Pursuing Culturally Responsive Math Teaching By Secondary Math Educators: A Professional Development Action Research Study

Emily Bell Redding
University of South Carolina

Follow this and additional works at: https://scholarcommons.sc.edu/etd

Part of the Education Commons

Recommended Citation

This Open Access Dissertation is brought to you by Scholar Commons. It has been accepted for inclusion in Theses and Dissertations by an authorized administrator of Scholar Commons. For more information, please contact digres@mailbox.sc.edu.
PURSUING CULTURALLY RESPONSIVE MATH TEACHING BY SECONDARY MATH EDUCATORS: A PROFESSIONAL DEVELOPMENT ACTION RESEARCH STUDY

by

Emily Bell Redding

Bachelor of Science
Kansas State University, 2003

Master of Science
Radford University, 2016

Submitted in Partial Fulfillment of the Requirements

For the Degree of Doctor of Education in

Educational Practice and Innovation

College of Education

University of South Carolina

2023

Accepted by

Yasha Becton, Major Professor

Todd Lilly, Committee Member

Jonathan Schulz, Committee Member

Suha Tamim, Committee Member

Ann Vail, Dean of the Graduate School
Dedication

I would like to dedicate this dissertation to my family, colleagues, and students. First, to my parents, husband, and children. Thank you for your support and patience throughout this doctoral journey. Thank you for your understanding when I would need to escape for a day to write, thank you for your encouragement to persevere when I got discouraged, and thank you for believing in me and this mission enough to support this dream financially and emotionally. To my colleagues, thank you for letting me bounce ideas off you, to dream up future solutions and brainstorm current problems. Your dedication and partnership with our students are amazing to observe every day. And finally, thank you to my many students I have served over the years in various educational roles. You are my inspiration. I hope the work being done now will continue to grow and evolve, so each math classroom can be an environment where students believe math is meaningful to their personal lives, where they can become problem solvers of global and local issues, and where math is a gateway to future goals.
Acknowledgements

I would first like to acknowledge my school division for their partnership and collaboration with this research. Throughout the research journey, state and division leadership changed, along with new initiatives and directives. Through it all, the support and perseverance from the school division leadership team allowed this research to be conducted with fidelity. Secondly, I would like to acknowledge the participants of this study, who dedicated after school time to learn more about Culturally Responsive Math Teaching. I know your time was extremely valuable, especially with many new initiatives and expectations, so thank you for investing your limited time to this study. Thank you to my dissertation committee of Dr. Todd Lilly, Dr. Suha Tamim, and Dr. Jonathan Schulz. Each of you have contributed to my journey as an educator as well as provided instrumental support and guidance in this study. Your time is valuable in your leadership roles, so thank you for believing in me and in this research. Finally, a giant note of gratitude and appreciation to Dr. Yasha Becton, my advisor and mentor throughout this doctoral journey. Her patience and guidance have helped me refine my research and identify future areas of study to support teachers in Culturally Responsive Math Teaching. My hope is to continue this work that you and I have started together so many more teachers and students can be empowered with ways to honor student voice, culture, and identity within each math classroom.
Abstract

This action research study examines the use of professional development to build the self-efficacy of secondary math teachers in culturally responsive mathematics teaching (CRMT), with the hope to address achievement gaps of Black and Hispanic students. Seven math teachers from a school division in Southwest Virginia participated in a 9-week professional development that included virtual meetings to learn about CRMT, collaboration with colleagues, classroom applications, and self-reflection. Quantitative and qualitative data were collected throughout the 9 weeks in the forms of questionnaires, meeting transcripts, and reflection journals. The research study results found the professional development to build teacher self-efficacy, especially with the key aspects of collaboration, classroom application, and reflection. Further research may be helpful to learn how to best train teachers on how to find and use CRMT resources with the demands of state and national curriculum standards, testing, and school division initiatives.

Keywords: culturally responsive math teaching, professional development, secondary math teachers, culturally responsive pedagogy, self-efficacy
Table of Contents

Dedication ........................................................................................................................................ iii
Acknowledgements ........................................................................................................................ iv
Abstract ........................................................................................................................................... v
List of Tables .................................................................................................................................... ix
List of Figures ................................................................................................................................... x
List of Abbreviations ......................................................................................................................... xi
Chapter 1 Introduction ...................................................................................................................... 1
  1.1 Introduction ................................................................................................................................. 1
  1.2 Statement of the Problem of Practice ......................................................................................... 5
  1.3 Research Question ....................................................................................................................... 6
  1.4 Purpose of the Study .................................................................................................................... 6
  1.5 Theoretical Framework ............................................................................................................... 7
  1.6 Overview of Methodology .......................................................................................................... 9
  1.7 Positionality ............................................................................................................................... 11
  1.8 Significance of the Study ........................................................................................................... 14
  1.9 Limitations of the Study ............................................................................................................. 17
  1.10 Dissertation Overview ............................................................................................................. 17
  1.11 Definition of Terms .................................................................................................................. 18
Chapter 2 Literature Review ............................................................................................................. 19
  2.1 Introduction ................................................................................................................................. 19
  2.2 Literature Review Methodology ................................................................................................. 21
5.2 How the Research Study Relates to Existing Research ............................................. 105
5.4 Implications .................................................................................................................. 108
5.5 Action Plan ................................................................................................................... 112
5.6 Recommendations for Future Research ...................................................................... 114
5.7 Results and Summary of the Study ............................................................................. 116

References ......................................................................................................................... 117

Appendix A: Overview of Professional Development Design ........................................... 140
Appendix B: (needs a descriptive title) ............................................................................. 142
Appendix C: (needs a descriptive title) ............................................................................. 143
Appendix D: Pursuing Culturally Responsive Math Teaching PD
  Content ............................................................................................................................... 144
Appendix E: Pre-Professional Development Questionnaire ............................................. 146
Appendix F: Post-Professional Development Questionnaire ......................................... 148
Appendix G: Culturally Responsive Math Teaching Guided Reflection
  Journal Prompts .................................................................................................................. 150
Appendix H: Culturally Responsive Math Teaching Focus Group
  Interview .............................................................................................................................. 151
List of Tables

Table 3.1 Culturally Responsive Math Teaching Questionnaire Statements .......................................................................................................................... 66

Table 3.2 Culturally Responsive Math Teaching Guided Reflection Journal Prompts .............................................................................................................. 68

Table 3.3 Culturally Responsive Math Teaching Focus Group Interview Questions ........................................................................................................... 70

Table 4.1 Pre-Professional Development Questionnaire Statement Results......................................................................................................................... 79

Table 4.2 Comparison of VDOE Statements in Questionnaire Responses Between Pre-PD and Post-PD ................................................................. 82

Table 4.3 Participants’ Desired Outcomes of Professional Development .......................................................................................................................... 87

Table 4.4 Participant Responses to Effectiveness of Professional Development ......................................................................................................... 102

Table 5.1 Research Results through a Theoretical Framework ................................................................................................................................. 106

Table A.1 Professional Development Design Plan .................................................................................................................................................. 140
List of Figures

Figure 1.1 VA Standards of Learning (SOL) Math Pass Rates for 2021-22 ................................................................. 2

Figure 1.2 Mathematics Pass Rate for Virginia Students 2010-2022 ...................................................... 3

Figure 1.3 Projected racial demographics for teachers and students in 2023 in US ................................. 5

Figure 1.4 Virginia Standards of Learning Math Assessment Pass Rates for State and County 2021-22 ................................................................. 16

Figure 2.1 Theoretical Framework Overview of Research Study .............................................. 38

Figure 3.1 Integrated Mixed Methods Data Collection ........................................................................ 58

Figure 3.2 Research design and timeline ......................................................................................... 59

Figure 3.3 Professional Development Action Learning Cycle .................................................... 60

Figure 3.4 Research Participants Demographics ............................................................................. 64

Figure 3.5 Professional Development CRMT Learning Topics .................................................. 72

Figure 4.1 Emerging Themes from Qualitative Data Collection ............................................... 86
List of Abbreviations

CRT ................................................................. Culturally Responsive Teaching
CRMT .............................................................. Culturally Responsive Math Teaching
CRP ................................................................. Culturally Responsive Pedagogy
PD ................................................................. Professional Development
Chapter 1

Introduction

1.1 Introduction

Throughout my years in math education and various roles as a math tutor, math teacher, math instructional coach, and now building administrator, I have strived to pursue the mission to reach and support all students in mathematics, no matter the circumstance. Initially, I became a math teacher to change the narrative for young people after hearing so many adults share their disconcerting loss of a career dream due to the barrier of a math class or a math test. Through the last twenty years within the education profession, I continue to grapple with the question: “How can I break down any barrier within the educational system impeding the progress of students, so every student has the capacity and skill to pursue their dreams?”

Through my experience of working with students with disabilities, English-language learners, students from poverty, and students from marginalized communities, I have observed firsthand the importance of engaging students in the classroom in a way that makes sense to them, their identity, and their culture. The more students' mathematical identities were valued and fostered in the classroom, the better students performed in math. I found it valuable to increase opportunities for student voice throughout every lesson, to create projects that related to student interests and current community events, and to create a climate of high mathematical rigor with the freedom to
make mistakes and grow. As a result, many students’ mathematical identities were transformed from ones of apathy or fear to ones with confidence and competence.

Despite my intentional efforts within the math classroom, I found other math teachers growing frustrated with their students, the academic gaps, and the perceived apathy or lack of motivation. Additionally, as I grew in my knowledge of equity and culturally responsive pedagogy, I found many of the training or professional development offerings around those topics to be lacking mathematical application. On more than one occasion, I heard math educators comment dismissively regarding these trainings as now applicable. They would argue math as different from the humanities, being without language, culture, or bias. In my experience, there simply seemed to be a disconnection with some math teachers between poor student achievement in mathematics and the components of culturally responsive mathematics teaching.

Most recently, the Virginia Department of Education (VDOE) posted assessment results of the annual Standards of Learning (SOL) assessments in mathematics for the school year 2021-22. Once again, American Indian or Alaska Native, Hispanic, and Black students passed at rates lower than the average. See Figure 1.1.

<table>
<thead>
<tr>
<th>Virginia Standards of Learning (SOL) Assessments</th>
<th>Mathematics Pass Rates for 2021-22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Racial Subgroup</td>
<td>Pass Rate</td>
</tr>
<tr>
<td>Asian</td>
<td>86.1%</td>
</tr>
<tr>
<td>White, not of Hispanic origin</td>
<td>76.4%</td>
</tr>
<tr>
<td>Native Hawaiian or Pacific Islander</td>
<td>79.5%</td>
</tr>
<tr>
<td>Non-Hispanic, two or more races</td>
<td>70.2%</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>66.4%</td>
</tr>
<tr>
<td>American Indian or Alaska Native</td>
<td>65.9%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>53.3%</td>
</tr>
<tr>
<td>Black, not of Hispanic origin</td>
<td>48.9%</td>
</tr>
</tbody>
</table>

Figure 1.1

VA Standards of Learning (SOL) Math Pass Rates for 2021-22
While the American Indian or Alaska Native student subgroup passage rate was quite close to the average, Hispanic students had mathematics passage rates 13% lower than the average (VDOE, 2022). Furthermore, Black students had passage rates at an exceeding level of 17% lower than the average, as well as 13% lower than White students (VDOE, 2022). Additionally, these achievement disparities for specifically Black and Hispanic students were not new and have persisted throughout the years. Since 2010, these specific racial subgroups of students have continued to perform at a lower mathematical passage rate than the average passage rate for all Virginia students. See Figure 1.2.

![Mathematics Pass Rates for Virginia Students 2010-2022](image)

**Figure 1.2**

Mathematics Pass Rate for Virginia Students 2010-2022
As shown in the figures, these two focus subgroups of students who identify as Black or Hispanic consistently demonstrated a discrepancy in mathematical mastery based on Virginia math assessment passage rates. Furthermore, at a national level, achievement gaps over the last few decades continue to persist, especially at the high school level (Hanushek, 2019). Additionally, the COVID pandemic of 2020-22 damaged any progress of minimizing achievement disparities in mathematics for Black and Hispanic students (Mervosh, 2022).

In addition to the concerns with racial achievement disparities for students identified as Black or Hispanic, there was also growing data demonstrating the racial disparity between teachers and students as the United States continued to grow more diverse each year (deBray et al., 2019; Taie & Goldring, 2020). The National Center for Education Statistics (2023) found in the 2020-21 school year, 80% of all public school teachers to be White, while only 46% of all public students being White. On the other hand, only 6% of all public school teachers were Black compared to 15% of students being Black, and 9% of teachers were Hispanic with 28% of students being Hispanic (National Center for Education Statistics, 2023). See Figure 1.3.

The National Center for Education Statistics (2023) predicts in 2023, there will be a decrease of White students from 45% to 42%, a decrease in Black students from 15% to 14%, and an increase of Hispanic students from 28% to 30%.
1.2 Statement of the Problem of Practice

This study addressed the Problem of Practice (PoP) of racial disparity in mathematical achievement and the need to build teacher efficacy in culturally responsive math teaching (CRMT). As a result, the following needs were identified to support teacher development in CRMT:

- A need to foster higher levels of understanding culturally responsive math teaching (Aguirre & Zavala, 2013; Gay, 2009; Kumar 2021; NCTM, 2020; VDOE, 2021).
- A need to work collaboratively together as math teachers to critically reflect how to effectively incorporate culturally responsive math teaching (Aguirre, 2009; Bonner & Adams, 2012; Schunk & DiBenedetto, 2020).
A need to implement culturally responsive math instructional strategies and lessons with fidelity (Bonner, 2021; Kitchen, 2005; Copur-Gencturk et al., 2019; NCTM, 2020).

While the need for culturally responsive math teaching would support the problem of practice of addressing racial disparities, Bonner (2021) asserted “CRMT has been widely studied but can be difficult to conceptualize in terms of teacher practice” (p. 7). While the concepts of CRMT align with effective instructional practices in education, the specific strategies and lens are not implemented regularly with fidelity in the classroom (Bonner, 2021). Therefore, research must be explored in how to support teachers in contextual and authentic ways to use culturally responsive mathematics teaching with fidelity and regularly in math classes.

1.3 Research Question

To address the concern of racial disparities in mathematics and to support teacher efficacy in the use of culturally responsive math teaching, this study explored the research question:

**Research Question:** How does the implementation of a professional development centered on Culturally Responsive Mathematics Teaching impact math teachers’ efficacy in regard to the use of culturally responsive teaching?

1.4 Purpose of the Study

While some, including Galileo, have argued that math is simply universal, researchers have challenged the notion that mathematics, and specifically the teaching of mathematics, was culture free (Fyenman, 2019; Greer et al., 2009). Even prominent mathematical historian Frank Swetz (2009), after researching multiple cultures
throughout thousands of years, reported the observance that there is not part of mathematics teaching that is free from cultural influences. As a result, the culture of the math teacher and the influence of that culture impacts the teaching of mathematics within the classroom.

Therefore, this research hoped to foster the understanding of secondary math teachers as it related to the variety of cultures present in the current classroom and to help fortify their commitment “to envisioning and enacting pedagogies that are...centered on contending in complex ways with the rich and innovative linguistic, literate, and cultural practices of Indigenous, Black, Latinx, Asian, Pacific Islander, and other youth and communities of color” (Paris & Alim, 2017, p. 2).

The purpose of this study was to pursue culturally responsive strategies for math teachers, specifically called culturally responsive math teaching (CRMT), in order to support equitable access for all students and to minimize racial disparities in mathematics achievement. Further, the purpose of this study also supported the most recent *Access and Equity in Mathematics Education* position by the National Council of Teachers of Mathematics (2022):

NCTM Position: Creating, supporting, and sustaining a culture of access and equity require being responsive to students’ backgrounds, experiences, cultural perspectives, traditions, and knowledge when designing and implementing a mathematics program and assessing its effectiveness (para 2).

**1.5 Theoretical Framework**

To approach the problem of practice, research question, research design, and intervention, a theoretical framework was constructed as a lens to view each (Merriam &
Tisdell, 2016). The theoretical framework that grounded this integrated mixed-methods action research study was a three-pronged epistemological perspective embedding culturally responsive mathematics teaching known as CRMT (Aguirre, 2009), social cognitive theory (Bandura, 1986) and situated learning theory (Lave & Wenger 1991). The combination of these theories emphasized the need for teachers to reflect, learn, plan, and act collaboratively to implement culturally responsive math teaching to support all students in the math classroom.

Culturally responsive math teaching (CRMT) stemmed from culturally responsive pedagogy (Gay, 2000; Ladson-Billings, 1994) with the specific focus and intentionality on math education. Aguirre and Zavala (2013) described CRMT as mathematical understanding, use, and application of pedagogical skills that empower student thinking and mastery. CRMT focuses on building new material on a student’s community funds of knowledge (Sowder, 2007), creating authentic student use and application of mathematics (Civil, 2007), using cultural mathematical resources to amplify the math lessons (Perkins & Flores, 2002), and exploring mathematics through the local lens (Diez-Palomar et al., 2009).

Social cognitive theory supported CRMT in the theoretical framework as it provided the next steps for math teachers to take the knowledge of CRMT and turn it into practice. Schunk and DiBenedetto (2020) defined social cognitive theory as a perspective on humans that focuses on the critical role the social environment has on motivation and learning. Social cognitive theory supported the valuable cognitive development teachers need to build efficacy in CRMT. Aguirre et al. (2013) challenged teachers to assess their beliefs first, since those beliefs filter into instructional practice and classroom application.
In order to develop in the area of culturally responsive teaching, teachers must address the cognitive filters first.

Situated learning theory completed the theoretical framework as it supported the process of learning through doing activities (Dewey 1925; Lave & Wenger, 1991). Situated learning theory is an instructional practice established by Lave and Wenger in 1990s, emphasizing the importance of learning during real-life opportunities within the authentic culture and climate of the classroom in a meaningful way (Anderson et al., 1996; Fraihat et al., 2022). Cobb et al. (1992) applied this research early in the field of mathematics education by stressing the importance that mathematical mastery should lead to a practical and social practice. As a result, situated learning theory supports this professional development intervention, as participants not only learned CRMT strategies but then applied them in the classroom. Furthermore, situated learning theory also supported the collaborative nature of the group of secondary math teachers throughout the professional development, creating an aspect of a community of learners working together to experience CRMT as a collective group of fellow math educators. These concepts will be discussed in greater detail in Chapter 2.

1.6 Overview of Methodology

Action research was intentionally chosen as the modality of this research study since many researchers have found action research to be an intentional model for improving instruction (Efron & Ravid, 2020). Furthermore, Mertler (2009) advocated for the benefits of the cyclical nature of educational action research and its lack of an endpoint, supporting student growth through collecting and analyzing data, evaluating effectiveness, and modifying with improvements for future practice. Action research
supported the cyclical nature of supporting educators as they continually learn and adapt from the ever-changing student population.

This study was an integrated mixed-methods action research, conducted over a 9-week period within a school division in Virginia (Efron & Ravid, 2020). Creswell and Creswell (2018) described the value of a mixed-methods design as one that collects both qualitative and quantitative data in a parallel manner. Greene (2007) posited a mixed method approach can offset method biases and compensate for weaknesses in each method. The benefits of a triangulating design of mixed methods include complimentary data points which utilize different methods and allow for opportunities of convergence and thorough analysis (Almalki, 2016; Johnson & Turner, 2003). In addition, mixed methods studies capitalize on the strength of both the quantitate method and qualitative method and can produce more credible studies (Clark and Ivankova, 2015).

Throughout the research design, both the quantitative and qualitative instruments were used to measure the concept of teacher self-efficacy, which includes their belief, confidence, and application in the classroom. The design included data collection throughout the 9 weeks. Quantitative data consisted of two sets of questionnaires with Likert-scaled response statements to measure each teacher’s perceived efficacy of culturally responsive math teaching. Qualitative data was collected through optional short answers on each questionnaire, each educator’s personal reflection journals, as well as transcripts of each of the five virtual meetings.

Participants were voluntary secondary math educators in the school division who signed up for a 10-hour professional development centered on culturally responsive math teaching (CRMT). Volunteers included secondary math teachers, special education
teachers teaching secondary math, and secondary instructional math coaches. The researcher collaborated with the school division’s Director of Equity, Director of Mathematics, Director of Professional Development, and Director of Research to honor the participant’s time and professionalism. The Director of Mathematics and Director of Equity reviewed the CRMT resources and content, collaborating with the researcher on resources. The Director of Professional Development and Director of Research collaborated with the researcher regarding the distribution of information about the PD, the allowance for teachers to only participate in the PD but not the study, and the distribution of continuing education credits for those teachers who completed the PD.

The elements of the professional development (PD) consisted of attending five virtual meetings in which participants reflected on classroom practices, learned new CRMT strategies, and collaborated to plan instruction for math classes. The PD also encouraged classroom application of CRMT and keeping a reflection journal throughout the 9-week duration. Additionally, at the beginning and end of the professional development, participants were asked to complete a questionnaire regarding their perceived efficacy of culturally responsive math teaching.

1.7 Positionality

I am a current school administrator who evaluates secondary math teachers, as well as a data-driven educator who often uses informal mixed-methods action research within the classroom or school to improve student outcomes. I initially wouldn’t have described myself as a culturally responsive math teacher during my years in the classroom; however, as I learned more about culturally responsive teachers and descriptions of such by Gay (2000), I found many similarities in my own teaching. I
affirm I have always believed strongly in the dignity and intelligence of each student, as well as the multiple dimensions of growth within the classroom setting (Gay, 2000). With my advocacy and beliefs on culturally responsive teaching, I have presented workshops on instructional strategies in secondary mathematics in the division level, regional level, and state level. More specifically, I often presented workshops on how to work with underperforming students in secondary math: students with disabilities, English Language Learners, racial minorities, and students from trauma.

During these times, I realized that many teachers may want to learn new strategies; however, their self-efficacy in implementing the strategies was lacking. I view self-efficacy as both the confidence and ability to implement a task with fidelity (Bandura, 1997). Learning a new skill during a professional development session was not enough to build confidence, nor skills. The one-hour trainings on culturally responsive teaching only skinned the surface, with teachers often leaving those meetings with “But how does that work in the classroom?” As a result, during my positionality as a leader in math education, training other math teachers at conferences and after-school meetings, the trainings alone didn’t seem to be enough to build the confidence or skills for a teacher to have self-efficacy in implementing the tasks with fidelity.

Therefore, I wanted to research how to build secondary math teachers’ efficacy with culturally responsive pedagogy. My reputation within the school division and math community is one of a strong math teacher with high energy, creative problem solving, and high performing student outcomes. While those qualities may be strengths within the classroom, I am also aware of the converse effect of my “fix-it” critical lens and my quick desire to “conspire, scheme, and ‘plot goodness’” might affect my work within this
research (Upton, 2020, p. 389). With this critical perspective that has driven great initiatives in my past roles, I am aware of the concerns of acting as a solutionist in this action research study, considering heavily the warnings of Bryk (2014) in educational advancements:

When a pressing problem presents itself, we often jump to implement a policy or programmatic change before fully understanding the exact problem to be solved. We call this phenomena solutionists. It is a form of group-think in which a set of beliefs crystallizes based on an incomplete analysis of the problem to be addressed and without full consideration of potential problem-solving alternatives (p. 468).

