (Mertler, 2017).

The researcher conducted this study in her own third-grade classroom over a six week period. During this time period, students were tasked with developing a solution to a community problem. Students grappled with the larger issue while completing four math tasks, related to the greater project. CRP was interlaced with this project as students examined community change agents and inequities within their own communities.

The data collection instruments utilized in this study comprised a pre- and post-survey, behavioral observations checklist, and student interviews. The pre- and post-survey questions examined students’ sense of confidence. The behavioral observation checklist probed students’ mathematical understandings, as well as perseverance, leadership, and task avoidance behaviors. Finally, student interviews were conducted on students who demonstrated the lowest confidence scores on the pre-survey. These interviews were completed with the hopes of understanding how these interventions impacted the students overall.

Results and Findings

To determine the answers to the research questions, the researcher analyzed the quantitative results using both deferential and inferential statistics. The researcher also analyzed the qualitative data from observations and interviews using inductive analysis.
The results are inconclusive as there is a tremendous amount of variability in the data. However, it does suggest that the interventions of CRP and PBL had an impact on students’ sense of confidence, critical thinking, and overall mathematical achievement.

**Major Findings 1: Attitudes**

Quantitative analysis shows that African American students demonstrated a +0.34 improvement in attitudes from pre-survey data to post-survey. This proved to not be a statistically significant increase, but it was an increase. Students need to believe they can be successful. A strong sense of self has been proven to be a consistent predictor of achievement (Diemer, et al., 2016). This increase was echoed in the behavioral checklist data as African American students showed a +0.37 increase in perseverance behaviors. Students were more likely to keep trying at a problem rather than giving up quickly, which differed from the start of this intervention. An increase in attitudes towards mathematical was also apparent in student interviews. A theme that emerged from the interviews was that of increased confidence. Every student interviewed stated they felt more confident after these interventions were employed. Participant 16 noted “I feel like I can do better in math now”.

**Major Findings 2: Critical Thinking**

Critical thinking is a key component of mathematical competency (Lefkowitz, 2021). The quantitative data analysis shows that African American students increased their critical thinking skills as they relate to mathematics. This increase was determined to not be statistically significant, but it was an improvement. This increase in critical thinking was supported by the qualitative data. Of the students interviewed, half of them...
stated that this project helped them to use mathematics in different ways. Participant 16 specifically shared that it helped him understand math in different situations.

**Major Findings 3: Mathematical Achievement**

Quantitative findings show that African American students did not have a significant increase in mathematical achievement after completing this project, but they did improve. Students showed an increase of +0.34 on behavioral checklists. After the application of PBL and CRP in the classroom, students were more able to discuss and explain mathematical tasks. They also showed a significant increase in the ability to determine the reasonableness of an answer. Through this augmentation of skill, students were more able to enjoy math and felt better about their abilities. The qualitative data bears this out as well. Students made statements during the interviews such as “I have better grades in math now”.

**Recommendations for Practice**

The researcher recommended the instructional strategies for classroom implementation, based on the findings of this study. The results of this study demonstrated a significant increase in skills as they relate to mathematical achievement. The results also showed a pronounced impact on Hispanic students as well. As a district with a substantial Hispanic population, the impact of these interventions could be substantial for students beyond African Americans.

**Recommendation 1: Cultural Inclusiveness**

Students spend their classroom time viewing skills and concepts through a Eurocentric curriculum. The majority of their teachers are white and middle class. For African American and Hispanic students, there is a need to invest time in developing a
classroom climate and lessons that support and diverse learners. Through increasing a student’s confidence and cultural pride, higher academic performance is possible (Gay, 2018).

**Recommendation 2: CRP training**

In order for teachers to successfully support a diverse student population, they must be trained to do so. This can occur with an intentional change in the approach to training teachers. Districts and individual schools must include an introduction to diversity and culturally relevant pedagogies so that the school can begin to ensure that teachers are addressing the diverse student body.

