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DePaul University
College of Education

**A Spotlight on Teachers' Culturally Sustaining Beliefs and Responsive Practices
for Students of Color in Mathematics**

A Dissertation in Education
With a Concentration in Educational Leadership

by

Susan J. Ejma

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Submitted in Partial Fulfillment
of the Requirements for the Degree of
Doctor of Education

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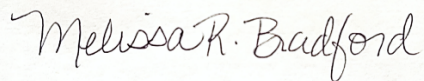
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Certification of Authorship

I certify that I am the sole author of this dissertation. Any assistance received in the preparation of this dissertation has been acknowledged and disclosed within it. Any sources utilized, including the use of data, ideas and words, those quoted directly or paraphrased, have been cited. I certify that I have prepared this dissertation according program guidelines as directed.

Author Signature *Susan J. Ejma* Date 5/5/23

Abstract

School leaders and educators across the country are striving to improve instruction for ethnically, culturally, and socio-economically diverse students for long term learning and growth. For years, researchers and scholars praised the tenets of culturally responsive instruction as the solution to meeting the needs of this growing diversity in schools. Unfortunately, many students from ethnically and culturally diverse communities do not have schooling experiences that validate and affirm their knowledge. Culturally responsive teaching is still an area that is under researched, specifically in mathematics. Drawing on the theoretical lens of culturally responsive pedagogy, this mixed methods case study aimed to gain a deeper understanding of mathematics teachers who have culturally sustaining beliefs of their students of color. The study collected information on their planning and implementation of culturally responsive practices and sought to learn about what contributes to or limits their practices on a daily basis. A survey was administered to mathematics teachers in a suburban public school district in the Midwest to identify participants for an interview. Six 3rd-5th grade teachers were interviewed and the findings were organized around six major elements tied to the Culturally Responsive Framework. Overall, the findings illuminated some aspects of the Framework as well as areas of continued growth. Two areas of significance were districtwide culturally responsive training and a newly adopted math curriculum and its impact on the teachers' use of culturally responsive practices. The findings may provide guidance to district leadership on district initiatives and the alignment with other areas of focus, such as culturally responsive training and adopting new curriculum.

Keywords: Culture, culturally responsive teaching, ethnically, culturally, and socio-economically diverse learners

Table of Contents

Table of Figures	vii
List of Tables	viii
Acknowledgements	ix
Chapter 1: Introduction	1
Problem Statement.....	3
Definition of Terms	4
Study Objective	4
Research Questions	5
Overview of Methodology and Rationale	5
Significance of Study	7
Chapter 2: Literature Review	8
Literature Review Process.....	8
Student Outcomes.....	9
Teacher Beliefs.....	12
Teacher Practices.....	15
Gaps in the Literature	19
Teachers’ Attitudes and Expectations	20
Teacher Use of Culturally Responsive Teaching Practices within Mathematics	21
Factors that Contribute to and Limit Teachers’ Use of Culturally Responsive Practices	22
Summary.....	23
Theoretical Framework	23
Foundational Pillars of Culturally Responsive Teaching.....	25
Teachers’ Attitudes and Expectations	25
Cultural Communication	28
Diverse Content in the Curriculum	30
Culturally Congruent Instruction	32
Chapter 3: Methodology	35
Overview	35
Goals and Research Questions	35
Mixed Method Case Study Design.....	36
Overview	36
Survey Research.....	38
Interviews	39
Documents.....	41
Rationale.....	42
Research Site	43
Participants	44
Sampling Frame and Sampling	45
Procedures	46
Recruitment and Teacher Sample	46
Instrumentation	48
Data Collection	51
Data Analysis	53
Trustworthiness	53
Researcher Positionality	54

Summary.....	55
Chapter 4: Findings	57
Introduction	57
Survey Participants and Survey Findings.....	57
Overview of Elements	64
Research Question #1: What are Teachers’ Attitudes and Expectations About Supporting Their Students’ Ethnic, Cultural, and Socioeconomic Diversity in Mathematics?	67
Teachers’ Attitudes & Expectations	67
Research Question #2: What Ways, if Any, Do Teachers Who Have Culturally Sustaining Beliefs Use Culturally Responsive Teaching Practices in Mathematics?	75
Cultural Communication	75
Diverse Content in Curriculum	78
Cultural Congruent Instruction	86
Research Question #3: What Limits or Contributes to a Teachers’ Use of Culturally Responsive Teaching Practices in Mathematics?.....	92
Factors that Contribute Teachers’ Use of Culturally Responsive Teaching	92
Factors That Limit Teachers’ Use of Culturally Responsive Teaching	94
Summary of Findings	95
Chapter 5: Discussion	97
Introduction	97
Summary.....	97
Discussion.....	98
Teachers’ Attitudes & Expectations	98
Newly Adopted Curriculum	101
Limitations.....	103
Implications	103
Recommendations	106
Conclusion.....	108
References	110
Appendix A: Culturally Responsive Framework	120
Appendix B: Survey	132
Appendix C: Individual Interviews	150
Appendix D: Mondrian’s Art Lesson	160
Appendix E: Student Assessments	167