As a result of Bryk’s (2014) cautions of acting through a solutionist lens, analysis of the problem was analyzed and collaborated prior to the research to brainstorm a wide variety of problem-solving alternatives. Throughout the research design journey, I had to challenge myself regarding researching plausible solutions for supporting teachers’ efficacy in culturally responsive math teaching. Additionally, I had to consider the “solutionist” view from the state and school division and their own perspectives of supporting teachers’ growth and how to modify the research to support all stakeholders involved in the research (Herr & Anderson, 2015).

Finally, I recognize my positionality within the school division, as well as personal bias from past experiences which may affect the research study and design. First of all, due to my leadership roles and the multiple intersecting positions within the school division, I was vigilant in my curiosity and discernment of any conflicting associations within this action research and participants (Herr & Anderson, 2015). Secondly, I was
aware that action research often stems from a frustration or contradiction in the workplace over a series of time, causing the researcher to pose questions and seek understanding (Herr & Anderson, 2015). Consequently, this action research study birthed from past experiences in trainings and with math teachers, who dismissed the need to embed more cultural responsiveness in math instruction, often noting a lack of need for math to be viewed through a cultural lens.

To address my positionality and avoid any bias or deficit mindset when creating this action research, I sought out critical colleagues and school division leaders to collaborate and vet the research design and interventions (Herr & Anderson, 2015). To build efficacy and minimize “solutionist” thinking, the action research design has been created with the intention for the group of teachers to the authors, implementers, and self-evaluators of their own learning journey (Creswell & Miller, 2000). Finally, the participants of the study were limited to secondary math teachers within the school division; however, no teachers under my supervision or evaluation were allowed to participate in the study (Creswell & Miller, 2000).

1.8 Significance of the Study

This mixed-methods action research was designed to provide insight in effective ways to support math teachers in culturally responsive math teaching. Since math teachers have a significant impact on a student’s mathematical achievement outcomes, this study sought to find ways to build culturally responsive math teaching practices to support all students in the classroom (Aguirre et al., 2013). Furthermore, while the field of mathematics itself could be argued to have no bias, neuroscience showed that humans, even math teachers, cannot be without bias (Amodio, 2014). A December 2019 study
supported this claim as it found math teachers were not biased toward math solutions, but bias was evident toward their perceptions of math ability, with bias happening most often with Black and Hispanic Females (Copur-Gencturk et al., 2019). Additionally, Grissom and Reading (2019) found a disproportionality in the identification of gifted students with an assignment gap for Black students in both reading and math, even when accounting for control variables.

Furthermore, federal, state, and local data revealed a racial achievement discrepancy with Black and Hispanic students consistently scoring lower on math assessments than the average student (National Center for Educational Statistics, 2023; Virginia Department of Education, 2022). At the national level, for all assessments since 1990, according to the National Center for Educational Statistics (2023), the average mathematics scores for White students in grade 8 were higher than their Black or Hispanic peers. At the Virginia state level, since 1998, Black and Hispanic students consistently scored below the state average, as well as the White student average (Virginia Department of Education, 2023). Lastly, the site of the research study, a county school division, also revealed a discrepancy of math achievement for Black and Hispanic students (Virginia Department of Education, 2023). Though the county data revealed a higher pass rate than the state pass rate, there was still a 7% decrease of math pass rates of Hispanic students compared to the average and an 18% gap between Black students and the average (Virginia Department of Education, 2023). See Figure 1.4.
Therefore, by focusing on culturally responsive math teaching, this study may have significant impact not only on math instruction and addressing racial disparities, but also in minimizing bias of math ability and gifted identification.

In addition to increasing student achievement, this research study has significance in regard to its focus on the growth of teacher self-efficacy, which could be defined as an individuals’ beliefs about their ability to carry out a specific task (Bandura, 1997). Researchers posited improved teacher self-efficacy could reduce stress and improve satisfaction in the job (Klassen & Tze, 2014). Furthermore, perceived self-efficacy played a critical role in a teacher’s control for motivation (Bandura & Wood, 1989). Therefore, this action research study was significant not only for student development and advancement, but for math teacher job satisfaction as well.
1.9 Limitations of the Study

This action research contained limitations due to the researcher’s positionality, timing of the study, and duration of the study. For positionality, the researcher was a building administrator of one of the middle schools within the school division and evaluated the secondary math teachers in that school. Therefore, teachers in that one school were not allowed to participate in the study to avoid any hint of coercion. Secondly, the timing of the study was conducted during an extremely busy school year in which many divisions professional development sessions were being mandated and teacher morale was low. Herr and Anderson (2015) construed the importance of recognizing the juxtaposition of the theory of the research and the practical complications of conducting that research with the current academic environment and limitations and its impact on the volunteer participants and research. Finally, the duration of the study for 9 weeks also caused a limitation on volunteers, who were hesitant to commit to this much time. Nevertheless, the study needed to be conducted over 9 weeks to support effective development of culturally responsive math teaching (Campbell & Lee, 2017).

1.10 Dissertation Overview

This action research dissertation in practice consists of five chapters on the effectiveness of a professional development centered on culturally responsive math teaching. Chapter 2 discusses the literature review covering the multifaceted layers of this action research. Chapter 3 outlines the methodology of the action research, including the design, rationale, and data collection and analysis. Chapter 4 brings light to the data and results from the action research study. Finally, Chapter 5 reviews the research results and
recommends future research to continue supporting teachers in culturally responsive mathematics teaching.

1.11 Definition of Terms

For purposes of this study on supporting the growth of culturally responsive math teaching, the following terms are defined as follows:

**Critical Reflection:** “The process of analyzing, reconsidering, and questioning one’s experiences within a broad context of issues and content knowledge” (Jacoby, 2010, para 3)

**Culturally Responsive Teaching:** Classroom strategies and instruction which result in culturally inclusive and responsive learning environments to ensure academic achievement for all students and to promote equity (Virginia Board of Education, 2021).

**Culturally Responsive Mathematics Teaching:** “A set of specific pedagogical knowledge, dispositions, and practices that privilege mathematical thinking, cultural and linguistic funds of knowledge, and issues of power and social justice in mathematics education” (Aguirre & Zavala, 2013, p. 164).

**Professional Development:** An ongoing process involving teacher education, teachers’ knowledge and beliefs, classroom application, and student learning (Desimone, 2009; Sancar et al., 2021)

**Teacher Efficacy:** An individuals’ beliefs about their ability to carry out a specific task (Bandura, 1997)
Chapter 2

Literature Review

2.1 Introduction

The problem of practice which navigated this study was to seek out culturally responsive strategies for math teachers, specifically called culturally responsive math teaching (CRMT), to support equitable access for all students and to minimize racial disparities. The purpose of the study was to better support all students and address the racial disparity of mathematical achievement. In order to address the problem of practice, the following needs were identified to support teacher development in culturally responsive math teaching.

- A need to foster higher levels of understanding culturally responsive math teaching (Aguirre & Zavala, 2013; Gay, 2009; Kumar 2021; NCTM, 2020; VDOE, 2021).

- A need to work collaboratively together as math teachers to critically reflect how to effectively incorporate culturally responsive math teaching (Aguirre, 2009; Bonner & Adams, 2012; Schunk & DiBenedetto, 2020).

- A need to implement culturally responsive math instructional strategies and lessons with fidelity (Bonner, 2021; Kitchen, 2005; Copur-Gencturk et al., 2019; NCTM, 2020).

Therefore, the dissertation in practice addressed the following research question using an integrated mixed-method action research design:
**Research Question:** How does the implementation of a professional development centered on Culturally Responsive Mathematics Teaching impact a math teacher’s efficacy in regard to the use of culturally responsive teaching?

At any point, one can look to the news, social media, or a community event to hear the variety of conflicting information and beliefs of education, equity, and its role together (Greer et al., 2009). To better understand the need for culturally responsive mathematics teaching, a variety of literature was reviewed and synthesized through the lens of the theoretical framework of culturally responsive math teaching, social cognitive theory, and situated learning theory. Throughout the literature review, the researcher continued to explore the research question of this integrated mixed-methods action research.

Within this chapter, the methodology of the literature review revealed the strategies of compiling the literature. Secondly, historical perspectives were then analyzed, including different historical perspectives of instruction, social efficacy’s influence on curriculum, social reconstruction’s influence on curriculum, and the rise of both culturally responsive teaching and culturally responsive mathematics teaching. Thirdly, theoretical frameworks of culturally responsive mathematics teaching, social cognitive theory, and situated learning theory were explored regarding the problem of practice and research question. Next, it was necessary to look at related research and how past researchers approached culturally responsive teaching with mathematics education. Additionally, to be able to understand the full picture culturally responsive math teaching, barriers to use CRMT were discussed, including rigorous demands of math curriculum, teacher stereotypes and biases, teacher resistance, and teacher fear. Once the
methodology, theories, historical perspectives, and barriers to this work were identified, interventions were explored to respond to the problem of practice and research question of this action research.

2.2 Literature Review Methodology

For this literature review, a variety of methods were used to gather information. Search engines and databases of National Council of Teachers of Mathematics (NCTM), University of South Carolina Library, Taylor and Francis Online, ERIC, Sage Journals, Academia, Research Gate, JSTOR, ScienceDirect, and Google Scholar were utilized to explore peer reviewed journals, scholarly articles, and literature reviews. Additionally, for the barriers and interventions, current publications, websites, and books from the National Council of Teachers of Mathematics and the Virginia Department of Education were consulted. Additionally, many peer reviewed research journals provided additional references and opportunities to explore books and journals similar to the topic.

2.3 Historical Perspectives

To be able to truly understand cultural competence and multicultural education, it was important to look at the history of education and its progression to the educational trends of today. Differing ideologies of education lead to a variety of methods and initiatives to create curriculum, train teachers, and define student success. It was necessary to understand the different historical perspectives of curriculum and its influence on instruction.

Differing Historical Perspectives of Curriculum and Instructional Theory

The American curriculum was simply an accumulation of various doctrines, ideologies, and practices (Kliebard, 1988). Curriculum specialists actively analyzed
historical curriculum developments in order to theorize, identify flaws, and create new ideas (Olivia & Gordon, 2013). Part of understanding the evolution of curriculum was understanding the history of hierarchical structure of the American educational systems (Williamson et al, 2007; Paris & Alim, 2017). Educators debated if the goal, as a national public school system, was to be efficient and effective in meeting accreditation goals and standardized testing scores, or to provide culturally sustaining pedagogy in our diverse schools (Saatcioglu et al., 2021). These different ideologies and pedagogies influenced the curriculum used today in schools and affect the way educators view cultural competence and its role in curriculum and instruction (Paris & Alim, 2017; Pitchford, 2020). Therefore, to better support educators and their journey of embedding cultural competence, it was important to know the possible ideologies supporting each teacher’s view of education and its role in society.

Social Efficiency’s Influence on Curriculum

Some educators focused on curriculum design that is founded on social efficiency ideology that can prioritize specific measurable objectives, with high attention to standards-based measurement and standardized testing (Schiro, 2013). By focusing on meeting specific test scores related to accreditation criteria, schools concentrated on methods and practices that are effective and maximize productivity (Koski et al, 2017). To accomplish this task, Koski and researchers (2017) found school systems often prioritize group cohesion and productivity to maximize effectiveness, which commonly resulted in hierarchical grouping and a justification for assimilation.

However, this focus on efficiency often led to testing practices, grouping practices, and tracking contributing to ethnic and racial inequities within schools (Ford,
Curriculum specialists examined the discipline of curriculum, the dominant culture’s influence, and its historical development in its entirety (Olivia & Gordon, 2013). In his book *Culture and Power in the Classroom*, Darder (2016) challenged educators to examine the dynamics and influence of the majority culture and power on the current curriculum and instruction, especially looking for the hidden power and culture within the curriculum. When examining curriculum throughout history, social efficacy’s influence on education was evidenced from the white indoctrination of South European immigrants to integrated schools to the *No Child Left Behind* initiative (Williamson et al., 2007; Saatcioglu et al., 2021).

**Social Reconstruction’s Influence on Curriculum**

In contrast, some educators focused on social reconstructionism ideology by creating culturally sustaining pedagogy in the curriculum (Schiro, 2013). This ideology required an understanding and acceptance of a variety of cultures and a commitment to envisioning and enacting pedagogies that are...centered on contending in complex ways with the rich and innovative linguistic, literate, and cultural practices of Indigenous, Black, Latinx, Asian, Pacific Islander, and other youth and communities of color” (Paris & Alim, 2017, p. 2). By having a goal of culturally sustaining pedagogy, success was not determined by unidirectional assimilation into White education or test scores, but rather a focus on a sustaining pedagogy that supports diverse, heterogeneous practices (Williamson et al., 2007).

Additionally, as social reconstruction ideologies influence today’s curriculum, this curriculum influences instruction. With curriculum being the “what” or end result, then instruction is the “how,” the methods and means to get to the specific curricular end
result (Olivia & Gordon, 2013). As some social reconstructionist theorists pursue culturally responsive efforts, educators’ roles in writing curriculum and instruction were analyzed through that lens. Paris and Alim (2017) challenged not to focus on filling in achievement disparities through a white-washed lens, pursuing assimilation, with “students and families being asked to lose or deny their languages, literacies, cultures, and histories in order to achieve in schools” (p. 1). Additionally, Pitchford (2020) cautioned to avoid white gaze or a white ethnocentric focus when preparing curriculum and instruction.

Though viewing curriculum and instruction through the lens of social reconstruction enabled students to view concepts, problems, and solutions from a diverse cultural perspective and help them see themselves in the curriculum, it was not commonly used in science and math (Banks, 2016). In a 2021 study of 200 science and math teachers, evaluating their educational theory, social reconstructionism was ranked fourth out of five ideologies (Reyes, 2021). The skills needed for math and science teachers to successfully employ in a classroom, skills such as organization, focus, and academic achievement, often support the social efficiency model of curriculum, not social reconstruction (Reyes, 2021).

**Rise of Culturally Responsive Teaching**

Due to the societal problem of inequities in mathematics, the use of social reconstructionist theory could help address such inequities and hopefully produce change (Paris & Alim, 2017). Therefore, a practical way to implement the theory was needed (Morettini et al., 2019). Culturally responsive teaching was one of the factors that arose
as a possible means to break down achievement gaps and produce more culturally 
responsive classrooms (ASCD, 2020).

In an examination of three different studies on effective implementations to close 
achievement disparities in schools, conclusions highlighted the necessary importance to 
implement cultural competence for educational outcomes to improve (Howard, 2010). 
Furthermore, Howard (2010) argued having a lens of cultural competence is essential for 
culturally inclusive and responsive teaching, learning, and environments. Therefore, the 
need for culturally responsive teachers was evident, with outcomes of improved student 
achievement and equitable school climates (Banks et al., 2005; Morettini et al., 2019).

As a result, organizations both at the national level and state level have advocated 
for teachers to be trained in culturally responsive teaching. The Association of Teacher 
Educators identified cultural responsiveness as one of the main standards for teacher 
educators, promoting social justice in teacher education (2008). Even the Association for 
Supervision and Curriculum Development (ASCD) published a recent book Cultural 
Competence Now (2020) in which Mayfield presents fifty-six exercises to help educators 
understand cultural competence and challenge bias, racism, and privilege.

In addition to federal initiatives, states, including the researcher’s state of 
Virginia, have added initiatives to increase the culturally responsive and equitable 
practice of educators. The Virginia Department of Education emphasized the importance 
of culture within education:

Culture strongly influences the attitudes, values, and behaviors that students and 
teachers bring to the instructional process, making culturally responsive educators
necessary for the equitable achievement of today’s increasingly diverse student population” (VDOE, 2021, p. 21).

Furthermore, cultural competency and the drive to create culturally responsive educators is not simply about embedding diverse content, but rather it is a mindset, a perspective, or even a lens educators embody to look at our students and approach their content.

**Rise of Culturally Responsive Mathematics Education**

While cultural responsiveness could be integrated and embedded in all content fields, opportunities were not as apparent or easy for specific subject areas such as mathematics (Banks, 2016). Additionally, research found teacher bias, based on the race and gender of the student, to be evident in mathematical perceptions and course placement (Copur-Gencturk et al., 2020). While Martin (2017) acknowledged some efforts of reform and equity-based conversations have been tried in mathematics, Black learners still experienced racial hierarchies in math classrooms.

Current research showed a bias in mathematics curriculum and instruction (Copur-Gencturk et al., 2020; NCTM, 2020; Aguirre et al., 2013). While mathematical solutions may have little room for bias, the teacher’s perception and belief in their students, depending on their gender and ethnicity, has been proven biased (Copur-Gencturk et al., 2020). Conscious and unconscious beliefs about students and what they can do in math existed based on stereotypes and biases (NCTM, 2020). Even Ruby Payne, a once prosperous school consultant on poverty and education, who sought to inform teachers on poverty with common sense ended up reinforcing and deepening negative stereotypes for teachers on students and families in poverty (Gorski, 2012). Gorski (2012) dissected these stereotypes and biases, dismissing the work of Payne
through multiple sources debunking these stereotypes (Rank et al., 2003; Lee & Bowen, 2006; Waldron et al., 2004). Additionally, Johnson (2021) highlighted the biological and physical results of bias and macroaggressions experienced by marginalized students, often without teachers realizing what they are doing. The unknown harm being imparted on our marginalized students must be addressed.

Bias not only affects the belief in students, but the class recommendations math teachers give to students. Aguirre et al. (2013) cautioned that the power of school mathematics and the placement of students in varying classes can serve as both the gateway as well as the gatekeeper for opportunities both in and out of the classroom. The gateway of math placement supports the erroneous notion that only some people can achieve mastering higher mathematics; consequently, Black, Laninx, and students from poverty are often underrepresented in regular and advanced level math classes (Boaler, 2010; Boaler, 2022). Oakes and Lipton (1999) argue that those who promote homogenous tracking groups “claim that these classifications are objective and color blind, rather than...reflecting myths and prejudices” (p. 133).

Due to biases and stereotypes in the placement of higher level math courses, as well as gifted identification, some have argued for math educators to consider not tracking students with early math placements (NCTM, 2020). The National Council of Teachers of Mathematics (2020) asserted that tracking is inequitable with students receiving vastly different experiences in math and creates a barrier to student success. Scott and researchers (2020) posited a rethinking of protocol for identifying students in gifted to provide more equitable access for all students, as well as eliminate common obstacles and misconceptions (Scott et al, 2020).
As cautioned by Johnson (2021) and Nguyen (2019), educators should not continue to let harmful actions such as unconscious or conscious biases toward students and their beliefs about students, math class tracking, or gifted identification go unnoticed. Educational leaders should analyze the data, explore stereotypes, and make reforms to combat harmful patterns present within the math curriculum and instruction. An intentional approach to support all stakeholders in addressing these harmful patterns must be implemented (Banks, 2016).

**Math Teachers Role in Culturally Responsive Math Teaching**

If math teachers were not embedding these culturally responsive standards, emphasized at both the state and nation level, the question was raised, “why not?” Banks (2015) cautioned educators that when we do not explain the details of multicultural education in math, paraphrase “we risk frustrating motivated and committed teachers because they do not have the knowledge and skills to act on their beliefs” (p. 7). Similar to how educators teach students, the same strategies were needed for training teachers by explicitly explaining to math teachers the “why” and “how” of curriculum reform before we address “what” the reform will be. Furthermore, if multicultural education was implemented with less fidelity in math classrooms than other classrooms, it could not be assumed it is teachers' resistance but rather the lack of knowledge and skills in the training.

But how did curriculum and instructional leaders most effectively support teachers in this work on cultural competency and culturally responsive pedagogy? In the origins of cultural competency, Cross et al (1998) explained that individuals fall within “a continuum that ranges from cultural destructiveness to cultural proficiency (p. 13). Just as
teachers differentiate instruction for students, education leaders differentiated the training for math teachers since each one will fall on a different place on the continuum. Banks (2016) encouraged that “given the real world of the schools, we might experience more success in multicultural teaching if we set limited but essential goals for teachers, especially in the early phases of multicultural educational reform” (p. 7). Pollock (2010) and fellow Harvard researchers provided a framework to address the common teacher response, “what can I do?” when it comes to addressing racism and diversity (p. 211). They created a model of how to guide teacher conversations through the breakdown of thoughts by principal, strategy, and immediate solutions (Pollock et al., 2010). For math teachers specifically, a systematic approach was needed if culturally competent curriculum and instruction is embedded effectively and with fidelity.

**Culturally Competent and Responsive Math Education Initiatives**

Due to bias and harm in math classrooms, national, state, and even local agencies provided frameworks to better embed cultural competency. The National Council of Teachers of Mathematics wrote this statement of what they believed all math teachers owed to students:

All students, in light of their humanity—their personal experiences, backgrounds, histories, languages, and physical and emotional well-being—must have the opportunity and support to learn rich mathematics that fosters meaning making, empowers decision making, and critiques, challenges, and transforms inequities and injustices.
Equity does not mean that every student should receive identical instruction. Instead,
equity demands that responsive accommodations be made as needed to promote
equitable access, attainment, and advancement in mathematics education for each student. (as cited in Aguirre et al., 2013, p. 9)

Furthermore, states such as Virginia, also created statements that advocate for cultural competence and responsiveness among teachers. The Virginia Department of Education wrote, “Establishing expectations for culturally responsive practice among Virginia’s educator workforce is critical to ensuring inclusive learning environments and equitable outcomes for all students” (VDOE, 2021). Virginia implemented a newest evaluation standard, revising the Guidelines for Uniform Performance Standards and Evaluation Criteria for Teachers, in which Standard 6 defined culturally responsive teaching as “the teacher demonstrates a commitment to equity and provides instruction and classroom strategies that result in culturally inclusive and responsive learning environments and academic achievement for all students” (Virginia Board of Education, 2021, p.11).

Finally, at the local level, many divisions created equity statements, per state and federal guidance. The Virginia Department of Education defined the goal of equity as being “achieved when we eliminate the predictability of student outcomes based on race, gender, zip code, ability, socioeconomic status or languages spoken at home” (VDOE, p. 30). Therefore, the researcher’s school division adapted the phrase “eliminate the predictability of student outcomes” as a theme of the division’s equity initiative. Starting 2020-21, teachers were required to attend anti-bias, anti-prejudice training. Additionally, staff equity cabinets and student equity cabinets were created at each school. However,
no specific training had been provided for math teachers yet providing resources for how
to remove bias and stereotypes from the curriculum and instruction and how to
effectively embed cultural competence in the everyday math classroom.

2.4 Theoretical Framework

The theoretical framework grounded the action research and “undergirds [the
researcher’s] thinking with regards to how [they] understand and plan to research [their]
topic, as well as the concepts and definitions from that theory that are relevant to [their]
topic” (Grant & Osanloo, 2014, p. 13). The theoretical framework is the researcher’s lens
to view the world (Merriam & Tisdell, 2016). The theoretical framework that grounded
this action research study was a three-pronged epistemological perspective embedding
culturally responsive mathematics teaching known as CRMT (Aguirre, 2009), social
cognitive theory (Bandura, 1986) and situated learning theory (Lave & Wenger, 1991).