This introduction can only be the start, however, as professional learning opportunities need to be ongoing and active in order to be effective (Ngounou & Guitierrez, 2017; Zepeda, 2019). Teachers should be required to attend multiple sessions on culturally relevant pedagogy. Schools should support year-long coaching models to support teachers as they develop their culturally relevant skills and implement them into the classroom. Through the implementation of CRP, authentic relationships between the school and families can be built (Ladson-Billings, 2009, 2021). Teachers create classroom cultures where learning is meaningful for all students and students feel connected to their culture through the learning taking place (Gay, 2018; Ladson-Billings, 2009, 2021).

**Recommendation 3: Problem-Based Learning**

The last recommendation stemming from this study is the inclusion of problem-based learning in classroom instruction. PBL in the classroom is shown to increase a student’s connection to the learning (Dole, et al., 2017). It improves their critical thinking
skills and improves their sense of voice and solidifies their locus in their own learning (Dole, et al., 2017; Suastra, et al., 2019). While developing PBL scenarios does take the classroom teacher additional time and effort, studies are proving this is a worthwhile investment. PBL gives students the sense of autonomy that enables them to explore their own ideas through the context of real-world situations. The ability to apply ideas and concepts is improved and students develop a greater sense of confidence (Dole, et al., 2017; Suastra, et al., 2019; Zhang, et al., 2021).

Implications for Future Research

Findings from this study suggested that the implementation of CRP and PBL led to a clear increase in student attitudes towards mathematics, critical thinking, and mathematical achievement. The improved skills were demonstrated by all students. African American students showed a substantial increase in all skills. Analysis of the data revealed Hispanic students had the most improvement after the intervention took place. All of this suggested that CRP and PBL are just good teaching (Ladson-Billings, 1995; Schmeichel, 2012).

A clear achievement gap exists between white students and African American and Hispanic students, especially in the area of mathematics. This gap is pernicious as it creates multiple secondary issues in learning for African American students. African American students are more likely to be placed in remedial classes and have more referrals for behaviors (Berry, et al, 2014; Gibson, 2022; Gravemeijer, et al, 2016; Harper, 2021). Furthermore, a study conducted by Wang, et al. (2022), suggests that African American students are more prone to embracing negative stereotypes about themselves. This points to an even greater reason to disrupt systems that perpetuate
inequities for African American students. As studies suggest, confidence is a key contributor to academic success (Dole, et al. 2017; Suastra, et al. 2019; Zhang, et al. 2021). If African American students are positioned to believe the worst about themselves, the ability to see themselves as successful diminishes.

Further research possibilities include expanding the focus of this intervention to include Hispanic students, especially English Language Learners. The results of this study suggested that these students showed the greatest overall increase in attitudes, critical thinking, and math achievement. Narrowing the focus to Hispanic students could demonstrate the greater impact of CRP and PBL on all traditionally marginalized groups.

A final future research implication from this study is ensuring students understand the separation or difference of being a good student academically, as opposed to behaviorally. During the interview process, four students separated being a good student from being good at academics. These students were all Hispanic. This finding presents opportunities for future research in the examination of the Hispanic culture on student identity in academics.

**Limitations of the Study**

This study does contain limitations that provide implications for future research. As the study was conducted with one group of third graders, there is limited generalization possible with the results. Also, while every attempt was made to ensure students that there was no right or wrong answer to interview questions, it is also possible that students were attempting to please the teacher with their interview responses. A further limitation to this study’s findings is that the improvements suggested may be a result of comfort with the situation and format as well as an improvement in skills.
Students had limited experience with collaborative problem solving prior to this intervention.

**Action Plan**

The results from this mixed-methods study suggested that the implementation of PBL and CRP in an elementary classroom led to significant increases in attitudes, critical thinking, and mathematical achievement for all students, not just African American students. These findings indicate that the intervention of CRP and PBL does have a positive impact on all students. Because the impact encompasses all students, these interventions can and should be incorporated in all classrooms.