Culturally Responsive Mathematics Teaching

Culturally responsive mathematics teaching (CRMT) was first mainstreamed at a
2004 conference, with its conception and organization heavily contributed by Montana
State University and Elisabeth Swanson (Greer et al., 2009). Following the conference, a
book project, Culturally Responsive Math Education, compiled a number of different
authors and their contributions to address critical issues of mathematics education and
improve achievement in school mathematics (D’Ambrosio, 2009). Culturally Responsive
Math Teaching CRMT) is a set of pedagogical knowledge and practices that support
mathematical thinking to include cultural and linguistic funds of knowledge. (Aguirre &
Zavala, 2013, p. 164). CRMT stemmed from culturally responsive pedagogy (CRP) and
its framework to promote equity for historically marginalized students (Gay, 2000; Ladson-Billings, 1994), as well as social reconstruction theory (Martin, 1994).

According to Gay (2000), culturally responsive pedagogy (CRP) concurrently develops not only academic mastery but also cultural competence and social consciousness. Ladson-Billings (1995) described CRP as a theoretical model that supports student affirmation and acceptance into their personal identity. Unfortunately, too often Black student academic success was at the sacrifice of cultural wellbeing; however, CRP allows a way for students to be academically successfully while honoring the integrity of their culture, voice, and identity. (Ladson-Billings, 1995; Thomas & Berry, 2019). Within the field of culturally responsive pedagogy (CRP) is culturally responsive teaching, which includes the application of this theory in the daily classroom and in meaningful ways (Hammond, 2015).

CRP not only affirms the culture of students, but Howard (2010) proved its usefulness to help close racial achievement disparities. Howard (2010) examined three different studies on effective implementations to close achievement disparities in schools, and the conclusions highlighted the necessary importance to understand race and culture if educational outcomes want to be improved. Consequently, he argued that cultural competence is imperative to the development of culturally inclusive teaching, learning, and climates (Howard, 2010). Therefore, the need for culturally competent teachers is evident, with outcomes of improved student achievement and equitable school climates (Banks et al., 2005; Morettini et al., 2019).

Unfortunately, research has revealed that CRP has been limited to multicultural education classes, not specific content-based classes, such as mathematics (Cochran-
Smith et al., 2004; Nasir et al., 2008). CRP extended into mathematics education through the areas of community funds of knowledge (Sowder, 2007) and teaching mathematics for social justice (Christiansen, 2008) and thus creating culturally responsive mathematics teaching (CRMT). The community funds of knowledge contribution to CRMT stemmed from approaching mathematics in an authentic and meaningful way through the cultural activities of the student (Civil, 2007), using cultural or native mathematical resources to enhance the learning (Perkins & Flores, 2002), and exploring mathematics through the lens of the local culture and community (Diez-Palomar et al., 2009). Aguirre et al. (2012) argue that community funds of knowledge is necessary for teachers to engage in culturally responsive math teaching.

The second factor that extended CRP into the mathematics field was teaching mathematics as a tool to understand and investigate social justice issues and power dynamics (Christiansen, 2008; Gutierrez, 2009). For math teachers to become a culturally responsive math teachers, Aguirre and Zavala (2013) suggested the following practices.

1. Develop a socio-cultural-political consciousness.
2. Understand and embrace social constructivist and socio-cultural theories of learning.
3. Know and leverage mathematical resources of students, families, and communities.

These suggestions by Aguirre and Zavala (2013) and the emphasis of educators focusing on social change within the school environment by addressing current problems and inequities was founded on social reconstruction (Martin, 1994). In social reconstruction curriculum theory, educators sought to resolve social problems to develop
a healthier vision of society (Schiro, 2013). If social problems such as biases, discrimination, and inequalities were present in current math curriculum and instruction as cited by Copur-Gencturk (2019), social reconstruction provided the theoretical framework for how to use education to combat such problems. Social reconstruction theory asserts education can be the method of improving society’s dangerous problems, by educating on injustices, providing opportunities to understand the current problems, and bring about authentic change (Schiro, 2013). Nevertheless, Banks (2016) cautioned educators that if we simply focus on social reconstruction without specifying how that reform might happen, there is a risk motivated teachers may feel frustrated with a lack of skills to act on these social changes. Therefore, the ideals of social reconstruction theory cannot stand alone. It needs other theories, such as itself nestled within culturally responsive mathematics teaching (CRMT) to support its implementation and support in providing the skills and resources for teachers to embed cultural competence in math.

In conclusion, the theory of culturally responsive mathematics teaching was grounded on culturally responsive teaching and social reconstruction theory. Aguirre and Zavala (2013) explained it in this way:

To summarize, culturally responsive mathematics teachers leverage mathematical learning by expanding children’s mathematical thinking, building bridges between previous knowledge and new knowledge, supporting bilingualism and academic language development, fostering connections with cultural funds of knowledge and experiences, and cultivating critical mathematical knowledge that enables students to analyze and address authentic problems (p. 168).
Social Cognitive Theory

A second theory embedded in the theoretical framework of this action research was social cognitive theory. While CRMT addresses the culturally responsive pedagogy and social reconstruction aspect of pedagogy, social cognitive theory addresses how the teachers will think about those theories and if those theories turn into practice. Social cognitive theory was originally created by Bandura (1986) and emphasized the triangulation of people, their behavior, and their environments. Social cognitive theory is a perspective on human functioning and how the social environment plays a pivotal role on motivation and learning (Schunk & DiBenedetto, 2020).

Social cognitive theory is a crucial factor in building motivation and self-efficacy (Stajkovic & Luthans, 2002). Teachers’ beliefs affect their behaviors, as their thoughts filter their motivation and implementation of new strategies (Aguirre et al., 2012). Specifically, for math teachers to apply Culturally Responsive Math Teaching authentically and with fidelity, teachers must shift their way of thinking and adopt CRMT as a daily pedagogical practice (Bonner, 2021).

Social cognitive theory is a necessary theory to ground this research given the cognitive thoughts that drive action in humans (Aguirre et al., 2012). In her article Getting Mindful about Race in Schools, Aguirre emphasized the role educators play in racial inequities: “racial inequities exist in schools largely because of educators’ actions - but actions emerge from beliefs. We do what we do because of what we think” (p. 62). As a result, the research will focus on encouraging teachers to reflect on their thoughts, beliefs and actions, through the lens of social cognitive theory, in order to build motivation and self-efficacy.
Situated Learning Theory

The third theory grounding this action research is situated learning theory, as it supports two different interventions in this action theory: 1) it supports teachers actively engaged in their own learning through practice in their classrooms, and 2) it also supports teachers collaborating with one another through a community of practice (Lave & Wenger, 1991; Wenger, 1999). In simplistic terms, situated learning is the process of learning through the participation of activities (Dewey 1925; Lave & Wenger, 1991; Voskoglou, 2019; Vygotsky, 1987). Donaldson et al. (2020) explained situated learning pedagogy to include authentic, real-life instruction within a community of practice, along with active participation.

The theory of situated learning includes four components according to Wenger (1998):

1. **Meaning**: Learning occurs through activity or experience.

2. **Practice**: This indicates that learning takes place through mutual participation in action and application of knowledge in a social environment.

3. **Community**: This indicates that learning happens through the social environment of a situation, including place, tools, people, and social interaction.

4. **Identity**: This underlines that learning takes place through changing thinking and knowledge in the context of society.

Through the research of Wenger (1999), she also created the concept “communities of practice.” Wenger (2011) described a community of practice as a group of individuals who share a passion for something they already do and a desire to learn how to do it better. The professional learning community proposed as an intervention in
this integrated mixed-methods action research would constitute a community of practice; thus, situated learning theory, through the lens of community of practice, created a foundational theory for this action research which uses PLC as one of its interventions.

Specifically, in the field of culturally responsive mathematics teaching, situated learning lends itself to not only the way teachers learn but also how students learn mathematics (Cobb et al., 1992; Kumar, 2021). Situated learning supports mathematics education by emphasizing that abstract concepts can be easier to learn and master when taught in a real context within the culture (Kumar, 2021). Fraihat (2022) synthesized situated learning in mathematics education in the following way:

Situated learning takes place through a real-life situation within the culture of the community and the needs of the students, where the students and the teacher build a community that consists of them as individuals, and the place where the experience or activity that represents the situation will be applied in a practical way, with all the necessary tools provided (p. 2).

Therefore, while situated learning theory supports the application of CRMT in the classroom, as well as the PLC, situated learning theory has also shown great results in mathematics education for teachers. Therefore, this third theory complemented culturally responsive mathematics teaching and social cognitive theory well in the theoretical framework.

The three theories of culturally responsive math teaching, social cognitive theory, and situated learning theory all overlap in multiple ways to provide a sturdy foundation to this integrated mixed-methods approach to fostering higher needs of culturally responsive math teaching in secondary math classrooms. Each theory alone could not support this
multifaceted approach, yet the three of them together provide the lens through which the researcher conducted the action research. The theoretical framework of this action research embedded culturally responsive math teaching (CRMT), social cognitive theory, and situated learning theory (Aguirre, 2009; Bandura, 1986; Lave & Wenger, 1991). Each of these theories intersected together to support the research design and the development of the professional development intervention and its different elements. Figure 3.1 revealed how each theory supported the problem of practice, research question, intervention, and data.

<table>
<thead>
<tr>
<th>Addressing this action research through each theory’s lens:</th>
<th>Culturally Responsive Math Teaching</th>
<th>Social Cognitive Theory</th>
<th>Situated Learning Theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem of Practice: The problem of practice guiding this study was a need for secondary math teachers to build efficacy in culturally responsive math teaching in order to better support all students and address racial disparities in math achievement.</td>
<td>A need to foster higher levels of understanding culturally responsive math teaching.</td>
<td>A need to work collaboratively together as math teachers to critically reflect how to effectively incorporate culturally responsive math teaching.</td>
<td>A need to implement culturally responsive math instructional strategies and lessons with fidelity.</td>
</tr>
<tr>
<td>Research Question: How does the implementation of a professional development centered on Culturally Responsive Mathematics Teaching impact a math teacher’s efficacy in regard to the use of culturally responsive teaching?</td>
<td>Professional development centered on Culturally Responsive Mathematics Teaching</td>
<td>Professional development embeds individual and group reflection throughout 9 week duration</td>
<td>Professional development consists specifically secondary math educators to reflect, learn, plan, and practice strategies in the classroom.</td>
</tr>
<tr>
<td>Intervention and Data: Use of quantitative and qualitative integrated mixed-methods data</td>
<td>PD meetings to learn content, collaborate, and plan culturally responsive math teaching strategies</td>
<td>Individual reflection journals, as well as times to reflect as a collaborative group during PD meetings</td>
<td>Practice implementing CRMT lessons in secondary math classes</td>
</tr>
<tr>
<td>Key Theorists</td>
<td>(Aguirre, 2009; Bonner &amp; Adams, 2012)</td>
<td>(Bandura, 1986; Schunk &amp; DiBenedetto, 2020)</td>
<td>(Kumar, 2021; Lave &amp; Wenger, 1991)</td>
</tr>
</tbody>
</table>

Figure 2.1

Theoretical Framework Overview of Research Study
2.5 Related Research

A variety of related research has attempted to improve cultural responsiveness among math teachers. Some research focused on best methods to create an effective learning community for secondary math teachers while others focused on providing time to reflect while creating and implementing culturally competent lessons (Campbell & Less; 2017, Morettini et al., 2019; Parker et al., 2017; Harper, 2020; Jones, 2015; Bonner, 2022). Campbell and Lee (2017) concentrated on learning communities with math teachers and discovered a greater need for intentional focus on mathematical instruction in order to best support teachers’ growth. The second study of Marettini et al. (2019) conducted a yearlong study, citing the benefits of both self-reflection and community of practice. Similar to this action study, the third related research study of Parker et al. (2017) focused on supporting teachers to grow in culturally responsive teaching, identifying a growth in teachers’ cultural awareness but not in their understanding of societal structures that also involve culture dynamics. Alternatively, the fourth study by Harper (2020) focused more on power in society by providing teachers with tools and strategies to teach social justice math, though the strenuous demands of the curriculum proved to be a barrier. Research was also explored best practices for implementing culturally relevant and cognitively demanding math tasks (Jones, 2015). Finally, the last related research covered applicable practices and suggestions for teachers when implementing culturally responsive math teaching (Bonner, 2021).

Development of Math Teachers in a Professional Learning Community

Campbell and Lee (2017) investigated high school math teachers in Professional Learning Communities to identify possible opportunities, if any, for teachers to develop
mathematical knowledge for teaching. The PLCs contained purposeful sampling of two PLCs focused on Algebra 1 content in two different high schools, each with a fellow math teacher as leader (Campbell & Lee, 2017). The schools provided a late start to school once per week for the PLC to meet throughout the school year, though student clubs and other activities often interfered with teachers attending the PLC (Campbell & Lee, 2017). Data was collected through audio recordings of the PLC meetings, as well as one of the author’s field notes which included attendance, seating arrangements, flow of the meeting, and observed teacher interactions (Campbell & Lee, 2017). This data was then coded and analyzed. Unfortunately, through their study, they found that without a specific focus on mathematical content, without engaging dialogue among math teachers, and without a key facilitator of the content, the teachers did not develop the mathematical knowledge for teaching as expected (Campbell & Lee, 2017). As a result of this study, the researcher chose to be the facilitator of the PLC, to help guide the conversation on mathematical dialogue through the lens of culturally responsive math teaching. Make sure to use proper citations throughout (Campbell & Lee, 2017).

**Cultural Competence in a Teacher Education Setting**

Morettini et al. (2019) conducted a year-long self-study as three faculty researchers exploring the anchoring question, “In what ways can teacher educators affect cultural competence in a teacher education setting?” (p. 358). Throughout the year, researchers worked together to create activities and readings for their preservice teacher candidates and after each month’s implementation, researchers would reflect in independent journal entries (Morettini et al., 2019). The journal entries were shared among the three researchers to react and respond, as well as meeting monthly to
summarize and discuss each month’s experience (Morettini et al., 2019). Data was compiled through a determined coding scheme and results included three major themes: prior expectations were apparent in how a conversation on cultural competence may go in the classroom, modeling conversations may influence how a teacher will approach it in their future classroom, and the conversations often lacked depth and frequency (Morettini et al., 2019). This study confirms the importance of self-reflection and Professional Learning Communities as teachers learn about their own beliefs of cultural competence but also how they model it to students (Morettini et al., 2019).

**Secondary Math Teachers and Culturally Responsive Teaching**

Alternatively, Parker et al. (2017) focused on educating math teachers through a course designed to support secondary math teachers in their understanding and capacity growth in order to better provide culturally responsive teaching. They hoped to study how teachers' perceptions changed throughout the course. The course included readings, weekly online classes, and asynchronous discussion boards, along with four individual projects each teacher had to complete (Parker et al., 2017). Data was collected from video recordings of the classes, text from the discussion boards, and the teachers’ individual projects. Parker et al. (2017) found that through this setting, teachers seemed to expand their cultural awareness to better know and understand their students; however, teachers did not develop the awareness of power and privilege in society, which also is needed for cultural responsiveness (Parker et al., 2017). This study shows the continuum and complexity of growth needed for cultural competence, as well as the strategies in how to provide education to math teachers, which will be helpful when considering concepts and methodology of interventions (Parker et al., 2017).
Culturally Competent Tools and Strategies for Math

Rather than focusing on educating teachers on culturally responsive teaching, Harper (2020) provided teachers with culturally competent tools and strategies to teach mathematics for social justice (TMSJ) in their current middle school math classes. Harper (2020) trained the teachers on a TMSJ unit investigating wealth inequality and then data was collected and analyzed from transcripts of pre-enactment interviews and post-enactment debriefings, unit planning materials, and field notes from the classroom. Harper (2020) wanted to specifically explore how white teachers may disrupt or perpetuate whiteness in math education. Harper (2020) found that the teachers, though they wanted to improve in their teaching and learning of social justice, simply could not balance it with the goals and needs of the mathematics curriculum. Additionally, the analysis by Harper (2020) identified how whiteness can present specific challenges in learning to teach math for social justice, as well as its approach in the classroom. To continue on the work of TMSJ, without the interference of whiteness, Harper (2020) suggested 1.) teachers recognize this work as an ongoing learning process, similar to having a growth mindset, and 2.) teachers adapt and integrate TMSJ lessons that are both explicit in the cultural inequities the lesson may cover as well as on-grade level mathematically. This study represents the challenge of taking the theory of embedding cultural competence in secondary math and making it a reality in the classroom that is effective, helpful, and supports the drive of social reconstruction (Harper, 2020).

Math Teachers use of Culturally Relevant Cognitively Demanding Math Task Rubric

Jones (2015) focused on best practices for designing and implementing math tasks that were culturally relevant cognitively demanding (CRCD). The researcher used the
CRCD Mathematics Task Rubric, created by Matthew et al. (2013) as a tool to examine the math tasks created by teachers. Matthew et al. (2013) adapted their rubric from the Mathematics Task Framework by Stein et al. (2009), though Matthews et al. Five graduate students, who were also practicing math teachers and familiar with the CRCD Mathematics Task Force completed a series of activities as part of the study: 1) read three articles, 2) created or modified CRCD math tasks with implementation, assessment, and reflection using the CRCD Mathematics Task Rubric, 3) secondary math teachers implemented the tasks in secondary math classrooms, and 4) the classroom teachers provided a reflection about student engagement (Jones, 2015). Jones (2015) found the combination of the CRCD Mathematics Task Rubric and authentic, candid conversations about current literature on culturally relevant teaching “offered teachers a starting point in their practice to become culturally relevant educators” (p. 25).

**Culturally Responsive Mathematics Teaching (CRMT)**

Bonner (2021) sought to bridge the gaps between theory and practice with ways math teachers could embed culturally responsive math teaching in a concrete, realistic manner in the classroom. Though disparities in achievement were being combatted with theoretical ideas such as culturally responsive teaching, Bonner (2021) noted the challenge to translate the theory of increasing achievement to daily practice and evidence in the classroom. Therefore, Bonner (2021) explored four cornerstones of CRMT, created by Bonner and Adams (2012), which are knowledge, communication, relationships/trust, and constant reflection and revision. For each of the four areas, Bonner (2021) suggested the following strategies:
● **Knowledge**: Suggestions included reading articles to learn more about CRT, to survey students to understand their culture, to have students share about their own personal history in math, and to enhance personal interaction with students (Bonner, 2021).

● **Communication**: Suggestions included to practice self-awareness of communication with students, to clearly communicate high expectations, to use students’ diversity and culture to develop patterns of communication for students to best understand, and to utilize each student’s own funds of knowledge they bring to the classroom (Bonner, 2021).

● **Relationships and Trust**: Suggestions included communicating with parents and guardians frequently, providing math instruction and support to parents and guardians, and getting involved in community organizations (Bonner, 2021).

● **Reflection and Revision**: Suggestions included to reflect and analyze the background and culture the teacher brings into the classroom, to observe and document the student mathematical discourse in the classroom, and to analyze interactions with parents and the community (Bonner, 2021).

In addition to these four cornerstones, Bonner (2021) also addressed the importance of analyzing a teacher’s own power dynamics and how students may feel in the math classroom due to multiple factors. She encouraged teachers to give students more of a voice when describing mathematical procedures, to facilitate more mathematical discourse among students, and to use students' home languages within instruction (Bonner, 2021).
2.6 Challenges of Implementing Culturally Responsive Math Teaching

The need for culturally responsive teaching in all curricula, especially in math, is evident; however, there were barriers to implementing effectively and with fidelity (Greer et al., 2009). These barriers included the rigorous demands of math curriculum standards, teacher stereotypes and biases, teacher resistance, teacher shame, and teacher fear. Exploring these barriers in implementing culturally responsive math teaching is necessary to be able to address the challenges for educators and continue to pursue opportunities of CRMT (Bonner, 2021).

**Rigorous Demands of Math Curriculum Standards**

In the most recent Programme for International Student Assessment (PISA) report in 2018, the United States ranked below the international average in mathematics, continuing a common trend since 2003, even though the US scored above average in both reading and science (OECD, 2019). During the last three decades, the United States made intentional efforts to improve math education and standards, and researchers such as Hill (2021) see an improvement in teachers’ mathematical understanding but still limited gains for students. Hill (2021) argued that while teachers are showing a better understanding of math, they are still focused on past instructional strategies and only modifying small portions of practices. Bartell (2013) identified the indispensable need for teachers to not only teach math for mastery in the current system but also expose students to obstacles and opportunities for authentic application.

With the rigorous demands on improving math scores and the expectations to cover multiple instructional goals within a thorough math curriculum, teachers had limited to no time to incorporate anything else, including multicultural or social justice
math (Leong & Chick, 2011). Furthermore, Bartell et al. (2017) disclosed that the current Common Core State Standards of Math (CCSSM) may actually sustain inequities through its policies, as well as a lack of addressing equity sufficiently in its standards. Therefore, future research was needed to create a framework to explicitly and efficiently address equity in math (Bartell et al., 2017). The rigorous demands of math curriculum standards and testing created a barrier for teachers to address inequities or embed cultural competency into their math class.

**Teacher Stereotypes and Biases**

In addition to juggling math instructional goals, teachers also had to balance the learning styles of multiple types of learners in their math classrooms. The environment of stress and time constraints required teachers to make multiple automatic decisions daily with their students, often resulting in quick biases based on assumptions (Gulati, 2020). Gulati (2020), in her article in NeuroLeadership Institute explained biases as adaptive processes that develop from prior knowledge and previous experiences and then inform present and future choices. Therefore, when teachers felt time constraints or had a lot on their minds, they had to rely on quick associations that can lead to implicit biases. These biases often stemmed from teachers’ judgment based on stereotypes and expectations (Kleen & Glock, 2018). Therefore, teachers’ stereotypes and biases created a barrier for teachers to fully embed cultural competence in the math curriculum.

**Teacher Resistance**

In addition to the demands of math instructional goals, as well as biases and stereotypes from teachers, teachers also could have been resistant to this work for different reasons. In Promoting Diversity and Social Justice: Educating People from
Privileged Groups, Goodman (2011) addressed why people are resistant to promoting diversity and social justice. One of the factors of resistance was teachers’ focus on their own pain and story and therefore inability to see their own privilege in any situation (Goodman, 2011). If a teacher grew up in poverty, he most likely felt oppressed and possibly victimized. As a result, Goodman (2011) explained that as a result, people who experienced feelings such as victimization may struggle to acknowledge any form of privilege. If the teacher was scrutinizing over his own security, he would have little interest in worrying about others’ financial concerns or even having empathy for them. Therefore, it was important to acknowledge the physiological factor creating the resistant barrier. Teachers needed to acknowledge their own feelings and emotions to be able to fully empathize and understand others. Alice Miller (1990), in her book Banished Knowledge: Facing Childhood Injuries, reminded us in that for humans,

It’s not possible for someone really to clarify his situation and dissolve his fears until he can feel them rather than discuss them. Only then is the veil lifted and he realizes his true need: not a tutor, not an interpreter, not a confessor; he needs space for his own growth and the company of an enlightened witness on the long journey on which he has set out. (p. 184)

Teachers, like Miller (1990) stated, needed space for growth to be able to combat the resistance to learning about other cultures and a different worldview. However, it was important to note that this space for growth need to not be dichotomous: teachers are neither the oppressor or the oppressed, the resister or the acceptor. Each human had aspects of life that have been oppressed and other aspects that have not. All are on a continuum: in their identities, in their growth, and in their self-reflections. When these
continuums were acknowledged with authenticity, teachers may be more honest and open to learn about others. To be able to combat the resistant teacher, Bohn (2014) challenged administrators and educational leaders to transform teachers’ resistance into resilience. However, to be able to turn resistance into resilience, it was important to note the guilt and shame that educators may feel and experience as a barrier to embedding cultural competence in their curriculum and instruction.

Teacher Shame

Teacher resistance could have also stemmed from guilt and shame, especially if teachers were from the majority culture and reflecting on their own actions and words toward students that might have been unknowingly harmful (Estrada & Matthews, 2016). Shame was associated with the urge to hide and withdraw and can lead to anger, resentment, and bitterness (Tangney & Dearing, 2002), as well as causing teachers to feel trapped, powerless, and isolated (Brown, 2006). The culmination of these emotions had been identified as having a harmful impact on multicultural learning and growth (Ancis & Szymanski, 2001). Consequently, the emotions of shame and guilt were identified and explored, along with feelings of discomfort. Though it is hard work, it was an opportunity for teachers to build empathy, understanding, and perseverance for themselves and for their students.

Teacher Fear

Once teachers had become less resistant and willing to acknowledge their feelings of discomfort and possibly shame, there was a final barrier that often got in the way of successful implementation of cultural competence: fear. When teachers had students of different cultures or backgrounds, the fear of the unknown would possibly bring anxiety,
misconceptions, and even biases (Verma and Apple, 2021). Emdin (2016) explained the complexity of the expectations of current teachers whose effectiveness are often measured with student test scores, graduation rates, and. He continued on to explain the fragile state of being a teacher, including the fear of sharing personal stories to connect material or with students or trusting students with expensive equipment (Emdin, 2016). As a result, this fear hurts the ability of teachers to connect with students and build relationships. Emdin (2016) encouraged teachers that it takes courage to address the fear to go beyond the curriculum expectations and get to know students from different backgrounds.

In addition to fear of the unknown, there was also a fear of messing up as a teacher. Bailey and Katradis (2016) studied preservice teachers and their experience in navigating the concepts of social justice in education. Through the research, preservice teachers experienced fear when it comes to social justice because they were not prepared to confront difficult conversations or injustices. As a result, Bailey and Katradis (2016) found creating opportunities for complicated dialogue as the only way for teachers to get over their fear of speaking up, avoiding standing up for social justice, and not promoting social justice conversations in the classroom. Teachers needed a chance to practice and gain confidence in embedding cultural competence to dismantle the fear of the unknown or of messing up.

2.7 Intervention to Consider

Throughout the literature review, it was apparent there was a lack of support for teachers to embed culturally responsive teaching into math education. Biases, stereotypes, and a lack of focus on equity affected students daily in the math classroom.
(Bartel et al., 2017). Therefore, through a culturally responsive and equity-based lens, questions were asked in how to address the need to foster more culturally responsive math teaching, not only as an individual math teacher but as a group of professionals. Additionally, it was necessary to be mindful of the challenges of this work, such as rigorous math curriculum standards, teacher bias, teacher resistance, and teacher fear. Interventions must have been considered that could effectively support math teachers in their holistic and intrinsic growth in culturally responsive teaching, without adding to the daily stress and time constraints of teaching.

To unravel the multifaceted need of culturally responsive math teaching, a multifaceted intervention is needed. Herr and Anderson (2015) posited the benefits of action research through its stance to confront the culmination of many multifaceted parts rather than a compilation of discrete parts. Therefore, the considered intervention was a professional development centered on culturally responsive math teaching, with CRMT resources, collaboration, and a reflection journal.

**Professional Development**

The professional development intervention was created to be an intentional time for educators to learn, collaborate, reflect, have accountability, and improve teaching (DuFour and Marzano, 2011; Desimone et al., 2009; Sancar et al., 2021). The professional development intervention needed an element of teachers being able to learn culturally responsive math teaching and how to implement it in their own classrooms (Desimone et al., 2009). Sancar and researchers found the most effective professional developments have a holistic and natural process, with the professional development climate being integral to the process (2021). Therefore, the professional development
considered the participants, learning environment, duration, design, and content. See Figure 2.2.

**Figure 2.2**

*Considerations in Professional Development Intervention*

When considering the participants and learning environment, specific factors were identified as significant. The study sought to impact positively the efficacy of secondary math educators, but the question remained as to whether said participants should be drawn from the state, regional, or school division level. The learning environment was also considered with respect to the size of the learning community (DuFour and Marzano, 2011. The rationale was to have math educators meet regularly to collaborate in their efforts to support student growth and achievement (Goddard et al., 2000). Chu and Garcia (2021) posited the value of shared beliefs among a group contributed to the collective
ability to collaborate and execute needed action. The learning aspect of CRMT was intentionally designed within the virtual meetings so teachers could learn together, confer with one another, and discuss classroom application.

In addition to the size and composition of this team of educators, the duration of the professional development was yet another factor to be taken into account. The researcher assessed the duration of the study and the comprehensiveness of the training based on the time frame and environment (Sancar et al., 2021). As a result, the duration of the professional development was programmed to span 9-weeks or one quarter of the school year, for teachers to have time and space to collaborate, apply, and reflect. Additionally, meetings were conducted by telecommute, rather than on-site, in order to obviate issues of scheduling and discrepant access to a common locale.

Finally, the design and content of the professional development content was examined. Goodman (2011), when describing strategies and responses to address resistance when promoting social justice, named the importance of providing teachers with a balance of both challenge and support. He continued by saying the key to reducing resistance in teachers is by designing a safe space for teachers to be vulnerable and exploring challenging material (Goodman, 2011). Similarly, Bailey and Katradis (2016) concluded in their research that teachers must practice culturally competent conversations more to be able to minimize the fear of failure and build confidence. One method of supporting a safe space to discuss challenging material is to provide a professional learning community dedicated to reflection, learning, and collaboration.
Reflection

Jacoby (2010) defined critical reflection as “the process of analyzing, reconsidering, and questioning one’s experiences within a broad context of issues and content knowledge” (para 3). Lucas (2012) examined the multiple perspectives of critical reflection and unfortunately struggled to find a common definition among theorists. However, Lucas (2012) explained that regardless of the definition,

Critical reflection is an essential component of the pedagogy of cooperative education and other forms of work integrated learning. The process of critical reflection needs to be facilitated with structured strategies within the course that encourage engagement in reflection. It is important to create a culture where reflection is valued as a learning tool, and it is safe to be honest. Practice and feedback on reflection throughout the program are important to enable the student to progress through their learning experience (p. 167).

In light of this specific action research study, it was important to note that the Commonwealth of Virginia recently added an evaluation for educators on cultural competency, focusing on culturally responsive teaching and equitable practices (VDOE, 2020). However, naming an initiative does not guarantee an understanding of it; educators must understand the need behind this initiative, as well as its impact on students (Darling-Hammond et al., 2017). Antiracism work cannot simply be done in the classroom; it must be authentically lived out every day in actions, thoughts, and words, both personally and professionally (Pollock et al., 2010).

In a study by Aboud and Doyle (1996), where students were paired up talking about racial issues with other students of varying levels of prejudice, the researchers
found students who measured high in prejudice before the intervention scored significantly less prejudice after the intervention of peer discussions. Aboud and Doyle (1996) found the decrease in prejudice greater when the student had a partner who shared statements about cross-racial similarities. Critical conversations among colleagues can help change the understanding of teachers.

**Collaboration**

Owens (2016) connected the psychology of collaborating as a group to be linked with positive psychology’s wellbeing and found collaboration to be highly effective in regard to a change of teachers’ beliefs and practices. Fraihat et al. (2022) found students had an increase in their ability to not only master content but apply it as well when teachers collaborated and shared resources with one another. Since this action research was focused on not only learning CRMT but also applying it in the classroom, collaboration was necessary as a key component of the professional learning intervention.

**2.8 Conclusion**

Through exploring the historical perspectives of social efficacy’s influence on curriculum and social reconstruction’s influence on curriculum, as well as the literature review on culturally competent curriculum and instruction, its demand, and its influence on math, it can be concluded that secondary mathematics classrooms commonly neglect cultural competence and often fail to demonstrate an environment free from bias, prejudice, and discrimination. Theoretical frameworks of reconstruction theory, growth mindset theory, and mindfulness theory were explained in response to the problem and possible solutions. However, before addressing possible interventions, barriers to
embedding cultural competence in math were identified, such as rigorous demands of math curriculum, teacher stereotypes and biases, teacher resistance, and teacher fear.

In the end, a combination of interventions was explored in how to support teachers to embed cultural competence in secondary math. Interventions included professional learning communities, growth mindset exercises, mindfulness exercises, and critical discussion and reflection. Finally, four current research papers were presented, showing how cultural competence can be approached through self-study, mindfulness, education, and teaching resources.
Chapter 3
Methodology

3.1 Overview of Study

The problem of practice guiding this study centered on a need for secondary math teachers to build efficacy in culturally responsive math teaching in order to better support all students and address the racial disparity of mathematical achievement. In order to address the problem of practice, several needs were identified to support teacher development in culturally responsive math teaching (Aguirre & Zavala, 2013; Bonner, 2021; Gay, 2009; Kitchen, 2005). There is a need to support the facilitation of culturally responsive math teaching, as well as the collaboration and reflection regarding how to incorporate CRMT in class, and the application of CRMT in secondary math classrooms with fidelity. Therefore, the dissertation in practice addressed the following research question using an integrated mixed-method action research design:

**Research Question**: How does the implementation of a professional development centered on Culturally Responsive Mathematics Teaching impact a math teacher’s efficacy in regard to the use of culturally responsive teaching?

To address this complex and multifaceted problem, mixed methods integrated action research was designed and implemented (Bonner, 2021). Seven volunteer math teachers in a school division in Southwest Virginia participated in a 9-week professional development in which quantitative and qualitative data were collected before, during, and after the professional development.
3.2 Research Design

McCutcheon and Jung (1990) defined action research as an inquiry by the participants which is intentional, collaborative, and self-reflective. Action research empowers individuals to conduct their own research with strategy, intentionality, and specific purpose (Efron & Ravid, 2020, Herr & Anderson, 2015). Additionally, action research focuses on the full scope of the problem, addressing a variety of aspects of the research problem (Herr & Anderson, 2015, p. 149).

In the specific field of education, action research supports practitioners and helps them to focus on their specific practice to enhance their specific growth by understanding their specific students and situation (Efron & Ravid, 2020). Action research validates the strength, resiliency, and results within the school walls. Charest (2019) posited the potential for classrooms to be environments of struggle, connection, liberation, and creativity, while also including opportunities to acknowledge differences to promote justice, democracy, and equity. Lewin (1946) claimed action research was necessary to support specific stakeholders of the social group who were part of the situation that needed to be changed. Therefore, the action research design used in this specific education setting was developed with aspects of discovery and insight by the participants, with the hope of making a difference in each participants’ mathematics teaching (Merriam & Tisdell, 2016).

This action research study utilized an integrated mixed-methods research design, collecting both qualitative data and quantitative data over 9 weeks. Quantitative data was collected through pre-PD and post-PD questionnaires with Likert-scale ranking statements. Qualitative data was collected through optional short answers on the
questionnaires, personal reflection journals, and meeting transcripts. The research utilizes a convergent mixed method design where all of the data is collected separately, analyzed separately, and then analyzed and integrated side-by-side and merged together (Creswell & Creswell, 2018). The data is then integrated and analyzed to see if the data converges or not and if there are any common themes (Almalki, 2016). See Figure 3.1.

![Integrated Mixed Methods Data Collection](image)

**Figure 3.1**

*Integrated Mixed Methods Data Collection*

The study assessed the effectiveness of professional development to build teacher efficacy in culturally responsive math teaching (Efron & Ravid, 2020; Upton, 2020). In the design, the practitioners participated in a 9-week professional development which consisted of five virtual meetings to learn, collaborate, and plan CRMT strategies. The professional development also requested educators to practice CRMT in their classrooms.
and keep a reflection journal. Finally, participants also completed two questionnaires, one at the beginning and one at the end of the professional development. See Figure 3.2 for the overview of the research design and timeline and Appendix A for the detailed process of the research design.

<table>
<thead>
<tr>
<th>Week</th>
<th>Participants will do the following...</th>
<th>Data Collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Complete Pre- Intervention Questionnaire</td>
<td>Pre-Intervention Questionnaire</td>
</tr>
<tr>
<td>2</td>
<td>PD Meeting #1</td>
<td>Meeting Transcript #1</td>
</tr>
<tr>
<td>3</td>
<td>PD Meeting #2</td>
<td>Meeting Transcript #2</td>
</tr>
<tr>
<td>4</td>
<td>Classroom Application with Reflection</td>
<td>Personal Reflection Journal</td>
</tr>
<tr>
<td>5</td>
<td>PD Meeting #3</td>
<td>Meeting Transcript #1</td>
</tr>
<tr>
<td>6</td>
<td>Classroom Application with Reflection</td>
<td>Personal Reflection Journal</td>
</tr>
<tr>
<td>7</td>
<td>PD Meeting #4</td>
<td>Meeting Transcript #1</td>
</tr>
<tr>
<td>8</td>
<td>Classroom Application with Reflection</td>
<td>Personal Reflection Journal</td>
</tr>
<tr>
<td>9</td>
<td>PD Meeting #5 (Focus Group Interview)</td>
<td>Meeting Transcript #1</td>
</tr>
<tr>
<td>9</td>
<td>Complete Post- Intervention Questionnaire</td>
<td>Post-Intervention Questionnaire</td>
</tr>
</tbody>
</table>

**Figure 3.2**

*Research design and timeline*

Within this study, the participants used the action research cycle to reflect, learn, plan, and apply collaboratively within their professional learning community meetings (Herr & Anderson, 2015; Revans, 2011). Data was compiled before, throughout, and at the end of the professional development to gather both qualitative and quantitative data points.
3.3 Intervention

To address the problem of practice to increase math teachers’ efficacy in culturally responsive math teaching, an intervention of a professional development centered on culturally responsive math teaching was designed and implemented over 9 weeks. The professional development was entitled “Pursuing Culturally Responsive Math Teaching” and consisted of five virtual meetings, in which the math educators participated in the following action learning cycle: Reflect, Learn, Plan, and Apply (Taylor et al., 1997; Wade & Hammick, 1999; Revans, 2011; Kemp, 2019). An action learning cycle is a continuous process in which the adult learner learns from experience through reflection and action within a supportive and consistent set of colleagues (Wade & Hammick, 1999). See Figure 3.3.

![Professional Development Action Learning Cycle](image)

**Figure 3.3**

*Professional Development Action Learning Cycle*
Each virtual PD meeting started with opportunities for math educators to “Reflect” and share with one another recent classroom experiences with CRMT. In addition to the time for group reflection, participants were encouraged to keep a reflection journal throughout the 9-week intervention, with entries after applying a CRMT strategy. Participants chose the modality of that reflection journal and could answer guided questions such as “What worked well when applying a CRMT strategy? What didn’t work well? What surprised you? How would you do it differently?” Participants could also choose to freely write in their reflection journal as part of their critical self-reflection after applying a CRMT strategy.

After participants were able to “Reflect,” the researcher guided the participants in the “Learn” portion of the PD meeting, in which an intentional set of CRMT resources were provided to support the learning and growth of CRMT. CRMT content heavily focused on work from three sources: 1) a 2015 presentation by Aguirre entitled *Enhancing the common core with culturally responsive mathematics teaching: Key principles and strategies*, 2.) the *Culturally Responsive Mathematics Teaching Lesson Analysis Tool* by TEACH MATH (2012), and 3.) *The impact of identity in K-8 mathematics learning and teaching: Rethinking equity-based practices* by Aguirre et al. (2013). Additionally, each of the six categories, as defined in the CRMT-TM Lesson Analysis Tool created by TEACH MATH (2012), had two or more supplemental materials. All content for the “Learn” portion of the professional development can be found in Appendix D. To support action research validity, the CRMT strategies provided in the PD were collaborated and vetted by the Director of Mathematics and Director of Equity for the school division.
Next, the researcher provided engagement opportunities for the participants to collaborate with one another. Participants were encouraged to apply one of the CRMT strategies presented in the meeting to an upcoming math lesson or activity. The facilitator asked participants what barriers may be in the way in order to apply the strategy with fidelity, and participants had the opportunity to share those barriers that make embedding CRMT challenging. Often, during the session, participants collaborated. During times of silence, the facilitator asked clarifying questions to keep the collaboration going.

The final step of the professional development cycle in this intervention was “Apply.” Math educators were encouraged to apply at least one of the CRMT strategies during the “off weeks” when there were no meetings scheduled. After applying one of the strategies, participants were asked to complete a reflection journal entry. Reflection journals were encouraged to be in a format that was supportive to the math educator: journals could be hand-written, digital, audio, or visual. While guided questions were provided, math educators could choose to use whether or not to utilize those questions.

The professional development concluded during the fifth and final meeting, when a series of focus group interview questions were provided to the participants. The math educators were asked how the PD could have been improved, the barriers to the PD, what next steps were needed, and any other reflections from the intervention. Following the meeting, participants completed the post-intervention questionnaire that included the same fourteen CRMT statements on the pre-intervention questionnaire, as well as an additional eight statements measuring effectiveness of the professional development.
### 3.4 Setting and Context

The action research study was conducted in a school division in Southwest Virginia, which consisted of approximately 10,000 students and 3,000 staff (VDOE, 2022). Of the student population, 78% is White, 7.3% Hispanic, 5.7% Multiple Races, 4.5% Black, and 4.1% Asian (VDOE, 2022). The school division contained a total of 20 schools within the county and is broken into four geographic strands within the school county. Information was sent out from the Director of Research to eight of the nine secondary schools within the school division, with the researcher’s school excluded due to positionality. Participants could see a flyer of the study, as well as the benefits and risks to participating. Participants then could choose whether to participate in the professional development in isolation or along with the research study.

### 3.5 Participants

The seven participants included math teachers, math coaches, and a special education teacher who co-teaches math. In the pre-PD questionnaire (See Appendix E), each participant shared their years of total teaching experience, number of schools they have taught in, number of states and/or countries they have taught in, and their ethnicity (optional). Their average years of teaching was 15.3 years in an average of 3.6 schools in an average of 1.6 states. Six of the seven participants identified their race as White, and one identified as Black. Each of the four division strands were represented in the study. See Figure 3.4.
<table>
<thead>
<tr>
<th>Participant</th>
<th>Years of Teaching</th>
<th>Numbers of schools as teacher</th>
<th>Numbers of states as teacher</th>
<th>Role in School Division</th>
<th>Self-described Race</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant A</td>
<td>9</td>
<td>2</td>
<td>1</td>
<td>Math Teacher</td>
<td>White</td>
</tr>
<tr>
<td>Participant B</td>
<td>13</td>
<td>3</td>
<td>3</td>
<td>Math Coach</td>
<td>White</td>
</tr>
<tr>
<td>Participant C</td>
<td>9</td>
<td>4</td>
<td>2</td>
<td>Math Teacher</td>
<td>White</td>
</tr>
<tr>
<td>Participant D</td>
<td>17</td>
<td>4</td>
<td>1</td>
<td>Special Ed Teacher</td>
<td>Black</td>
</tr>
<tr>
<td>Participant E</td>
<td>17</td>
<td>5</td>
<td>2</td>
<td>Math Teacher</td>
<td>White</td>
</tr>
<tr>
<td>Participant F</td>
<td>22</td>
<td>3</td>
<td>1</td>
<td>Math Coach</td>
<td>White</td>
</tr>
<tr>
<td>Participant G</td>
<td>20</td>
<td>4</td>
<td>1</td>
<td>Math Teacher</td>
<td>White</td>
</tr>
<tr>
<td><strong>AVERAGE</strong></td>
<td><strong>15.3</strong></td>
<td><strong>3.6</strong></td>
<td><strong>1.6</strong></td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Figure 3.4**

*Research Participants Demographics*

### 3.6 Role of the Researcher

The researcher of this study was a former math teacher and secondary math instructional coach in the school division, and at the time of the study, the researcher was a school administrator in the division. The design of the professional development intervention for this action study deliberately avoided the researcher’s direct involvement in any evaluative or leadership-type role in the intervention process (Herr & Anderson, 2015). Instead, the participants in the study were authors of its content in order to reach a common goal (Efron & Ravid, 2020). Freier (1972) contested the value of participant input when defining the type of production for what and why will influence their amount of participation and development on themselves throughout the study. As a result, the role of the researcher was limited to simply being the orchestrator of the professional
development, providing and collecting CRMT resources, and acting as the facilitator of the meetings.

3.6 Data Collection Instruments

Quantitative and qualitative data were collected and analyzed as part of the mixed-method research (Efron & Ravid, 2020). The quantitative data consisted of questionnaire statements with response ratings based on an even Likert scale. Qualitative data included reflection journals, as well as focus group interviews during the fifth virtual PD meeting. These three data collection methods were used to triangulate the data to best understand the effectiveness of the intervention.

Quantitative Data Collection Instruments

CRMT Questionnaires. Questionnaires are a common form of quantitative data collection that can help provide a measure of baseline, as well as possible growth, throughout the study (Efron & Ravid, 2013). For this integrated mixed-methods action research study, two questionnaires bookended the study and its interventions. Both questionnaires contained a list of 14 statements that addressed the teacher’s perceived beliefs of their own culturally responsive and equitable practices. The statements were adapted from two sources: (1.) the Virginia Department of Education evaluation standards, specifically the new Standard 6 that was first implemented in the 2022-23 school year (Virginia Board of Education, 2021) and (2) the reflection responses from the CRMT™ Lesson Analysis Tool (TEACH MATH, 2012). The combination of these statements allowed participants to first assess their own perception of culturally responsive teaching. Then, the second half of the statements focused specifically on the lens of culturally responsive math teaching. See Table 3.1, as well as Appendix E.
Table 3.1

Culturally Responsive Math Teaching Questionnaire Statements

Directions: Rank the following statements on a scale of 1 to 6, with “1=Strongly Disagree, 2=Disagree, 3= Slightly Disagree, 4=Slightly Agree, 5=Agree, and 6=Strongly Agree”. After each ranking, there is optional space to explain why you chose that ranking.

1. I demonstrate a commitment to equity and provide instruction and classroom strategies that result in culturally inclusive and responsive learning environments and academic achievement for all students.