The researcher is leaving the classroom next school year and will focus primarily on reading intervention. However, as a mentor to beginning teachers, a resource for classroom teachers in grades 4-5, and a teacher leader in the school, the researcher will continue to share ways to incorporate CRP and PBL in classrooms. As part of that sharing, the researcher will be presenting at a district conference this summer. The topic of the conference is utilizing CRP to support management and climate development for classroom teachers. The researcher will continue to advocate for the use of CRP and PBL strategies in all classrooms and will utilize the results of this study to support that advocacy.

**Summary**

This action research study examined the impact of CRP and PBL in relation to the growth of students’ attitudes, critical thinking, and mathematical achievement. Students explored the idea of being a community change agent while implementing math tasks to help solve a community problem. Both quantitative and qualitative data was collected.
and analyzed to determine the impact of these interventions on student behaviors, thinking, and skills. The researcher will share the implications of this study through district professional development and daily work in her school. Students need to feel seen and represented in their classroom. Through the development of culturally relevant practices and problem-based learning, students can connect with the world around them and develop the understanding needed to close the achievement gap that exists for African American students in the area of mathematics.
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APPENDIX A STUDENT SURVEY

Student Survey

For each statement below, circle the number that best explains how you feel about the statement.
1= Strongly Disagree
2= Disagree
3 = I don’t know
4= Agree
5= Strongly Agree.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>I don’t know</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am a good student.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I am good at math.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I like to learn new things.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I learn new things easily.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I am able to keep working, even when tasks are hard.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
## APPENDIX B

### BEHAVIORAL RATING SCALE

<table>
<thead>
<tr>
<th>Student ___________________</th>
<th>Date Observed ____________________</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Not Demonstrated</th>
<th>Inconsistently Demonstrated</th>
<th>Consistently Demonstrated</th>
</tr>
</thead>
<tbody>
<tr>
<td>able to explain the problem/situation</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>develop steps to solve the problem/situation</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>explain if answer is reasonable</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>leadership behaviors</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>perseverance behaviors</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>task avoidance behaviors</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
## APPENDIX C
### OBSERVATION NOTES

<table>
<thead>
<tr>
<th>Observations</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Members:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Date:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Mathematical understanding</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Leadership</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Perseverance</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Task Avoidance</strong></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX D
INTERVIEW QUESTIONS

Semi-Structured Interview

Student: _________________

Today I am going to ask you some questions about the project we are completing in class. There are no wrong answers. Just do your best to answer the questions.

1. Did you enjoy learning math through these problem situations?
2. How do you think they helped you understand the math concepts?
3. What did you like best about learning math through these problem situations?
4. Why did you like that?
5. Is there anything you did not like? Tell me why you did not like that.
6. Do you think learning math this way helped you to be a better student? In what ways? Or why not?
7. Do you think it was helpful to see community leaders who look like you making changes in their community?
8. Do you think having the opportunity to work in groups helped you understand math better? How did working in groups help you?
9. Do you think these problem situations have helped you to express yourself better? Tell me how they helped.
APPENDIX E

SOCIAL STUDIES UNIT THAT SUPPORTED THIS STUDY

Values and Beliefs Within Cultures

Directions: Draw or write three activities that you value and tell why.

1

2

3

Why?

Why?

Why?
Name: ________________

**Values, Beliefs & Attitudes**

Core Idea: What you value influences your beliefs which determines your attitudes.

Value = what you think is important  
Belief = what you think is true  
Attitude = the way you express yourself in thoughts, words and actions because of your beliefs

Instructions: Fill out the boxes below to show some of your personal values, beliefs and attitudes. The first box is done as an example.

<table>
<thead>
<tr>
<th>Value:</th>
<th>Belief: A good education is important for success in life.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Attitude: I get upset when people don't do their best in school.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Value:</th>
<th>Belief:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attitude:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>
When he was 9 years old, elementary student Asean Johnson made a strong and spirited speech opposing Chicago Mayor Rahm Emmanuel’s proposal to close his school and 49 others in predominantly Black and Latino neighborhoods. “You should be investing in these schools, not closing them!” Asean said to the mayor. Partly because of Asean’s activism, his school, Marcus Garvey Elementary, remained open. His speech ended with him chanting “Education is a right. This is why we have to fight!”
When Greta Thunberg was 11 years old, she became so upset by people’s lack of concern about climate change that she stopped talking and eating. This is how concerned she was with the climate and how little people seemed to care about it.