2. I disaggregate assessment, engagement, behavioral, and attendance data by student groups and identify and apply differentiated strategies to address growth and learning needs of all students with specific attention to students within gap groups.

3. I foster classroom environments that create opportunities for access and achievement by acknowledging, valuing, advocating, and affirming cultural and social diversity in all aspects of the learning process, including for gender, race, ethnicity, English Language Learners, and students with disabilities.

4. I build meaningful relationships with all students anchored in affirmation, mutual respect and validation utilizing culturally responsive teaching practices, and by modeling high expectations for all students.

5. I utilize inclusive curriculum and instructional resources that represent and validate diversity from all rings of culture that include generational, gender, religion, class, nationality, race, ethnicity, native language, ability, and sexuality by connecting classroom curriculum and instruction to the cultural examples, experiences, backgrounds, and traditions of all learners.

6. I analyze, select, and integrate texts, materials, and classroom resources that reflect cultural inclusivity and the needs of all students, including for gender, race, ethnicity, English Language Learners, and students with disabilities.

7. I use communication strategies that are inclusive of the language, dialects, cultural, social and literacy needs of all students (including gender, race, ethnicity, English Language Learners, and students with disabilities).

8. I teach students the skills necessary to communicate and engage with diverse groups in ways that support the eradication of discrimination and bias while mitigating against classroom power imbalances (based on race, ethnicity, gender, identity, ability, and/or socioeconomic status) that perpetuate fear and anxiety of difference.

9. My math lessons regularly enable students to closely explore and analyze math concepts(s), procedure(s), and reasoning strategies.

10. My math lessons regularly make student thinking/understanding visible and deep.
11. My math lessons regularly create opportunities to discuss mathematics in meaningful and rigorous ways (e.g., debate math ideas/solution strategies, use math terminology, develop explanations, communicate reasoning, and/or make generalizations).

12. My math lessons regularly distribute math knowledge authority, value student math contributions, and address status differences among students.

13. My math lessons regularly provide academic language support for English Language Learners.

14. My math lessons regularly help students connect mathematics with relevant/authentic situations in their lives.

Questions adapted from VDOE, 2021 and TEACH MATH, 2012.

Each of the fourteen statements was attached to a 6-point Likert scale set of questions, with a continuum of responses from “Strongly Agree” to “Strongly Disagree” from which the participant could choose (Likert, 1932; Efron & Ravid, 2020). The benefit of using Likert-scale items in this survey was the consistency throughout the survey, as well as the continuum of options instead of dichotomous options (Krupat, 2021). Furthermore, the Likert-scale was an even 6-point scale to avoid a “neutral” position on each statement, and “even number of items in the response scale can yield groupings that are easier to understand and discuss” (Thompson, 2018, para 8).

**Qualitative Data Collection Instruments**

**CRMT Questionnaire Short Answers.** After each of the CRMT statements, participants had the option to write a short comment about their ranking. This discretionary short answer data was collected on both the pre-intervention questionnaire and post-intervention questionnaire. Additionally, on the post-intervention questionnaire, eight statements were also included to measure the teacher’s perception of the effectiveness of the professional development, and teachers shared short responses to
those statements as well if they desired. On those statements, the teachers could also share an optional short answer.

Reflection Journals. Throughout the 9-week professional development intervention, participants had opportunities for critical reflection through reflection journaling. Participants chose their own modality of journaling and submitted their journal entry in a shared Google Folder, viewable only by the participant and researcher. Reflection journals were implemented to allow teachers to reflect on the barriers, questions, and celebrations of their own journey with culturally responsive math teaching, as well as to develop a sense of autonomy for one’s own practice and growth (Sullivan et al., 2021). Additionally, embedded within each of the quantitative questionnaires were opportunities for participants to explain their Likert-scale rating. The integrated aspect of the mixed-methods action research provided ways for participants to reflect and explain their rating scales used in the questionnaires, as well as in the lesson analysis tool (Efron & Ravid, 2020). See Table 3.2 and Appendix G to reference the guided reflection prompts for the reflection journal entries.

Table 3.2

Culturally Responsive Math Teaching Guided Reflection Journal Prompts

<table>
<thead>
<tr>
<th>Prompt</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How did you apply CRMT to your math lesson/instruction?</td>
</tr>
<tr>
<td>2. What worked well?</td>
</tr>
<tr>
<td>3. What didn’t work well?</td>
</tr>
<tr>
<td>4. What surprised you?</td>
</tr>
<tr>
<td>5. How did the students respond?</td>
</tr>
<tr>
<td>6. How would you do it differently?</td>
</tr>
</tbody>
</table>
If you were focusing on one of the six CRMT categories, as defined by TEACH MATH (2013), you can also consider reflecting on the following reflection prompts for each category:

<table>
<thead>
<tr>
<th>CRMT Category</th>
<th>CRMT Reflection Prompts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive Demand</td>
<td>How does my lesson enable students to closely explore and analyze math concepts(s), procedure(s), and reasoning strategies?</td>
</tr>
<tr>
<td>Depth of Knowledge &amp; Student</td>
<td>How does my lesson make student thinking/understanding visible and deep?</td>
</tr>
<tr>
<td>Understanding</td>
<td></td>
</tr>
<tr>
<td>Mathematical Discourse</td>
<td>How does my lesson create opportunities to discuss mathematics in meaningful and rigorous ways (e.g., debate math ideas/solution strategies, use math terminology, develop explanations, communicate reasoning, and/or make generalizations)?</td>
</tr>
<tr>
<td>Power and Participation</td>
<td>How does my lesson distribute math knowledge authority, value student math contributions, and address status differences among students?</td>
</tr>
<tr>
<td>Academic Language Support for ELL</td>
<td>How does my lesson provide academic language support for English Language Learners?</td>
</tr>
<tr>
<td>Cultural/Community-based funds of</td>
<td>How does my lesson help students connect mathematics with relevant/authentic situations in their lives?</td>
</tr>
<tr>
<td>knowledge</td>
<td></td>
</tr>
</tbody>
</table>

**Meeting Transcripts.** The third piece of qualitative data collected was the virtual meeting transcripts. After each of the virtual meetings, the Google Meet video was collected and transcribed, and then verified with the original video recording. This data point provided both an intervention, using group reflection and collaboration as a method of learning, as well as data collection through narrative inquiry (Morettini et al., 2018). By using this method of qualitative research, participants were able to share their perspectives and insight, contrary to other research methodologies which might exclude these important meaning-making opportunities (Satchwell et al. (2020).
**Focus Group Interview.** During the final session, the participants were asked a series of questions as part of a focus group interview. These focus group questions allowed the participants to verbally process through their experience together as a group, while also seeking clarification on how to improve future professional development. See Table 3.1 regarding the questions the participants were asked after their 9-week professional development. See Table 3.3 and Appendix H for the questions used in the focus group interview.

**Table 3.3**

*Culturally Responsive Math Teaching Focus Group Interview Questions*

<table>
<thead>
<tr>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What do you see as the factors for the racial discrepancy of achievement for Black and Hispanic students?</td>
</tr>
<tr>
<td>2. What do you think are specific ways math teachers can address this issue of the racial discrepancy of achievement for Black and Hispanic students?</td>
</tr>
<tr>
<td>3. What are the barriers of using culturally responsive math teaching in your classroom?</td>
</tr>
<tr>
<td>4. What are the benefits of using culturally responsive math teaching in your classroom?</td>
</tr>
<tr>
<td>5. What steps, if any, would you like to take next to grow in your understanding and use of culturally responsive math teaching in your classroom?</td>
</tr>
<tr>
<td>6. What resources do you need to grow in culturally responsive math teaching?</td>
</tr>
<tr>
<td>7. Feel free to share any group takeaways from this professional development time.</td>
</tr>
</tbody>
</table>

The overall structure of the research design is for teachers to be the assessors of their own learning through questionnaires, self-assessments, and reflection prompts. As Wright and Wright (2020) explained, “One cannot teach, model, or support what one does not know, feel, or accept” (p. 137). Rather than simply telling teachers to embed
culturaly responsive math teaching, they needed to acknowledge its need, discuss it with fellow math teachers, and practice it in a safe community of fellow math teachers.

3.7 Research Procedure

To encourage participants, a recruitment flyer (see Appendix B) was created and shared with the school division’s Director of Research, who emailed all secondary school principals with the information about the study. The recruitment flyer included a link to the consent form (see Appendix C) and a virtual method of signing the Consent Form using Google Forms. As part of the volunteer process, the school division offered 10 professional development credits to teachers who participated and completed the professional development, though participating in the study was completely optional from the professional development. From that recruitment flyer, seven math educators completed the interest form and a total of seven educators chose to participate in the study, with all educators choosing to participate in both the professional development and the study.

During Week 1, the participants initially completed a pre-PD questionnaire, measuring their perception of efficacy regarding culturally responsive math teaching as an educator and in their secondary math lessons. That data was then collected and shared to the group during the first meeting of Week 2. Based on that data, as well as reviewing the six components of culturally responsive math teaching, as defined by TEACH MATH (2013), the group of participants together determined the three topics of study during the next three meetings, based specifically on the last six questions that identified directly with CRMT. The participants decided to focus on Power and Participation (Session 02),
Mathematical Discourse with a focus of ELL students (Session 03), and Cultural and Community-based funds of knowledge (Session 04).

During Sessions 02, 03, and 04, participants received information, resources, and examples of Culturally Responsive Math Teaching. The CRMT instruction was based on the elements of CRMT as defined by TEACH MATH (2012), and the resources were a collection of evidence-based practices vetted by the school division’s Director of Mathematics, Director of Equity, and secondary math instructional coaches.

### Session Theme | Session Topics
---|---
**Session 02:**
**Power and Participation**
(CRMT Statement 4) | 1. The *authority* of math knowledge is *widely shared* between teacher and students.
2. *All* mathematical contributions are *valued* and *respected*.
3. Student mathematical *contributions* are *actively elicited* by teachers and among students.
4. *Multiple strategies* to minimize status among students (and specific subgroups) are explicit and *widespread throughout* the lesson.

**Session 03:**
**Mathematical Discourse (with emphasis on EL students)**
(CRMT Statements 3 and 5) | 1. The creation and maintenance of *collective understanding* permeates the entire lesson.
2. This could include the use of *common terminology* and the careful negotiation of meanings.
3. Most students (50% - 90%) *participate*.

**Session 04:**
**Community/Cultural Funds of Knowledge**
(CRMT Statement 6) | 1. The creation and maintenance
   a. Of *collective understandings* about mathematics
   b. That involves *intricate connections to community/cultural knowledge* and
   c. *Permeates the entire lesson* (this would include hook/intro, main activities, assessment, closure, and homework).
2. Students are asked to *analyze the mathematics within the community context* and how the mathematics helps them understand that context.

**Figure 3.5**

*Professional Development CRMT Learning Topics*

For Weeks 3-8, the participants alternated between attending a virtual meeting and applying one of the CRMT strategies in their math class. After applying CRMT
strategies, the participants were encouraged to document their reflections in their journal. The math educators in the study had opportunities to share those reflections or takeaways at the beginning of each PD meeting, due to the cyclical nature of each PD meeting focusing on “Reflection,” “Learning,” “Planning,” and then “Applying” in the classroom the following week.

During the final week of the intervention, Week 9, the researcher led the participants in a focus group interview, which was recorded and transcribed for qualitative data. Participants also completed a post-PD questionnaire, not only measuring the teacher’s perceptions of efficacy in the use of CRMT, but also their beliefs in the effectiveness of the professional development intervention and its various components. See Figure 3.1 for an overview timeline of the research design for the intervention.

3.8 Data Analysis

The researcher used a variety of instruments to analyze and triangulate the combination of quantitative and qualitative data collected throughout the 9-week professional development intervention. Quantitative data from questionnaires and qualitative data from short answers on the questionnaires, reflection journals, and meeting transcripts were collected throughout the study and analyzed at the end of the study. The researcher then compared the results and triangulated the data looking for common themes, barriers, or changes of teacher’s self-efficacy (Efron & Ravid, 2020). The mixed methods research data analysis allowed both quantitative data to identify differences before and after the intervention of teacher self-perceived beliefs and abilities, while including narrative data from short answer, reflection journals, and meeting
transcripts that included reflection and collaboration. Together, this data was analyzed to better identify themes with the whole picture of the data.

**Quantitative Data Analysis**

**CRMT Questionnaire.** The researcher collected quantitative data through the pre-intervention and post-intervention CRMT questionnaires with 6-point Likert-scale questions. The researcher compared the participants’ ratings of the 14 statements with those before and after the 9-week intervention. The pre-intervention data was analyzed by identifying the mean (average), median (most frequent), and standard deviation (amount the data is spread out) of each statement. That data was shared during the first meeting for teachers to identify CRMT topics to focus on.

After teachers completed the post-intervention questionnaire, data from both questionnaires were analyzed to identify areas of growth, decline, or stagnation. The researcher calculated the t-test score to measure a significant difference as well as the p-score to measure the probability of the difference. Results shared in Chapter 4

**Qualitative Data Analysis**

The qualitative data was collected from the optional short answers on the questionnaires, the virtual meeting transcripts, as well as the reflection journals. The qualitative data was then analyzed together with comparative analysis, using open coding, axial coding, and selective coding to develop grounded theory (Merriam & Tisdell, 2016; Saldaña, 2021). The five meeting transcripts were coded and tallied, measuring any recurring themes over the entirety of the five focal group interview meetings (Boyatzis, 1998; Saldana, 2021). In the reflections in all three data points, the researcher looked for any comparative language as teachers reflect on their motivation to
change their beliefs and abilities in embedding cultural competence in their teaching practices (Corbin & Strauss, 2008; Saldaña, 2021). These codes can be found in Appendix I.

3.9 Summary

This education action research with mixed methods was designed to measure the effectiveness of a professional development centered on culturally responsive mathematics teaching on a math teacher’s efficacy in the use of culturally responsive teaching. The study was orchestrated as action research due to its viability as a model for change and improvement in the teacher-learner process (Efron and Ravid, 2015). The intervention of a professional development was selected because for the effectiveness of culturally responsive teaching to “take root in the classroom and affect teacher practice and student learning, the teacher them self must continuously and earnestly engage with a personal reflection, assessment, and interrogation of their own assumptions and biases” (DESE et al., 2021). Participants were active researchers in this design process, using both quantitative and qualitative measures to self-assess and provide critical reflection.
Chapter 4
Presentation and Analysis of Data

4.1 Overview of Study

Math teachers are not absolved from the need of culturally responsive pedagogy, regardless of the perceived universality of mathematics among cultures (Banks et al., 2005; Morettini et al., 2019). Consequently, there is a need for intentional and effective CRMT training for math teachers, so they can better embed more culturally responsive teaching in math classrooms (Aguirre & Zavala, 2013; Bonner, 2021; Gay, 2009; Kitchen, 2005). Not only do math teachers need to learn about CRMT, but they also need to implement it with fidelity in their own daily practices (Copur-Gencturk et al., 2019; NCTM, 2020).

The problem of practice guiding this study was centered on a need for professional development training for math teachers to foster growth in their understanding and use of CRMT. The intended goal was to decrease achievement disparity in mathematics as a result of CRMT practices and for students to see their own cultures and meaningful need of application within the math curriculum and instruction. Therefore, this research asked the following question: How does the implementation of a professional development centered on Culturally Responsive Mathematics Teaching impact a math teacher’s efficacy in regard to the use of culturally responsive teaching? Additionally, the problem of practice guiding the research focused on four key needs
within the professional development: understanding CRMT, reflecting, collaborating, and implementing it within the classroom.

In order to best understand the problem of practice and address the research question, a mixed-methods research was conducted with seven volunteer secondary math educators who represented each of the four strands within a school division in Southwest Virginia (Creswell & Creswell, 2018). The educators participated in a 9-week professional development session during the 3rd quarter of the school year, with five virtual professional development sessions.

The data collected throughout the research included the transcripts of the five virtual sessions, the pre-intervention and post-intervention questionnaire results, as well as optional short answers a teacher could share explaining a rating on the questionnaire. Additionally, participants were encouraged to complete 3 personal reflection journals after Sessions 02, 03, and 04 to reflect on their classroom application of a CRMT strategy. This data was collected throughout the nine-week professional development and triangulated to identify key themes.

4.2 Description of Participants and Purpose for Participation

The participants consisted of seven math educators, with four secondary math teachers, two secondary math instructional coaches, and one special education math co-teacher. All of the teachers but one self-described their race as White, and one teacher described their race as Black. Together, the participants had an average of 15.3 years of teaching experience over the span of an average of 3.6 schools in an average of 1.6 states. The seven participants in this mixed-method action research also represented each of the
four different strands within the Southwest school division, with each strand serving populations and community cultures different than the other strands.

4.3 Answering the Research Question

To address the concern of racial disparities in mathematics and to support teacher efficacy in the use of culturally responsive math teaching, this study explored the research question: How does the implementation of a professional development centered on Culturally Responsive Mathematics Teaching impact a math teacher’s efficacy in regard to the use of culturally responsive teaching? Based on the qualitative and quantitative data and the triangulating analysis, the implementation of a 9-week professional development dedicated to specifically culturally responsive mathematics teaching did impact the participants efficacy. Teachers responded well to the training and the specific focus of math. They desired to learn more, while also demonstrating an increase in their own self-efficacy of their understanding and use of CRMT within their secondary math classrooms.

4.4 General Findings

Throughout the research, quantitative and qualitative data were collected in the forms of questionnaires, meeting transcripts, and journal entries.

Part 1: Quantitative Findings from Pre-Intervention and Post-Intervention

Questionnaires

To answer the research question, the quantitative data was reviewed first. Data was collected from a pre-intervention questionnaire before participants participated in the professional development and a post-intervention questionnaire at the conclusion of the professional development. In the pre-intervention questionnaire, the participants
responded to fourteen culturally responsive pedagogical statements with a 6-point Likert scale response ranging from 1 (Strongly Disagree) to 6 (Strongly Agree). Participants completed the fourteen-question questionnaire, and the results were shared with the group during the first session. See Table 4.1.

Table 4.1

*Pre-Professional Development Questionnaire Statement Results*

<table>
<thead>
<tr>
<th>CULTURALLY RESPONSIVE TEACHING STATEMENTS (VDOE, 2021)</th>
<th>Pre-PD Mean</th>
<th>Pre-PD Median</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) I demonstrate a commitment to equity and provide instruction and classroom strategies that result in culturally inclusive and responsive learning environments and academic achievement for all students. (VDOE Performance Standard 6: Culturally Responsive Teaching and Equitable Practices, 2021).</td>
<td>4.143</td>
<td>4</td>
<td>0.690</td>
</tr>
<tr>
<td>2) I disaggregate assessment, engagement, behavioral, and attendance data by student groups and identify and apply differentiated strategies to address growth and learning needs of all students with specific attention to students within gap groups (VDOE Performance Standard 6.1, 2021).</td>
<td>2.857</td>
<td>3</td>
<td>1.574</td>
</tr>
<tr>
<td>3) I foster classroom environments that create opportunities for access and achievement by acknowledging, valuing, advocating, and affirming cultural and social diversity in all aspects of the learning process, including for gender, race, ethnicity, English Language Learners, and students with disabilities (VDOE Performance Standard 6.2, 2021).</td>
<td>4.429</td>
<td>4</td>
<td>0.976</td>
</tr>
<tr>
<td>4) I build meaningful relationships with all students anchored in affirmation, mutual respect and validation utilizing culturally responsive teaching practices, and by modeling high expectations for all students (VDOE Performance Standard 6.3, 2021).</td>
<td>4.714</td>
<td>5</td>
<td>1.254</td>
</tr>
</tbody>
</table>
5) I utilize inclusive curriculum and instructional resources that represent and validate diversity from all rings of culture that include generational, gender, religion, class, nationality, race, ethnicity, native language, ability, and sexuality by connecting classroom curriculum and instruction to the cultural examples, experiences, backgrounds, and traditions of all learners (VDOE Performance Standard 6.4, 2021).

6) I analyze, select, and integrate texts, materials, and classroom resources that reflect cultural inclusivity and the needs of all students, including for gender, race, ethnicity, English Language Learners, and students with disabilities (VDOE Performance Standard 6.5, 2021).

7) I use communication strategies that are inclusive of the language, dialects, cultural, social and literacy needs of all students (including gender, race, ethnicity, English Language Learners, and students with disabilities) (VDOE Performance Standard 6.6, 2021).

8) I teach students the skills necessary to communicate and engage with diverse groups in ways that support the eradication of discrimination and bias while mitigating against classroom power imbalances (based on race, ethnicity, gender, identity, ability, and/or socioeconomic status) that perpetuate fear and anxiety of difference (VDOE Performance Standard 6.7, 2021).

### CULTURALLY RESPONSIVE MATH TEACHING STATEMENTS (TEACH MATH, 2012)

<table>
<thead>
<tr>
<th>CATEGORICAL GROUP</th>
<th>MEAN</th>
<th>預備</th>
<th>無預備</th>
<th>STANDARD DEVIATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) <strong>Cognitive Demand</strong>: My math lessons regularly enable students to closely explore and analyze math concepts(s), procedure(s), and reasoning strategies (CRMT-TM Lesson Analysis Tool, 2012).</td>
<td>4.000</td>
<td>4</td>
<td>1.291</td>
<td></td>
</tr>
<tr>
<td>2) <strong>Depth of Knowledge &amp; Student Understanding</strong>: My math lessons regularly make student thinking/understanding visible and deep CRMT-TM Lesson Analysis Tool, 2012).</td>
<td>3.714</td>
<td>4</td>
<td>1.113</td>
<td></td>
</tr>
<tr>
<td>3) <strong>Mathematical Discourse</strong>: My math lessons regularly create opportunities to discuss mathematics in meaningful and rigorous ways (e.g., debate math ideas/solution strategies, use math terminology, develop explanations, communicate reasoning, and/or make generalizations) (CRMT-TM Lesson Analysis Tool, 2012).</td>
<td>3.857</td>
<td>4</td>
<td>1.069</td>
<td></td>
</tr>
</tbody>
</table>
4) **Power and Participation**: My math lessons regularly distribute math knowledge authority, value student math contributions, and address status differences among students (CRMT-TM Lesson Analysis Tool, 2012).

<table>
<thead>
<tr>
<th>Statement</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power and Participation</td>
<td>4.429</td>
<td>1.272</td>
</tr>
</tbody>
</table>

5) **Academic Language Support for ELL**: My math lessons regularly provide academic language support for English Language Learners [] (CRMT-TM Lesson Analysis Tool, 2012).

<table>
<thead>
<tr>
<th>Statement</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Language Support for ELL</td>
<td>3.286</td>
<td>1.113</td>
</tr>
</tbody>
</table>

6) **Cultural/Community-based funds of knowledge**: My math lessons regularly help students connect mathematics with relevant/authentic situations in their lives (CRMT-TM Lesson Analysis Tool, 2012).

<table>
<thead>
<tr>
<th>Statement</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultural/Community-based funds of knowledge</td>
<td>3.571</td>
<td>1.272</td>
</tr>
</tbody>
</table>

7) What are you hoping to get out of this professional development? (optional short answer only)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>What are you hoping to get out of this professional development</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Based on the pre-professional development questionnaire and the conversation during the first session, the participants chose the key topics of CRMT they wanted to focus on during the next three professional development sessions. Those three topics the group chose were Power and Participation (based on CRMT Statement 4), Mathematical Discourse with emphasis on EL students (based on CRMT Statements 3 and 5), and Community/Cultural Funds of Knowledge (based on CRMT Statement 6).

After the five virtual professional development sessions, the participants completed a post-intervention questionnaire with the same fourteen statements, as well as eight statements measuring the effectiveness of the professional development. All seven participants completed both the pre-intervention questionnaire and post-intervention questionnaire. The questionnaire instrument provided means for participants to identify their own self-efficacy of culturally responsive math teaching before and after professional development. The data was further extrapolated by calculating the difference in the mean (average) of each score, See Table 4.2.
Table 4.2

Comparison of VDOE Statements in Questionnaire Responses Between Pre-PD and Post-PD

<table>
<thead>
<tr>
<th>CULTURALLY RESPONSIVE TEACHING STATEMENTS (VDOE, 2021; TEACH MATH, 2012)</th>
<th>Pre-PD Mean</th>
<th>Post-PD Mean</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) I demonstrate a commitment to equity and provide instruction and classroom strategies that result in culturally inclusive and responsive learning environments and academic achievement for all students. (VDOE Performance Standard 6: Culturally Responsive Teaching and Equitable Practices, 2021).</td>
<td>4.143</td>
<td>5.143</td>
<td>1.000</td>
</tr>
<tr>
<td>2) I disaggregate assessment, engagement, behavioral, and attendance data by student groups and identify and apply differentiated strategies to address growth and learning needs of all students with specific attention to students within gap groups (VDOE Performance Standard 6.1, 2021).</td>
<td>2.857</td>
<td>3.571</td>
<td>0.714</td>
</tr>
<tr>
<td>3) I foster classroom environments that create opportunities for access and achievement by acknowledging, valuing, advocating, and affirming cultural and social diversity in all aspects of the learning process, including for gender, race, ethnicity, English Language Learners, and students with disabilities (VDOE Performance Standard 6.2, 2021).</td>
<td>4.429</td>
<td>5.000</td>
<td>0.571</td>
</tr>
<tr>
<td>4) I build meaningful relationships with all students anchored in affirmation, mutual respect and validation utilizing culturally responsive teaching practices, and by modeling high expectations for all students (VDOE Performance Standard 6.3, 2021).</td>
<td>4.714</td>
<td>5.571</td>
<td>0.857</td>
</tr>
<tr>
<td>5) I utilize inclusive curriculum and instructional resources that represent and validate diversity from all rings of culture that include generational, gender, religion, class, nationality, race, ethnicity, native language, ability, and sexuality by connecting classroom curriculum and instruction to the cultural examples, experiences, backgrounds, and traditions of all learners (VDOE Performance Standard 6.4, 2021).</td>
<td>3.143</td>
<td>4.571</td>
<td>1.429</td>
</tr>
<tr>
<td>6) I analyze, select, and integrate texts, materials, and classroom resources that reflect cultural inclusivity and the needs of all students, including for gender, race, ethnicity, English Language Learners, and students with disabilities</td>
<td>3.000</td>
<td>4.286</td>
<td>1.286</td>
</tr>
</tbody>
</table>
7) I use communication strategies that are inclusive of the language, dialects, cultural, social and literacy needs of all students (including gender, race, ethnicity, English Language Learners, and students with disabilities) (VDOE Performance Standard 6.6, 2021).

8) I teach students the skills necessary to communicate and engage with diverse groups in ways that support the eradication of discrimination and bias while mitigating against classroom power imbalances (based on race, ethnicity, gender, identity, ability, and/or socioeconomic status) that perpetuate fear and anxiety of difference (VDOE Performance Standard 6.7, 2021).

<table>
<thead>
<tr>
<th>CULTURALLY RESPONSIVE MATH TEACHING STATEMENTS (TEACH MATH, 2012)</th>
<th>Pre-PD Mean</th>
<th>Post-PD Mean</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Cognitive Demand: My math lessons regularly enable students to closely explore and analyze math concepts(s), procedure(s), and reasoning strategies (CRMT-TM Lesson Analysis Tool, 2012).</td>
<td>4.000</td>
<td>4.429</td>
<td>0.429</td>
</tr>
<tr>
<td>2) Depth of Knowledge &amp; Student Understanding: My math lessons regularly make student thinking/understanding visible and deep (CRMT-TM Lesson Analysis Tool, 2012).</td>
<td>3.714</td>
<td>4.286</td>
<td>0.571</td>
</tr>
<tr>
<td>3) Mathematical Discourse: My math lessons regularly create opportunities to discuss mathematics in meaningful and rigorous ways (e.g., debate math ideas/solution strategies, use math terminology, develop explanations, communicate reasoning, and/or make generalizations) (CRMT-TM Lesson Analysis Tool, 2012).</td>
<td>3.857</td>
<td>4.286</td>
<td>0.429</td>
</tr>
<tr>
<td>4) Power and Participation: My math lessons regularly distribute math knowledge authority, value student math contributions, and address status differences among students (CRMT-TM Lesson Analysis Tool, 2012).</td>
<td>4.429</td>
<td>4.571</td>
<td>0.143</td>
</tr>
<tr>
<td>5) Academic Language Support for ELL: My math lessons regularly provide academic language support for English Language Learners (CRMT-TM Lesson Analysis Tool, 2012).</td>
<td>3.286</td>
<td>3.714</td>
<td>0.429</td>
</tr>
<tr>
<td>6) Cultural/Community-based funds of knowledge: My math lessons regularly help students connect mathematics with relevant/authentic situations in their lives (CRMT-TM Lesson Analysis Tool, 2012).</td>
<td>3.571</td>
<td>4.000</td>
<td>0.429</td>
</tr>
</tbody>
</table>
Note: The questionnaire scale scores represent Mean (average) scores based on a Likert-scale of 1 (Strongly Disagree) to 6 (Strongly Agree).

In comparing the Likert-scale responses of the same fourteen statements on the pre-intervention and post-intervention questionnaire, the participants showed an increase on all fourteen culturally responsive pedagogical statements, measuring their perceived self-efficacy of the understanding and use of CRMT. The data further identified the highest increase or growth in the teachers’ perceptions of commitment to equity (question 1, part 1) by providing instruction strategies that are culturally inclusive (from 4.14 to 5.14), their inclusive communication strategies (from 3.71 to 5.00), and their teaching of skills to students to communicate and engage with diverse groups (from 3.14 to 4.43). The data also revealed emerging trends of utilizing inclusive curriculum and instructional resources and analyzing (from 3.14 to 4.57), selecting, and integrating material that reflect cultural inclusivity (from 3.00 to 4.29).

Part 2: Qualitative Findings from Optional Short Answers on Questionnaires, Video Transcripts, and Reflection Journals

In this mixed-method action research, both quantitative and qualitative data were collected. The qualitative data consisted of video transcripts, reflection journals, focus group interview, and optional short answer responses to each questionnaire statement. To supplement the Likert-ratings on the questionnaire statements, participants had the option for a short answer response to offer further explanation or rationale. This opportunity was available to each participant on the pre-intervention questionnaire and post-intervention questionnaire.
In addition to the data collected on the questionnaires before and after the 9-week professional development, data was also collected throughout the 9-weeks. During each of the five virtual sessions on Google Meet, auto-generated transcripts were enabled to collect participant’s comments throughout the meetings. The transcripts were reviewed and synchronized with each video recording to prevent any inconsistencies. The last virtual meeting was a Focus Group Interview, which also was recorded, transcribed, and verified for consistency. Finally, participants were encouraged to complete personal journals after each of the three classroom applications, with guiding reflection prompts if needed. These reflections were completed on Google Documents and shared only with the researcher.

The short answers, video transcriptions, and journal entries were then collected, synthesized, and coded as a whole. Based on the frequency and substance of the coding, different themes emerged as a result of this process. The 8 themes emerging were lack of understanding of culturally responsive teaching, a desire for growth, a need for more support disaggregating data, more awareness of the data and racial disparities, lack of adequate resources, additional time needed, student needs (relationships, learning styles, communication), and cultivating teacher growth mindset. See Figure 4.1.
Figure 4.1

Emerging Themes from Qualitative Data Collection

**Theme 1: Lack of Understanding of Culturally Responsive Teaching**

In the short answer responses on the questionnaire, participants explained they didn’t know what inclusive curriculum might look like in the classroom, nor did they have time to explore it. One teacher explained their frustration with inclusive math curriculum in this way:

- I don't discuss cultural or social differences in class, but I do feel that I am welcoming and inclusive of all groups. I don't always make a point to plan for different genders, races, or ethnicities. However, ELL students and students with disabilities are always at the forefront when planning lessons (Participant B, Pre-PD Questionnaire, Short Answer to #3)
I’m not sure if I know what this looks like in a classroom! I’m sure I could make huge improvements in this area (Participant E, Pre-PD Questionnaire, Short Answer to #5).

I have not found many good math examples that include a good range of diversity. Many times, when required to include diversity in a lesson, I feel that I had to make something work, just to check a box. I haven’t found much that fits organically with the curriculum. (Participant B, Pre-PD Questionnaire, Short Answer to #5)

**Theme 2: Desire for Growth**

At the end of the pre-intervention questionnaire, participants had the option to complete the question *What are you hoping to get out of this professional development?* The responses to each participants’ answers can be found on Table 4.3.

**Table 4.3**

*Participants’ Desired Outcomes of Professional Development*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Response to <em>What are you hoping to get out of this professional development?</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant A</td>
<td>Perspective and how I can help reach students in my class that I may not be reaching or specifically designing/catering instruction to meet.</td>
</tr>
<tr>
<td>Participant B</td>
<td>I would love some ideas, tools, and resources that can be implemented in classrooms right away. It would be great if I had information that I could share with the math teachers at my school to help improve inclusivity in the math classroom. Implementing this PD couldn’t have come at a better time! Student moral seems to be at an all time low, and anything we can do to help our students be more involved and valued in math classes would be a huge benefit!</td>
</tr>
<tr>
<td>Participant C</td>
<td>Better ways to connect with students of different cultural backgrounds and get better strategies to teach all learners.</td>
</tr>
<tr>
<td>Participant D</td>
<td>PD points and just see where other math teachers are on this topic</td>
</tr>
</tbody>
</table>
Overall, participants demonstrated a desire to learn how to best connect with students, learn from fellow math colleagues, and gain resources and strategies to implement culturally responsive teaching in the math classroom.

**Theme 3: A Need for more support in disaggregating data**

In the post-intervention questionnaire, some teachers described a theme of needing more support regarding how to disaggregate data by student groups to identify gaps. When offered an opportunity to explain their ranking to Questionnaire Question #2 (*I disaggregate assessment, engagement, behavioral, and attendance data by student groups...with specific attention to students within gap groups*), teachers responded with the following:

- Still would like some help with this one (Participant B, Post-PD Questionnaire, Short Answer #2)
- I would love to do this but haven’t yet (Participant A, Post-PD Questionnaire, Short Answer #2)

These qualitative responses correlate with the quantitative results of the same statement on both the pre-intervention questionnaire and post-intervention questionnaire. For both questionnaires, Statement #2 received the lowest Likert-scale average ranking of all
fourteen statements. The data also revealed little growth in this area from before and after the intervention.

**Theme 4: Awareness of the Data and Racial Disparities.** During the first session, teachers were surprised by the data revealing racial achievement disparities for students identified as Black or Hispanic across the nation, the state, and the school division (National Center for Educational Statistics, 2023; VDOE, 2022). They were also surprised by the research identifying bias in math education (Swetz, 2009, Coper-Gencturk, 2019; Grissom & Redding, 2019). In reflecting historical math pass rates specifically in Virginia (see Table 1.5), the participants had the following conversation:

- There doesn’t seem to really be any change. When one group goes down, the other groups go down as well (Participant B, Session 01, 12:27).
- So when everyone is doing bad, everyone is doing bad. But one social group is doing worse all the time (Participant D, Session 01, 12:47).
- Those top four are always above the average and the bottom three [American Indian, Hispanic, Black] are always below the average (Participant B, Session 01, 13:04).
- And I am wondering why these two groups historically do the worst because I have been in other states and it’s always the same across every state (Participant C, Session 01, 13:20).

Furthermore, teachers were disheartened to learn that the achievement gap within the school division had not reduced more despite efforts over the last five years to decrease racial achievement disparities. The teachers discussed why those numbers had
not improved and one teacher commented that while the division was aware of the gap, there weren’t many resources.

- We’ve had such a push in the county with the gap groups from SOL scores, our ELL students, and our students with disabilities. But with our other cultural gap groups? Like, we’ve gotten a lot of help with the other groups, have co-teachers in our classrooms, we have coaches, we have extra resources for students with disabilities, but our other gap groups, our cultural gap groups, we don’t have that support built in yet (Participant B, Session 01, 51:13).

Finally, one other theme of awareness came as a result of learning about the racial differences between teachers and students (National Center for Education Statistics, 2023). The teachers discussed why that might be the case, but they were surprised by the differences and how it might affect the class. At first, some teachers felt it was a lack of pursuit of college or scholarships by the Black and Hispanic communities. Participant D named that he believed the lack of Black or Hispanic teachers was due to a lack of representation in college by Black and Hispanic students. However, one teacher who identifies Black explained it a different way:

- The interest isn’t there in the Black community. When I was growing up, no one wanted to be a teacher. It was looked upon like “a teacher”? It wasn’t seen as something you could do. It was more along “basketball” players. It wasn’t academics; it was more along athletics. Something like a teacher? You didn’t see it. And usually when you are pursuing a career, it is based on something that you have seen. Maybe your parents have done it. You have an interest level because of the friends you are hanging around. Maybe their parents did it. So you can
develop a love or respect for it in that manner. But when you’re in school and getting in trouble all the time by the teachers…they look at it like the police. It’s like, “I don’t want to do that!” So, I think it is a perception thing. They just aren’t use to that….And even here, at this school, when I tell people I am a teacher here, and I go to fairs to bring more diversity in. But every time I talk to any Black people, they be like “What? Southwest Virginia? Oh no! I don’t want to do that. I can’t go there.” When you are coming up, it is what you see” (Participant D, Session 01, 30:14).

Then, another participant explained the value of students needing to see teachers who look like them in the classroom.

- A lot of teachers become teachers because they had a connection with a teacher growing up. Well, if 80% of our teachers are White, our White students are going to be the kids with connections. So who is going to want to be a teacher when they grow up? (Participant B, Session 01, 33:15).

After Participants D and B finished sharing their perspective, Participant A then announced that he had been searching for recent data of college enrollment demographics to see if his hypothesis of low representation of Black and Hispanic students in college. He admittedly explained that his assumptions were inaccurate. He found the college enrollment numbers by race to mimic much closer to the public student population rather than the public teacher population. Therefore, lack of Black or Hispanic teachers cannot be connected to lack of college enrollment.

**Theme 5: Lack of Adequate Resources.** As teachers continued to wrestle with their own awareness to the racial achievement disparities, as well as the teacher-student
demographic differential, the group also identified a barrier to CRMT is the lack of resources, or awareness of those resources. Teachers explained that they had a wealth of information and resources for students with disabilities; however, they didn’t have resources that included culturally responsive pedagogy. Research supports this struggle by identifying the need for intentional focus to create the conceptual focus of CRMT (Ellerbrock & Vomvoridi-Ivanovicc, 2019).

- We've had such a push in the county with the gap groups from SOL scores are ELL students and our students with disabilities. So, I feel like the other cultural gap groups? Like we've gotten a lot of help with, we have co-teachers in our classrooms, we have coaches, we have extra resources for students with disabilities, but our other gap groups, our cultural gap groups, we don't have that support built in yet (Participant B, Session 01, 47:35).

- There are these subgroups that we need to target and have additional resources that are dedicated to them (Participant A, Session 01, 18:45).

During the 9-weeks, the teachers learned new CRMT resources but found that they were still hard to access or use quickly and with fidelity.

- And I think that's the thing. There's so many resources out there. But it's not being able to know really where to get them because we don't have access. It's a new thing with cultural competency and our standards and nobody's really given us a way to get a certain resource and there's been no real training on it (Participant C, Session 05, 46:30)

- We have so many good resources and things, and I agree with having them all linked in one spot. And maybe that's what we need. Just teachers need to be
aware. And we need to help everybody. See what is already there and how you can use them as a culturally responsive item. Maybe we just need more training (Participant B, Session 05, 39:27).

On the other hand, even after the 9-week session, some participants explained they still felt confused about where to look for resources. Therefore, the lack of resources or the lack of awareness of resources was still a barrier even after the professional development. One of the math coaches shared a desire to support this work during the next summer to better support teachers next school year:

- I feel like I'm in a good position where I can help teachers figure out a way to incorporate this, like have a resource bank. For next year, over the summer, work on a couple of things where we could incorporate some of these ideas into different parts of their content areas and then… they can start fresh and be able to use it a little more routinely through the year (Participant B, Session 05, 37:24).

**Theme 6: Additional Time Needed.** In addition to teachers identifying a need for more awareness and more resources, they also discussed the need for more time to intentionally pursue and embed CRMT. Barriers such as curricular demands, pacing, student behavior, and family involvement all limited the time teachers desired to spend on embedding CRMT within the curriculum and instruction. During the first session, the teachers analyzed their own group data of CRMT statements on the pre-intervention questionnaire, and they specifically talked about the statement “I disaggregate assessment, engagement, behavioral, and attendance data by student groups” which had an average of 2.86 on a scale of 1 to 6 (VDOE, 2021). When looking at this standard, one participant explained it this way:
• This is going to be a lazy answer. But some of it, just to be really frank, is just
time…. I’m like “Oh, on this common assessment, the class missed this question.
Like really low.” And I am looking at the data. “We missed this question. We
need to go over it as a class.” I’m not specifically looking at that [data by
demographic]. I mean, I probably could…but time” (Participant A, Session 01,
44:30).

The group then looked at the second lowest statement of which said “I analyze, select,
and integrate texts, materials, and classroom resources that reflect cultural inclusivity”
with a mean rating of 3.00 on a scale of 1 to 6 (VDOE, 2021).

• I think we are all like this. We are just trying to get by. Trying to get the content
to our kids and get through the day without any other behavior things, and it is
just like, I don’t have time to vet resources. Well, that’s bad. I have not prioritized
making time to vet resources that are culturally responsive in the classroom. …I
haven’t prioritized breaking down data into groups. If feels like such a lazy
answer and a cop out. And I feel like I can do better (Participant A, Session 01,
43:45).

• Our pacing guide is packed full already. So, getting this [CRMT] to feel like
something we can “intertwine with it” and not “add to it,” not making it feel like
more. Because I know plates are already so full (Participant B, Session 05, 29:51).

Throughout the application process of the professional development, teachers also
named their challenge with finding time to try new things in the midst of the high
demands of content, student behavior, and state standards and testing.
• I’m not sure how I can measure [applying CRMT] in such a short amount of time the effect of this intentional focus (Participant G, Journal Entry 02).

• I think that we have such a short amount of time to fill in the [mathematical content] gap, that we have to say, “Let’s go. We got to go.” It's building that confidence and being their cheerleader. I think that is where I sometimes. I can't worry about whether or not there's that parental involvement at home [in reference to Cultural Funds of Knowledge]. I've got to fix this situation right here and be your cheerleader (Participant E, Session 05, 23:14).

Another barrier teachers identified was getting families involved:

• [After interviewing students in class about family involvement], I wonder if [a factor for racial discrepancy could be] family involvement and availability. A lot of those Hispanic families have their parents or working late in the evenings, or they live with aunts and uncles and grandparents who aren't available as readily (Participant B, Reflection Journal 03).

• [After I sent home family surveys and none were returned], I think we just need to know the backgrounds. We really need to have those discussions with those students…in their homes and their families” (Participant C, Reflection Journal 03).

**Theme 7a Student Relationships:** A prevalent theme throughout the data included a focus on students, specifically student relationships, learning styles, and communication. Firstly, teachers described a belief of strong teacher-student relationships, often one of the reasons they were willing to participate in the study. The teachers explained multiple
times throughout the study how important they believed having a strong relationship is with a student.

- The building relationships part is the easy part. That’s our bread and butter. I mean, that’s where we live…If I don’t have the relationship, I can’t take them on solving two-step equations. (Participant E, Session 01, 45:56).

- It [building relationships] is the most important, especially in this day and age (Participant D, Session 01, 46:30).

- It’s just the inclusivity about it all. I mean, just everybody. One of my students said “[Teacher name], you just make us be family in here…I don't know how you do it.” I mean, and it's not anything. I don't do anything different guys (Participant E, Session 05, 33:06).

Even though the relationships were explained as highly valuable, the teachers were also aware of the challenges and barriers that arise with developing and maintaining those relationships:

- We have several students identified who have various cultural backgrounds. They are African American or biracial. How does old white guy [describing himself] help them to get closer to using more fully their abilities? (Participant G, Reflection Journal 01).

- It doesn't matter how much, how much information, how much instruction you’re giving them. They're not taking it in if that motors not started, if they’re not driven towards something, and it just seems like a lot of, a lot of students are just not driven. It’s hard to get them to participate if they are not driven to even try. You
know, we can't see what they do if they don't even try (Participant D, Session 01, 53:41).

Teachers also named the importance of full school understanding and buy-in of culturally responsive pedagogy, beyond just the math teachers:

- It’s not just mathematics, being culturally responsive… It’s everybody’s buy-in, not just the math teachers. But everybody. Cafeteria custodians. Everybody needs to have this buy-in regardless of whether who you are, what you teach, what you do (Participant C, Session 05, 33:11).

**Theme 7b Student Learning Styles.** In addition to building strong teacher-student relationships, a common theme of honoring student learning styles was an evident theme in the data. Teachers demonstrated a desire to learn and adapt to the different learning styles within the classroom including learning disabilities, language differences, and cultural differences:

- Not everybody learns the same way. That's the one thing going is not everybody learns the same way and it's okay. And being able to share how we implement it differently in our cultures. It just makes the classroom so much more engaging and much more friendly and enjoyable for everybody. Not everybody feels like it's just the teacher talking all the time. (Participant C, Session 05, 34:02).

- In terms of like learning styles and everything that I need to focus on, I’d more like to spread it out and have more variety in my classroom. And I think that is going back to the idea of best practices of what engages them and how they do their best. That’s how I’m going to view “culturally responsive” (Participant G, Session 05, 35:13).
• I’d like to actually do more of the engaging activities myself because I feel like I am that rigid person. Like I have my set ways that I’d like to do things. But allowing the kids to start doing more, exploring, and bringing in their own ideas and their own ways of doing it and just being able to share that with each other (Participant C, Session 05, 37:30).