In August of 2018, this Swedish teenager began a weekly sit in outside her nation’s parliament, which is the country’s government building. Her acts inspired young people all around the world to join with her in a movement called Youth for Climate. In March 2019, students in more than 1700 locations, including every continent, participated in a strike from school.

These young people developed a program called Project Petals to work with urban and rural communities that lacked resources.
She was five years old when she tried to get a letter to the Pope. She wanted him to help families like hers who had come to America from Mexico without the proper documentation. Since then, she has become a strong voice in the immigrant rights movement. She has spoken at the Women’s March in Washington, DC, as well as with former President Barack Obama about her concerns for immigrant families.

These people saw a need at their local beaches to combat pollution and trash. They started a clean up project to keep their beaches clean.
Havana is a young activist who, at a youth climate strike in Washington, DC, spoke to the crowd telling them, “Black, indigenous, and people of color are doing the least damage to the planet but we are the ones who are paying the price first.”

Havana was first on the national news at age 7 when she was the only child at her elementary school to participate in the National School Walkout against gun violence. Havana’s mom, Bethany Edwards, said Havana did it because she wanted to stand up for Africans and African-Americans who are victims of gun violence. She had a cousin who was a victim of gun violence.

Havana also supports girls, power and achievement. She developed a line of t-shirts, Unstoppable, to raise money for girls in Ghana, an African country.

Think about a way your community can be helped.

What can YOU do to improve where you live?

How would your idea make things better or easier for a group of people?
APPENDIX G

INITIAL BRAINSTORMING WORKSHEETS FOR GROUPS

Service Project Brainstorming Guide

Think about the community change agents and the issues we discussed. Identify the one problem in your community you want to help make better. What are the reasons it is a problem? What can you do to help people?

<table>
<thead>
<tr>
<th>Issue you wish to address</th>
<th>Why is this a problem?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What can you do to address the issue?</th>
<th>How will your solution make lives better for others?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

How does this issue show that some things are unequal in our community?
Service Project Budget Sheets

<table>
<thead>
<tr>
<th>Item</th>
<th>Site Found</th>
<th>Cost</th>
<th>Rounded cost</th>
<th>Quantity</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red bucket</td>
<td>Walmart</td>
<td>5.95</td>
<td>6</td>
<td>3</td>
<td>18</td>
</tr>
</tbody>
</table>

Total cost for project
**Service Project Budget Sheets**

**Questions**

**Name(s):**

**Project Name:**

1. What was the most challenging part of this task? __________

   Why? ________________________________

2. How did working together make it easier (harder) to complete?

   ________________________________

3. How did developing the budget help you understand your solution? __________

   ________________________________

4. Now that you have created your materials list and budget, are there things you would change about your solution? ________

   What are they? ________________________________

   ________________________________

   ________________________________

   ________________________________
APPENDIX I

SHOWCASE EVENT AREA/PERIMETER WORKSPACE

Service Project Event Planning
Area/Perimeter Worksheet

You will plan a community event to introduce the community to your project. Think about what types of activities you will need to showcase your project. On your grid paper, draw out your event space. Find the area and perimeter of each part of your event.

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APPENDIX J

SHOWCASE EVENT SCHEDULE ELAPSED TIME WORKSHEET

Service Project Event Planning
Elapsed Time Worksheet
You will need to plan a schedule for your community event. Decide on your starting and ending time. Then develop at least 3 activities that will take place during your event. Record the starting time, ending time, and elapsed time for each event.

Community Event:
Start time___________ End time ________ Elapsed ____________

Event One: ______________________
Start time___________ End time ________ Elapsed ____________

Event Two: ______________________
Start time___________ End time ________ Elapsed ____________

Event Three: ______________________
Start time___________ End time ________ Elapsed ____________