**Theme 7c Student Communication:** The third and final aspect of the “student” theme consisted of student communication. Participants described a theme of students struggling with a lack of skills to communicate and discuss with one another, especially in mathematical discourse. Throughout the journal entries and in the meetings, teachers shared the need to intentionally teach students how to discuss math with one another. When teachers applied “Mathematical Discourse” in the classroom, as one of the CRMT strategies, it was apparent more training is needed for students:

• Mathematical discourse doesn't happen on a regular basis. The kids don't know how to really actually talk mathematically (Participant C, Session 01, 54:00).

• What I think I see is that when it gets hard for them is in describing process…They honestly don’t know how to talk about what they are doing. It’s a meta skill. (Participant G, Reflection Journal 03).

• It seems like so much of the math discourse issue is that students don’t know how to start a math conversation… I’m wondering if our [once class] success stemmed from the fact that the information to be discussed was something the students felt comfortable with (Participant B, Reflection Journal 01).

• I used Frayer Model vocabulary for angles for my Advanced Math 7 class. It allowed students to have examples and not just words of each type of angle. It
was a 2 hour delay for school, so it was a bit rushed and students, but I do think that it helped with vocabulary building. Students actually got a better grasp of the vocabulary when it came time to apply it. Students responded well to the activity. I would do it again but students would do the looking up of vocabulary and examples. (Participant C, Reflection Journal 02).

**Theme 8: Teacher Growth Mindset:** The final theme that was apparent throughout the data collection was the teachers’ desire and willingness to grow and learn in order to better support students. First of all, teachers were willing to commit to a 9-week professional development study during the third quarter of a highly stressful academic year within the school division. Secondly, teachers routinely explained their purpose in the study was to grow and learn as an educator. They demonstrated growth mindset throughout the professional development:

- There’s so much more we can do (Participant E, Session 01, 53:46).
- You eat an elephant one bite at a time. And this is big. This is big (Participant G, Session 01, 53:46).
- I’m not going to say it went poorly. This takes some thought about the process (Participant G, Reflection Journal 03).
- [When adjusting lessons for student deficits even in Calculus], so you got just got to be willing to do it all, regardless of the deficits they show up with (Participant A, Session 02, 28:25)

While the teachers found the professional learning experience of learning new skills and strategies to be valuable and helpful, they also named the journey and the opportunity to reflect to also be detrimental to growth:
• The fact that we're even pausing and reflecting on what we're doing is the first initial step, or the first thing of just being aware and thinking about it. And so I think that's one of the takeaways…Progress isn't linear, you know. There's ups and downs, and so, I want to think about this, like a nice trajectory. (Participant A, Session 05, 46:12).

• I think the biggest barriers are internal barriers. That “thinking,” you know, when I have my own self-talk and say “when do I have time to do this? What do I need?” You know. Oh my gosh. It’s just so overwhelming. I’ve got to do something called culturally responsive teaching….So, for me it’s going to be a reset, a reframe, of what this really means. (Participant G, Session 05, 29:40).

Furthermore, at the conclusion of the professional development, teachers demonstrated a desire for the professional development to have lasted longer.

• This is a big conversation that is beyond the scope of this meeting (Participant G, Session 05, 31:02).

• This is so much to digest…I just need time to process it…Nine weeks is pretty condensed (Participant A, Session 05, 42:16).

• I needed the class and then needed someone to talk about it with or a small group. I need to talk about it even more and be like “what the heck was that?” (Participant E, Session 05, 43:15).

Teachers described their appreciation of doing this as a group, especially since they named the overwhelming feeling of the topic:

• It was always just nice to get together and talk about things to examine it more to see if you can do anything better (Participant E, Session 01, 10:05).
Overall, throughout the transcripts of the sessions and the personal journal entries, the themes emerging were Awareness, Resources, Time, Student Communication, Student Needs (communication, relationships, learning styles) and Teacher Growth Mindset emerged as prominent topics of interest for the research participants.

The purpose of the research was to address the needs of math teacher to support culturally responsive math teaching and to answer the research question, how does the implementation of a professional development centered on Culturally Responsive Mathematics Teaching impact a math teacher’s efficacy in regard to the use of culturally responsive teaching? In order to address the needs and answer the research question, the multiple data results within this mixed-methods action research were collected and analyzed.

When looking at the quantitative data of the pre- and post-professional development questionnaire statements, the following themes were identified as the greatest areas of increase:

(1) a commitment to equity and provide instruction and classroom strategies that result in culturally inclusive and responsive learning environments and academic achievement for all students,

(7) use of communication strategies that are inclusive of the language, dialects, cultural, social and literacy needs of all students (including gender, race, ethnicity, English Language Learners, and students with disabilities), and

(8) teaching students the skills necessary to communicate and engage with diverse groups in ways that support the eradication of discrimination and bias
while mitigating against classroom power imbalances (based on race, ethnicity, gender, identity, ability, and/or socioeconomic status) that perpetuate fear and anxiety of difference (VDOE, 2021).

These three statements were supported by the triangulation of data with the qualitative themes of Theme 8 Teacher Growth Mindset and Theme 7c Student Communication.

**Effectiveness of the Professional Development**

In addition to completing the Likert-scale ranking of the fourteen statements from the pre-intervention questionnaire, the teachers also completed an additional eight statements to identify aspects of the professional development that they deemed to be effective. Similar to the fourteen statements, the participants rated the professional development aspects on a Likert-scale of 6 points. The data was then collected and analyzed to identify the mean (average), median (most frequent) and standard deviation (the range of the responses).

**Table 4.4**

*Participant Responses to Effectiveness of Professional Development*

<table>
<thead>
<tr>
<th>PROFESSIONAL DEVELOPMENT EFFECTIVENESS STATEMENTS</th>
<th>Mean</th>
<th>Median</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Overall, the professional development helped me grow as a <strong>culturally responsive math teacher</strong>.</td>
<td>5.286</td>
<td>6</td>
<td>0.951</td>
</tr>
<tr>
<td>2) Overall, the professional development helped me grow in my <strong>culturally responsive math teaching and lessons</strong>.</td>
<td>5.143</td>
<td>5</td>
<td>0.690</td>
</tr>
<tr>
<td>3) I found the <strong>meeting virtually as math educators</strong> to be instrumental in the effectiveness of the professional development.</td>
<td>5.143</td>
<td>5</td>
<td>0.900</td>
</tr>
<tr>
<td>4) I found the <strong>resources in the meetings</strong> to be instrumental in the effectiveness of the professional development.</td>
<td>5.143</td>
<td>6</td>
<td>1.215</td>
</tr>
</tbody>
</table>
5) I found the **classroom applications** to be instrumental in the effectiveness of the professional development.  

6) I found the **CRMT-TM Lesson Analysis Tool rating** to be instrumental in the effectiveness of the professional development.

7) I found the **CRMT-TM Lesson Analysis Tool reflection responses** to be instrumental in the effectiveness of the professional development.

8) I would **recommend** this professional development to other secondary math educators.

9) Optional: How do you feel this professional development could have been created and implemented to better support you in culturally responsive math teaching? *(short answer only)*

<table>
<thead>
<tr>
<th>Statement</th>
<th>Score</th>
<th>Average</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>5) I found the classroom applications to be instrumental in the effectiveness of the professional development.</td>
<td>5.143</td>
<td>6</td>
<td>1.215</td>
</tr>
<tr>
<td>6) I found the CRMT-TM Lesson Analysis Tool rating to be instrumental in the effectiveness of the professional development.</td>
<td>4.857</td>
<td>5</td>
<td>0.690</td>
</tr>
<tr>
<td>7) I found the CRMT-TM Lesson Analysis Tool reflection responses to be instrumental in the effectiveness of the professional development.</td>
<td>4.857</td>
<td>5</td>
<td>0.900</td>
</tr>
<tr>
<td>8) I would recommend this professional development to other secondary math educators.</td>
<td>5.571</td>
<td>6</td>
<td>0.535</td>
</tr>
<tr>
<td>9) Optional: How do you feel this professional development could have been created and implemented to better support you in culturally responsive math teaching? <em>(short answer only)</em></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: The questionnaire scale scores represent Mean (average) scores based on a Likert-scale of 1 (Strongly Disagree) to 6 (Strongly Agree).

From the eight statements about the professional development, the teachers identified the effectiveness of the professional development as supportive of their growth as a math teacher (with an average of 5.286 on a 1-6 scale) and their recommendation of a professional development like this to other math teachers (average of 5.571). The data identified the themes of meeting together, learning resources, and applying those resources in the classroom to be effective in the professional development, with averages of 5.143. Slightly less effective was the CRMT-TM Lesson Analysis Tool rating and reflection responses, with an average of 4.857.

**4.5 Summary of the Data**

The overall strengths of the professional development were the use of a community of practice of fellow secondary math teachers to collaborate and share ideas, as well as a facilitator who has a math teaching background. On the other hand, throughout the professional development, teachers repeatedly named the following barriers to implementing Culturally Responsive Math Teaching with fidelity: not enough
time in the school day, not enough ready-to-use resources, other challenges within the classroom of attendance and standardized testing taking priority of any other initiative. Additionally, another barrier or challenge was teachers’ desires to use many of the CRMT at the beginning of school, rather than try them out in the 3rd quarter of a 4-quarter school year.

Overall, the participants in the study responded positively to the professional development, desiring for it to be spread out over a longer period of time and with more discussion between learning sessions. Areas of successes included increased awareness, teacher growth mindset, and collaboration with one another. Barriers such as time, resources, and training were a common theme. Overall, teachers desired to learn more about the “mindset” of culturally responsive pedagogy and named engagement in the professional development with fellow math educators to be a valuable community of practice methodology in this professional development.
Chapter 5
Discussion, Implications, & Recommendations

5.1 Overview of Study

This action research addressed the need for professional development on Culturally Responsive Math Teaching (CRMT) for secondary math teachers. The research question addressed how a professional development can impact a teacher’s self-efficacy in culturally responsive pedagogy in secondary mathematics. Participants volunteered for a nine-week professional development that focused on learning CRMT strategies, collaborating with others, applying them within their classrooms, and reflecting on those applications. The study was mixed-methods action research with the researcher acting as the facilitator of the professional development, collecting both qualitative and quantitative data throughout the study.

5.2 How the Research Study Relates to Existing Research

This research study relates to existing research in each of the three theoretical frameworks, as well as the importance of awareness. First, the study aligns with the three theories of the theoretical framework presented in the literature review. The results can be viewed in Table 5.1.
Table 5.1

Research Results through a Theoretical Framework

<table>
<thead>
<tr>
<th>Theoretical Framework</th>
<th>Themes</th>
<th>Areas of Growth</th>
<th>Barriers to Explore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culturally Responsive Math Teaching</td>
<td>Building new material</td>
<td>Awareness of discrepancies</td>
<td>The need to teach students how to have mathematical discourse</td>
</tr>
<tr>
<td></td>
<td>Creating authentic student application</td>
<td>Increase in mathematical discourse</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Using culturally mathematical resources</td>
<td>Attempt for parental involvement</td>
<td></td>
</tr>
<tr>
<td>Social cognitive theory</td>
<td>Teacher beliefs and motivation</td>
<td>Teacher Growth Mindset</td>
<td>Lack of time to digest and apply</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reflections on their own and in small groups</td>
<td></td>
</tr>
<tr>
<td>Situated learning theory</td>
<td>Learning through application</td>
<td>Collaboration with fellow math teachers</td>
<td>Lack of time</td>
</tr>
<tr>
<td></td>
<td>Community of learners</td>
<td>Applying CRMT in classrooms</td>
<td></td>
</tr>
</tbody>
</table>

**Culturally Responsive Math Teaching.** The goal of culturally responsive math teaching is to leverage math learning and help students build bridges to their learning (Aguirre & Zavala, 2013). This data in this study demonstrated teachers were willing to learn and be more aware of discrepancies at a local, state, and national level.

Furthermore, the teachers were willing to apply these strategies to support growth. Teachers increased their use of mathematical discourse and community involvement and were often willing to try again even if they did not entirely accomplish their desired outcome.
Social Cognitive Theory. The purpose of social cognitive theory is for participants to not only learn the theory but to also put that theory into practice through growth of self-efficacy (Bandura 1986; Stajkovic & Luthans, 2002). Throughout the professional development intervention, teachers expressed their willingness and desire to grow in their learning. Through that willingness, the post-questionnaire data revealed a growth in all fourteen CRMT statements when comparing averages, with two statements showing statistical growth trends and three showing statistically significant growth due to the intervention. Teachers voiced their appreciation to work together in a small group with other math professionals, even citing their desire for it to last longer and have more time to connect between sessions.

Situated Learning Theory. Through the lens of situated learning theory, teachers had opportunities for authentic collaboration in a community of practice, along with active application within the classroom (Donaldson et al., 2020). Many of the strategies the teachers tried in the classroom did not immediately yield the desired results on the first attempt. Instead of appearing discouraged or defeated, the teachers would reflect on their own and with content-specific colleagues to collaborate modifications and improvements in order to try again. Teachers had the opportunity to not only put theory into practice by applying CRMT within the classroom, but they also had authentic collaboration with a trusted community to share their growth. Teachers shared the value of learning from one another, often citing their desire to try another person’s strategy within their own classrooms. The teachers were able to make meaning of their learning, practice it in the classroom, reflect on it as a community, and embed it as a regular practice (Wenger 1998).
In addition to the lens of theoretical framework, the research also highlights the importance of the first step of building awareness of culturally responsive pedagogy (Esmail, 2017, University of Michigan, 2021). Jewell (2020) explains that “what we do not know, our lack of information and knowledge, contributes to our prejudices and biases” (p. 36). If this is the case, then our lack of information or awareness may perpetuate bias and stereotypes in the classroom (Haymarket Books, 2020).

The theoretical framework of culturally responsive math teaching, social cognitive theory, and situated learning theory not only laid the foundation for the study, but also its analysis of data and future implications. Through the triangulation of the mixed method data, analysis, and theories, future implications can be made with a greater scope of educational improvement and reform (Almalki, 2016). Each theory provided insight to the study’s themes, as well as the areas of observed growth and barriers to learning, lending supportive material for implications and future actions.

5.4 Implications

Education is a human and civil right, and all students deserve to be educated in a way in which they can cultivate the brilliance within themselves in all they do (Michigan State University, 2021). Educators can often be a gatekeeper or a gateway for a student’s growth and success, especially in mathematics (Aguirre et al., 2013). Unfortunately, math teachers, often unknowingly, can act as gatekeepers with the education of Brown and Black students, resulting in chronic achievement gaps (Haymarket Books, 2020; Jewell, 2020; Hammond, 2015). Hammond (2015) posited there is an epidemic of dependent learners within the school system, who are unprepared to use the cognitive depths within themselves to problem solve and think critically. Providing educators with the “what”
and “how” of culturally responsive pedagogy and neuroscience, while also addressing the most important aspect of the “why,” is necessary in math education to diminish gaps of mathematical achievement for students (Hammond, 2015; Sinek, 2009). The study, application, and collaboration of CRMT concepts would benefit teachers today, especially as the classrooms continue to become more diverse and the achievement gaps among cultures continues to be prevalent (Martin et al., 2014).

This action research sought to answer the question, "How does the implementation of a professional development centered on Culturally Responsive Mathematics Teaching impact a math teacher’s efficacy in regard to the use of culturally responsive teaching?" through the use of a 9-week virtual professional development with secondary math teachers within a school division in Southwest Virginia. Prior to the implementation of the professional development, participants expressed their desire to learn more about CRMT and how it can be easily applied within the secondary math classrooms. Throughout the professional development and analysis of the mixed-methods data, four themes emerged for implications of research: need for correlated resources, need for disaggregating data and communicating disparities, need for small, content-based communities of practice, and need for long-term training and commitment to CRMT implementation.

Need for Correlated Resources. Themes such as a lack of time for teachers to learn and apply CRMT, as well as a lack of readily available resources emerged during the first week of the study. The implications of these results reveal a need for correlated resources of culturally responsive math teaching strategies and curricula in order to support teachers who are new to culturally responsive math teaching. This coordination
of resources could be arranged by state standards, common core, or school pacing guides to best support teachers in following the curriculum guide while having a CRMT mindset and lens through the lessons and activities.

**Need for Disaggregating Data and Communicating Disparities.** Another common theme that emerged during the beginning of the professional development was a lack of awareness of the continuing racial disparities of math achievement at the local, state, and national level, as well as their possible reasonings for those disparities. The implications of these results demonstrate a need for frequent awareness and communication of disparities of math achievement. This awareness should be at each level of school, starting within the classroom and disaggregating data all the way through the national level. School leaders must share directly with teachers any disparities within the school in order to initialize a response to break down any barriers to achievement. Additionally, teachers must learn how to disaggregate their own data within the classroom, so they can use formative and summative feedback to address disparities as soon as possible. If all educators, from classroom teachers to national leaders, looked at achievement data frequently and used it to make data-driven instructional modifications and supports, there may be a lessoning of achievement gaps compared to past decades.

**Need for Small, Content-Based Communities of Practice.** During the 9-week professional development, teachers expressed an appreciation for collaboration and reflection emerged from the participants. The participants explained a thankfulness to meet with other secondary math teachers to learn, collaborate, and brainstorm new strategies to support culturally responsive math teaching, validating the importance of professional learning communities when learning new material. During those meetings,
teachers honestly reflected on both the successes and trials of applying CRMT within their secondary math classrooms, without hesitation of judgment or condemnation. These results imply a need for professional development to be conducted in small, content-based communities of practice when teachers are learning new material, especially in regard to culturally responsive pedagogy. By having a small group focused on a common goal in a common content area, the participants were more likely to share openly and honestly.

**Need for Long-Term Training and Commitment to CRMT.** At the end of the study, after all data was compiled and analyzed from pre-intervention and post-intervention questionnaires, transcripts of PD sessions, individual reflection journals, and a focus group interview, the professional development revealed a positive impact in each participant’s efficacy regarding the use of CRMT. All teachers scored themselves higher after the professional development on the post-intervention questionnaire regarding their understanding and use of culturally responsive math teaching. During their optional short answers on the post-questionnaire, many participants explained a desire to learn more about CRMT and its application after the PD had concluded. As a result, an implication to this study is the need for a long-term commitment in order to train and apply culturally responsive math teaching at the secondary level. Participants expressed a desire for a full-year PD, with frequent opportunities to reflect and collaborate with fellow math teachers, in order to best improve their CRMT practices. School leadership and facilitators of professional development should consider these needs when teaching and expecting culturally responsive pedagogy in the classroom.
5.5 Action Plan to Address Problem of Practice

This action research study identified key aspects of professional development which supported a growth in self-efficacy in CRMT, as well as aspects that need to continue to be developed. The study sought to identify the Problem of Practice (PoP) of racial disparity in mathematical achievement, as well as the need to build teacher efficacy, in regard to their confidence and skills of implementation, in culturally responsive math teaching (CRMT). The following needs were identified to support teacher development in CRMT:

- A need to foster higher levels of understanding culturally responsive math teaching (Aguirre & Zavala, 2013; Gay, 2009; Kumar 2021; NCTM, 2020; VDOE, 2021).
- A need to work collaboratively together as math teachers to critically reflect how to effectively incorporate culturally responsive math teaching (Aguirre, 2009; Bonner & Adams, 2012; Schunk & DiBenedetto, 2020).
- A need to implement culturally responsive math instructional strategies and lessons with fidelity (Bonner, 2021; Kitchen, 2005; Copur-Gencturk et al., 2019; NCTM, 2020).

First, teachers felt more confident in the knowledge and understanding of CRMT, as represented by the data and analysis. Hammond (2015) described the importance of culturally responsive pedagogy to be viewed as a mindset, grounded in brain-based principles to guide culturally responsive teaching. This professional development action research demonstrated the ability for teachers to learn this mindset, as well as their continued desire to grow in this area. The teachers explained their desire to do the
training again, but over a 36-week session rather than a 9-week session. Their understanding of CRMT sparked a desire to learn more and implement more frequently in their classroom.

Secondly, teachers voiced the effectiveness of the professional development consisting of a small group of secondary math teachers in a virtual setting. The use of the professional development on CRMT was structured in the way that everyone had opportunities to share, listen, and engage with the material and each other with fidelity and accountability (Esmail et al., 2017). Using the intentional setting of content-based teachers enhanced the learning, collaborating, applying, and reflecting process of the professional development. Due to the small group intimacy of the setting, the participants shared they could be more authentic in their reflection of CRMT, including the barriers and challenges of learning and applying CRMT within the classroom regularly and with fidelity. For the next action steps, the participants adequately described their desire for more resources, training, and time to collaborate within a similar setting.

Thirdly, the analysis of the data revealed teachers were able to identify the ultimate goal for learning and applying culturally responsive math teaching: to empower students to develop as self-directed learners (Hammond, 2015). Throughout the professional development, teachers implemented strategies which were at times effective and at times not effective. The process of application and reflection within the professional development provided a space and method for teachers to reflect on how the implementation could be improved for the next application. Additionally, while teachers demonstrated a desire to implement CRMT more in the future, they appreciated taking the first steps of implementation within the safe environment of a small group of
educators who understood the practicality of implementation within the secondary math classroom setting. Participants sited their need for more application of CRMT strategies and mindset, being aware of the positive results of students better connecting to the material, with higher mastery of concepts and deeper development of skills to critically problem solve.

5.6 Recommendations for Future Research

This action research skimmed the surface addressing the need for culturally responsive math teaching in secondary education and how to effectively train and support teachers to build efficacy in CRMT. The research was limited to one school system in southwest Virginia, with only seven participants involved in secondary mathematics. Based on the mixed-methods data and analysis, more research could be conducted in the following three areas to continue addressing the problem of practice of disparities within math education and the need for culturally responsive math teaching: CRMT resources, CRMT training, and CRMT community partnerships.

**CRMT Resources.** Future research is needed to identify methods for correlating CRMT resources within the state and/or federal curriculum guides. Participants demonstrated a desire to know what resources were already created within a mindset of CRMT, as well as how those resources can naturally align with the federal and/or state guidelines of their math curriculum. Due to the barriers of time and testing, having a bank of resources for immediate classroom application could improve the frequency and fidelity of CRMT implementation within the secondary math classroom.

**CRMT Training.** Future research is needed to identify effective settings and length of CRMT training, as well as the professional development process. The
participants expressed a desire for the professional development to have been longer than 9 weeks, with frequent interactions with other math teachers. The teachers described the need to feel safe and connected through like-minded content teachers, supporting research that the brain feels safest and relaxed when there is a connection of trust between people (Hammond, 2015; Esmail et al., 2017). Therefore, future research is needed to identify the setting and participants for best practices of training secondary math teachers to apply CRMT with fidelity and frequency.

Additionally, future research could also explore effective processes for training teachers with CRMT. Bryk (2014) challenged educators to avoid the pitfall of being a “solutionist” by jumping to a policy or program. It is important for teachers to intrinsically believe CRMT as best practices within their classroom mindset, rather than another program or checklist item in their lesson plan (NCTM, 2020; Aguirre et al., 2013). Therefore, more research is needed to identify CRMT training processes which support teachers to address cultural disparities within the classroom and provide training which will result in student improvement and decreased disparities.

CRMT Community Partnerships. Finally, a third recommendation for future research is to identify methods to authentically build community partnerships within each school community. Teachers desired to understand more about their students and families, with community collaboration, which requires time and intentional effort (Sanders & Galindo, 2014). Therefore, more research needs to be conducted to identify ways to effectively build community partnerships with the time and testing constraints current public American teachers face daily.
5.7 Results and Summary of the Study

In this action research study, within a school division of southwest Virginia, seven math secondary teachers participated in a 9-week professional development. Through their time, data was collected both quantitatively and qualitatively to better understand each teacher’s self-efficacy in their perception of understanding and using CRMT within the classroom. The study found teachers desired time, collaboration, practice, and resources to best embed CRMT within their curriculum. The barriers of time, curriculum demands, and lack of resources inhibited the application of CRMT within the classroom. Further research is needed to best understand how to provide secondary math teachers with the resources, training, and community partnerships to effectively embed CRMT with fidelity throughout their classroom practices.
References


https://www.nature.com/articles/nrn3800


https://doi.org/10.3102/0013189X025004005


https://ate1.org/resources/Documents/Standards/1A%20TE%20Standards%20-%20color.pdf

Ballenger, J., & Kemp-Graham, K. (2014). Assessing the level of cultural competence and mentoring experiences of educational leaders and identifying strategies for culturally and globally competent leadership: Building community through global
educational leadership. National Council of Professors of Education Administration.


https://doi.org/10.3102/0013189X15621543


Feynman, R. [@ProfFeynman](https://twitter.com/ProfFeynman). (n.d.). Tweets [Twitter profile]. Retrieved February 8, 2019 from [https://twitter.com/ProfFeynman/status/1093907464842633219?s=20](https://twitter.com/ProfFeynman/status/1093907464842633219?s=20).


Gutiérrez, R. (2009). Framing equity: Helping students “play the game” and “change the game.” *Teaching for excellence and equity in mathematics, 1*(1), 4-8.


https://sjunkins.wordpress.com/2016/11/21/depth-of-knowledge-in-the-content-areas/


Likert, R. (1932). A technique for the measurement of attitude scales.


https://doi.org/10.31274/isudp.2020.57


Mayfield, V. (2020). *Cultural competence now: 56 exercises to help educators understand and challenge bias, racism, and privilege*. ASCD.


https://www.youtube.com/watch?v=gq8GEEHzLa4&t=1290s


Nasir, N. S., & Cobb, P. (2007). Equity in students’ access to significant mathematical ideas. *TCP*.

Education Sciences. Retrieved [2023, June 8], from
https://nces.ed.gov/programs/coe/indicator/clr

Schools. Condition of Education. U.S. Department of Education, Institute of
Education Sciences. Retrieved [2023, June 8], from
https://nces.ed.gov/programs/coe/indicator/cge

National Council of Teachers of Mathematics. (2020). Catalyzing change in middle
school mathematics: Initiating critical conversations. National Council of
Teachers of Mathematics.

OECD (2018). Programme for international student assessment (PISA) results from PISA
2018: United States [pdf]. Organisation for Economic Co-operation and

Pearson.

Osler, J. (2007). A guide for integrating issues of social and economic justice in

Owen, S. (2016). Professional learning communities: Building skills, reinvigorating the
passion, and nurturing teacher wellbeing and “flourishing” within significantly


Shafer, L. (2016, June 2). Mathematics, everywhere for everyone: Bridging the gap between math in the classroom and math at home -- for all families [Research Stories]. *Usable Knowledge*  
https://www.gse.harvard.edu/news/uk/16/06/mathematics-everywhere-everyone


https://doi.org/10.3102/0013189X20912758


https://doi.org/10.1080/1356251990040202


Appendix A:

Overview of Professional Development Design

Table A.1

*Professional Development Design Plan*

<table>
<thead>
<tr>
<th>Week</th>
<th>Participants will do the following...</th>
<th>With the purpose of...</th>
<th>Research data collected will be...</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Learn about the study</td>
<td>Teachers learn about study, review consent form, and sign up electronically on Google Form (study) and Unified Talent (PD)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Pre- Intervention Questionnaire</td>
<td>Complete survey to self-assess teachers’ perceived abilities of culturally responsive teaching</td>
<td>Pre-Intervention Questionnaire</td>
</tr>
<tr>
<td>2</td>
<td>Attend Meeting #1</td>
<td>Welcome to PD</td>
<td>Video Transcript #1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Explain Professional Development Set Group Norms Go over pre-PD questionnaire average data Decide areas of CRMT to focus on during the next meetings</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Attend Meeting #2</td>
<td>Reflect on classroom practice and reflections Explore new practices (and resources) and compare to current practices Collaborate new strategies within secondary math Plan a lesson or activity to try</td>
<td>Video Transcript #2</td>
</tr>
<tr>
<td>4</td>
<td>Application with Reflection Journal</td>
<td>Practice any of the strategies discussed in recent meetings. Share findings in reflection journal.</td>
<td>Reflection Journal</td>
</tr>
<tr>
<td>5</td>
<td>Attend Meeting #3</td>
<td>Reflect on classroom practice and reflections Explore new practices (and resources) and compare to current practices Collaborate new strategies within secondary math Plan a lesson or activity to try</td>
<td>Video Transcript #3</td>
</tr>
<tr>
<td>6</td>
<td>Application with Reflection Journal</td>
<td>Practice any of the strategies discussed in recent meetings. Share findings in reflection journal.</td>
<td>Reflection Journal</td>
</tr>
</tbody>
</table>
| 7  | **Attend Meeting #4** | Reflect on classroom practice and reflections  
Explore new practices (and resources) and compare to current practices  
Collaborate new strategies within secondary math  
Plan a lesson or activity to try | Video Transcript #4 |
| 8  | **Application with Reflection Journal** | Practice any of the strategies discussed in recent meetings. Share findings in reflection journal. | Reflection Journal |
| 9  | **Attend Meeting #5** | Reflect on classroom practice and reflections  
Explore new practices (and resources) and compare to current practices  
Collaborate new strategies within secondary math  
Plan a lesson or activity to try | Focus Group Video Transcript |
| 9  | **Post-Intervention Survey** | Complete post-PD questionnaire, self-assessing the teachers’ perceived abilities of culturally responsive teaching, as well as the effectiveness of the different aspects of the Professional Development | Post-Intervention Questionnaire |
Appendix B:

(needs a descriptive title)

PURSUITING CULTURALLY RESPONSIVE MATH TEACHING PD

Secondary Math Educators are invited to participate in a 10-pt Professional Development (and optional research) centered on culturally responsive math teaching (CRMT)

- Five virtual meetings after school, from 3:15-4:15pm
- Learn evidence-based culturally responsive math teaching (CRMT) strategies that have worked in secondary math
- Collaborate and plan together with fellow math teachers
- Choose which culturally responsive topics to focus on
- Choose how you want to apply CRMT in your classroom
- Keep a reflection journal of any modality throughout the PD
- Collect evidence for the "new" Standard 6 goal
- Runs 3rd quarter from Jan 9 - Mar 10

Interested? Sign-up here

*Confidentiality Disclaimer. The data collected in this research study will be kept confidential, with all participants, schools, and division having a pseudonym. While the information and data resulting from this study may be presented at scientific meetings or published in a scientific journal, personal information will not be revealed.
Appendix C:
(needs a descriptive title)

MCPS Secondary Math Educators (teachers and instructional coaches),

You are invited to participate in a research study titled “Pursuing Culturally Responsive Math Teaching: A Professional Development Action Research Study”. The purpose of this action research is to measure the effectiveness of the “Pursuing Culturally Responsive Math Teaching (CRMT)” Professional Development on teacher efficacy in developing culturally responsive pedagogy. It is a 9-week professional development, consisting of five virtual meetings where secondary math educators will learn together, collaborate, and plan together based on specific math strategies. Teachers will then practice CMRT application in the classroom and keep a reflection journal. Finally, participants will complete a pre-intervention questionnaire and a post-intervention questionnaire. Participants in this study will receive 10 professional development points through the school division through Unified Talent.

To protect participants’ confidentiality and privacy throughout the action research, I will use a pseudonym for each participant, each school, and the entire school division. Taking part of this study is completely voluntary. At any point in the study, you may ask for your information not to be included in the action research study.

The direct benefits for participants include being exposed to culturally responsive math teaching resources, having time and space to collaborate with secondary math educators throughout the school division, and to collect evidence to support their portfolio for Standard 6, “Culturally Responsive and Equitable Practices”. Additionally, possible indirect benefits for participants may include opportunities for self-reflection to better understand one’s teacher identity, deeper connections among math colleagues in the school division, and increased confidence to implement culturally responsive mathematics teaching. No risks are anticipated from participating in this research.

Video recording will be available for each Google Meet virtual meeting in case a participant has to miss a meeting and watch the video later. The researcher will only collect the transcripts from the fifth and final meeting, since it will be a focus group interview, asking participants for suggestions for future professional development and research. All videos will be deleted 12 months after the study.

If you have any questions, you may contact Emily Redding at emilyredding@mcps.org or 540-466-4646. If you have any concerns regarding your rights in this study, you may contact the Institutional Review Board (IRB) at 607-255-5138 or access their website at https://researchservices.cornell.edu/offices/IRB.

Please complete the electronic waiver of consent if you choose to participate in the Professional Development and/or the Action Research.

Sincerely,

Emily Redding
Appendix D:

Pursuing Culturally Responsive Math Teaching PD Content

All virtual meetings will include content excerpts from
- Enhancing the common core with culturally responsive mathematics teaching: Key principles and strategies (Aguirre, 2015),
- CRMT™ Lesson Analysis Tool (TEACH MATH, 2012), and
- The impact of identity in K-8 mathematics learning and teaching: Rethinking equity-based practices (Aguirre et al., 2013)

Additionally, the following resources will be used in relation to the different categories of CRMT:

(1) Cognitive Demand: Levels of Cognitive Demand (Leinwald et al., 2014) and Levels of Cognitive Demand (North Carolina Collaborative for Mathematics Learning, 2018).

(2) Depth of Knowledge & Student Understanding: Rich Mathematical Tasks (VDOE, 2016) and Depth of Knowledge in Math (Junkins, 2016)

(3) Mathematical Discourse: Levels of Classroom Discourse (VDOE, 2018) and Secondary Number Talks (I’ll convince you with ducks) (Van Der Werf, 2016).


(5) Academic Language: 7 Strategies for Teaching Math to English Language Learners (Blankman, 2021), 10 Ways to help ELL Succeed in Math (Bresser et al., 2008), and the school division website resource ELlevation Math Collections.

(6) Cultural Funds of Knowledge: Mathematics, Everywhere for Everyone (Shafer, 2016) and Mathematical Mindsets: Unleashing Students’ Potential through Creative Math, Inspiring Messages and Innovative Teaching (Boaler, 2022)

Resources:
s_3-8_Mathematical_Practices/NCTM2015_Grade3-5Institute_Aguirre_Keynote_CRMT5.pdf


Appendix E:

Pre-Professional Development Questionnaire

**Section 1: Overview of Questionnaire**

Please take 15 minutes in a quiet place to complete the following questionnaire. There are no right or wrong answers, and your honest and authentic responses will be appreciated.

The first four questions are background questions. Then, the next two sections will cover the following:

1. 8 statements self-assessing different culturally responsive aspects of you as a math teacher
2. 6 statements self-assessing different culturally responsive aspects of your math lessons

*For each statement, you will rate the statement with the following rating scale: “1=Strongly Disagree, 2=Disagree, 3=Slightly Disagree, 4=Slightly Agree, 5=Agree, and 6=Strongly Agree”. After each ranking, there is optional space to explain why you chose that ranking.*

If you have any questions about the survey questions, contact Emily Redding at emilyredding@xxxx.org

**Section 2: Background Information**

*Directions: Please answer the following background questions to the best of your comfort level:*

1. Years of Teaching (including current year)
2. Number of schools taught in teaching career (including current school):
3. Number of states (including current one of Virginia) you have worked in during your professional career as an educator (If you taught outside of the United States, include each country you have taught in as a “state” in your count):
4. Your Ethnicity (optional):

**Section 3: AS A MATH TEACHER...**

*Directions: Rank the following statements on a scale of 1 to 6, with “1=Strongly Disagree, 2=Disagree, 3=Slightly Disagree, 4=Slightly Agree, 5=Agree, and 6=Strongly Agree”. After each ranking, there is optional space to explain why you chose that ranking.*

1. I demonstrate a commitment to equity and provide instruction and classroom strategies that result in culturally inclusive and responsive learning environments and academic achievement for all students.
2. I disaggregate assessment, engagement, behavioral, and attendance data by student groups and identify and apply differentiated strategies to address growth and learning needs of all students with specific attention to students within gap groups.
3. I foster classroom environments that create opportunities for access and achievement by acknowledging, valuing, advocating, and affirming cultural and social diversity in all aspects of the learning process, including for gender, race, ethnicity, English Language Learners, and students with disabilities.
4. I build meaningful relationships with all students anchored in affirmation, mutual respect and validation utilizing culturally responsive teaching practices, and by modeling high expectations for all students.
5. I utilize inclusive curriculum and instructional resources that represent and validate diversity from all rings of culture that include generational, gender, religion, class, nationality, race, ethnicity, native language, ability, and sexuality by connecting classroom curriculum and instruction to the cultural examples, experiences, backgrounds, and traditions of all learners.
6. I analyze, select, and integrate texts, materials, and classroom resources that reflect cultural inclusivity and the needs of all students, including for gender, race, ethnicity, English Language Learners, and students with disabilities.

7. I use communication strategies that are inclusive of the language, dialects, cultural, social and literacy needs of all students (including gender, race, ethnicity, English Language Learners, and students with disabilities).

8. I teach students the skills necessary to communicate and engage with diverse groups in ways that support the eradication of discrimination and bias while mitigating against classroom power imbalances (based on race, ethnicity, gender, identity, ability, and/or socioeconomic status) that perpetuate fear and anxiety of difference.

Section 4: MY MATH LESSONS...
Directions: Rank the following statements on a scale of 1 to 6, with “1=Strongly Disagree, 2=Disagree, 3=Slightly Disagree, 4=Slightly Agree, 5=Agree, and 6=Strongly Agree”. After each ranking, there is optional space to explain why you chose that ranking. Note: The term “regularly” means “a constant or definite pattern” (Oxford, 2022)

1. My math lessons regularly enable students to closely explore and analyze math concepts(s), procedure(s), and reasoning strategies.

2. My math lessons regularly make student thinking/understanding visible and deep.

3. My math lessons regularly create opportunities to discuss mathematics in meaningful and rigorous ways (e.g. debate math ideas/solution strategies, use math terminology, develop explanations, communicate reasoning, and/or make generalizations).

4. My math lessons regularly distribute math knowledge authority, value student math contributions, and address status differences among students.

5. My math lessons regularly provide academic language support for English Language Learners. My math lessons regularly help students connect mathematics with relevant/authentic situations in their lives. Questions adapted from VDOE, 2021 and TEACH MATH, 2012.
Appendix F:

Post-Professional Development Questionnaire

Section 1: Overview of Questionnaire
Please take 15 minutes in a quiet place to complete the following questionnaire. There are no right or wrong answers, and your honest and authentic responses will be appreciated.

There will be three sections to this Post-PD Questionnaire:
1. 8 statements self-assessing different culturally responsive aspects of you as a math teacher
2. 6 statements self-assessing different culturally responsive aspects of your math lessons
3. 8 statements assessing the effectiveness of the professional development.

For each statement, you will rate the statement with the following rating scale:
“1=Strongly Disagree, 2=Disagree, 3=Slightly Disagree, 4=Slightly Agree, 5=Agree, and 6=Strongly Agree”
After each ranking, there is optional space to explain why you chose that ranking.

If you have any questions about the survey questions, contact Emily Redding at emilyredding@xxxx.org

Section 2: AS A MATH TEACHER...
Directions: Rank the following statements on a scale of 1 to 6, with “1=Strongly Disagree, 2=Disagree, 3=Slightly Disagree, 4=Slightly Agree, 5=Agree, and 6=Strongly Agree”. After each ranking, there is optional space to explain why you chose that ranking.

8. I demonstrate a commitment to equity and provide instruction and classroom strategies that result in culturally inclusive and responsive learning environments and academic achievement for all students.
9. I disaggregate assessment, engagement, behavioral, and attendance data by student groups and identify and apply differentiated strategies to address growth and learning needs of all students with specific attention to students within gap groups.
10. I foster classroom environments that create opportunities for access and achievement by acknowledging, valuing, advocating, and affirming cultural and social diversity in all aspects of the learning process, including for gender, race, ethnicity, English Language Learners, and students with disabilities.
11. I build meaningful relationships with all students anchored in affirmation, mutual respect and validation utilizing culturally responsive teaching practices, and by modeling high expectations for all students.
12. I utilize inclusive curriculum and instructional resources that represent and validate diversity from all rings of culture that include generational, gender, religion, class, nationality, race, ethnicity, native language, ability, and sexuality by connecting classroom curriculum and instruction to the cultural examples, experiences, backgrounds, and traditions of all learners.
13. I analyze, select, and integrate texts, materials, and classroom resources that reflect cultural inclusivity and the needs of all students, including for gender, race, ethnicity, English Language Learners, and students with disabilities.
14. I use communication strategies that are inclusive of the language, dialects, cultural, social and literacy needs of all students (including gender, race, ethnicity, English Language Learners, and students with disabilities).
15. I teach students the skills necessary to communicate and engage with diverse groups in ways that support the eradication of discrimination and bias while mitigating against classroom power imbalances (based on race, ethnicity, gender, identity, ability, and/or socioeconomic status) that perpetuate fear and anxiety of difference.
Section 3: MY MATH LESSONS...
Directions: Rank the following statements on a scale of 1 to 6, with “1=Strongly Disagree, 2=Disagree, 3=Slightly Disagree, 4=Slightly Agree, 5=Agree, and 6=Strongly Agree”. After each ranking, there is optional space to explain why you chose that ranking. Note: The term “regularly” means “a constant or definite pattern” (Oxford, 2022)

1. My math lessons regularly enable students to closely explore and analyze math concepts(s), procedure(s), and reasoning strategies.
2. My math lessons regularly make student thinking/understanding visible and deep.
3. My math lessons regularly create opportunities to discuss mathematics in meaningful and rigorous ways (e.g. debate math ideas/solution strategies, use math terminology, develop explanations, communicate reasoning, and/or make generalizations).
4. My math lessons regularly distribute math knowledge authority, value student math contributions, and address status differences among students.
5. My math lessons regularly provide academic language support for English Language Learners.
6. My math lessons regularly help students connect mathematics with relevant/authentic situations in their lives.

Section 4: MY PROFESSIONAL DEVELOPMENT EXPERIENCE
Directions: Rank the following statements on a scale of 1 to 6, with “1=Strongly Disagree, 2=Disagree, 3=Slightly Disagree, 4=Slightly Agree, 5=Agree, and 6=Strongly Agree”. After each ranking, there is optional space to explain why you chose that ranking.

Overall, the professional development...

1. Overall, the professional development helped me grow as a culturally responsive math teacher.
2. Overall, the professional development helped me grow in creating culturally responsive math lessons.
3. Overall, my mindset has shifted to pursue more culturally responsive math teaching opportunities.
4. I would recommend this specific professional development to other secondary math teachers who would like to grow in culturally responsive math teaching.

For the effectiveness of the professional development:

5. Meeting virtually with other math educators contributed to the effectiveness of this professional development experience.
6. The CRMT resources shared with me in the meetings contributed to the effectiveness of this professional development experience.
7. Applying the CRMT resources and strategies in my classroom contributed to the effectiveness of this professional development experience.
8. Keeping a reflection journal contributed to the effectiveness of this professional development experience.
9. Reflecting with other math educators on my application of the CRMT resources and strategies in my classroom contributed to the effectiveness of this professional development experience.

For my growth in culturally responsive mathematics teaching:

10. Meeting virtually with other math educators supported my growth in culturally responsive math teaching.
11. The CRMT resources shared with me in the meetings supported my growth in culturally responsive math teaching.
12. Applying the CRMT resources and strategies in my classroom supported my growth in culturally responsive math teaching.
14. Reflecting with other math educators on my application of the CRMT resources and strategies in my classroom supported my growth in culturally responsive math teaching.

Optional: How do you feel this professional development could have been created and implemented to better support you in culturally responsive math teaching?
Questions adapted from VDOE, 2021 and TEACH MATH, 2012.
Appendix G:

Culturally Responsive Math Teaching Guided Reflection Journal Prompts

Note: Journal entries can be hand-written, typed, audio, or visual per the preference of the participant.

After applying a culturally responsive math teaching (CRMT) strategy in a math lesson or activity, take some time to respond to the following reflection prompts.

1. How did you apply CRMT to your math lesson/instruction?
2. What worked well?
3. What didn’t work well?
4. What surprised you?
5. How did the students respond?
6. How would you do it differently?

If you were focusing on one of the six CRMT categories, as defined by TEACH MATH (2013), you can also consider reflecting on the following reflection prompts for each category:

<table>
<thead>
<tr>
<th>CRMT Category</th>
<th>CRMT Reflection Prompts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive Demand</td>
<td>How does my lesson enable students to closely explore and analyze math concepts(s), procedure(s), and reasoning strategies?</td>
</tr>
<tr>
<td>Depth of Knowledge &amp; Student Understanding</td>
<td>How does my lesson make student thinking/understanding visible and deep?</td>
</tr>
<tr>
<td>Mathematical Discourse</td>
<td>How does my lesson create opportunities to discuss mathematics in meaningful and rigorous ways (e.g. debate math ideas/solution strategies, use math terminology, develop explanations, communicate reasoning, and/or make generalizations)?</td>
</tr>
<tr>
<td>Power and Participation</td>
<td>How does my lesson distribute math knowledge authority, value student math contributions, and address status differences among students?</td>
</tr>
<tr>
<td>Academic Language Support for ELL</td>
<td>How does my lesson provide academic language support for English Language Learners?</td>
</tr>
<tr>
<td>Cultural/Community-based funds of knowledge</td>
<td>How does my lesson help students connect mathematics with relevant/authentic situations in their lives?</td>
</tr>
</tbody>
</table>
Appendix H:

Culturally Responsive Math Teaching Focus Group Interview

(Final Meeting)

During the fifth meeting, the following questions were asked of participants in a focus group interview:

1. What do you see as the factors for the racial discrepancy of achievement for Black and Hispanic students?
2. What do you think are specific ways math teachers can address this issue of the racial discrepancy of achievement for Black and Hispanic students?
3. What are the barriers of using culturally responsive math teaching in your classroom?
4. What are the benefits of using culturally responsive math teaching in your classroom?
5. What steps, if any, would you like to do next to grow in your understanding and use of culturally responsive math teaching in your classroom?
6. What resources do you need to grow in culturally responsive math teaching?

Feel free to share any group takeaways from this professional development time.