Table of Figures

FIGURE 1.1: FOUNDATIONAL PILLARS	25
FIGURE 2.1: METHODS DESIGN	37
FIGURE 3.1: SAMPLING FRAME AND SAMPLING	46
FIGURE 4.1: SAMPLE TEACHER BELIEFS SURVEY RESPONSE ABOUT LEARNERS IN MATH (N=17)	59
FIGURE 5.1: SAMPLE SURVEY PARTICIPANT RESPONSES ABOUT SUCCESS IN MATHEMATICS (N=17).....	60
FIGURE 6.1: SAMPLE PARTICIPANT SURVEY RESPONSES ON PLANNING & IMPLEMENTING MATH (N=17).....	63
FIGURE 7.1: EXAMPLE OF LANGUAGE BEND	77
FIGURE 8.1: EXAMPLE OF LESSON PLAN	81
FIGURE 9.1: EXAMPLE END OF UNIT ASSESSMENT DATA	84
FIGURE 10.1: EXAMPLE OF ASSESSMENT QUESTIONS	84
FIGURE 11.1: EXAMPLE LESSON PLAN WITH GROUPINGS	88
FIGURE 12.1: EXAMPLE LESSON PLAN WITH STUDENT RESPONSES	91

List of Tables

TABLE 1.1: QUANTITATIVE SURVEY PARTICIPANTS (N=17)	58
TABLE 2.1: SAMPLE PARTICIPANT RESPONSES ON IMPLEMENTATION OF MATHEMATICAL PRACTICES (N=17)	61
TABLE 3.1: SUMMARY OF QUALITATIVE PARTICIPANTS (N=6)	64
TABLE 4.1: OVERVIEW OF SIX ELEMENTS AND RESPONSES	65

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Chapter 1: Introduction

Classrooms across the US continue to increase in ethnic, cultural, linguistic, and socio-economic diversity. The National Center for Education Statistics (NCES) reported a racial/ethnic redistribution across public schools from the fall of 2017 to the fall of 2020. Students who are White decreased from 61% to 48% in three years (NCES, 2020). While diversity of learners continues to increase through the years, that of teachers is not expected to change much given that most students enrolled in teacher education programs are typically female, White and of middle-class background (Cochran-Smith, 2003; McVee & Boyd, 2016; Sleeter, 2012). Many teachers are not adequately prepared to teach in classrooms with such varying needs.

There are differences in standardized achievement scores for ethnically diverse learners such as African American, Latinx, Asians, and Native Americans compared to European Americans. Research shows these differences are the result of the quality of instruction and not students' ability to learn (Boykin & Noguera, 2011; Sato & Lensmire, 2009; Wachira & Mburu, 2017). Sato and Lensmire (2009) speak to this by saying, "Children coming from homes with lower socio-economic status are being identified and labeled with grossly overgeneralized, deficit-laden characteristics that put them at risk of being viewed as less capable, less cultured, and less worthy as learners" (p. 365). Inaccurate understanding and reporting of results on assessments reinforce deficit views about ethnically, culturally, and socio-economically diverse learners that creates a cycle of low expectations for students and about teaching. As a result of these deficit views, there is a disparity in access to high quality instruction between students of color and their white peers.

The assessment data does not reveal a child's culture, community and identity that could offer a deeper understanding of them as a learner. Lemons-Smith (2008) points out, "educators in

the education community must learn how to ‘value the cultural and lived experiences of all children’ ...[and emphasize] the belief that all children possess strong intellectual capacity and bring a wealth of informal, out-of-school knowledge to the teaching and learning process” (p.912). There are many reasons for the need for more culturally responsive teaching practices, but one trend that continually stands out is the educational demographic shifts, growth, and achievement patterns of students. School achievement opportunity gaps based on economic, racial, cultural and ethnic diversity are historically persistent and extensive within the research (Au, 2011; Boykin & Noguera, 2011; Gorski, 2018; Meier & Knoester, 2017; Reardon, 2013). Solutions to this problem continue to be needed and one way to address this large-scale issue is through culturally responsive teaching.

As a former principal of an ethnically, culturally, and socio-economically diverse elementary school, I engaged in constant dialogue and debate on how to best approach the wide variety of student needs. Schools use multiple indicator data systems to identify skills and strategies students have or need improvement on within their learning to inform teacher instruction. Unfortunately, this system naturally develops a deficit mindset. Most often our students of color are brought up for problem-solving with a deficit-based versus a culturally sustaining lens. A teachers’ attitude and perception of a learner can either push us in the direction of deep and powerful learning or take us towards a path of teaching narrow skills that promotes disconnected and surface level learning. Teaching students of color without a connection to their rich ethnic and cultural knowledge within their communities will only perpetuate the opportunity gap in education. This is a real concern in many schools across the nation (Au, 2011; Boykin & Noguera, 2011; Gorski, 2018; Meier & Knoester, 2017; Reardon, 2013). Teacher’s instructional decisions that are made solely focused on academic achievement while disregarding the

importance of students' ethnic, cultural, and linguistic capabilities has an impact on student learning (Au, 2011; Boykin & Noguera, 2011; Gorski, 2018; Meier & Knoester, 2017; Pogrow, 2006; Reardon, 2013).

Problem Statement

School leaders and educators across the country are striving to improve instruction for ethnically, culturally, and socio-economically diverse students for long term learning and growth. For years, researchers and scholars praised the tenets of culturally responsive instruction as the solution to meeting the needs of this growing diversity in schools (Abdulrahim & Orosco, 2019; Aronson & Laughter, 2016; Gay, 2010, 2013, 2018). Unfortunately, many students from ethnically and culturally diverse communities do not have schooling experiences that validate and affirm their knowledge within the learning (Gay, 2018; Khalifa et al., 2016). There is a significant disconnect between research and best practice and the implementation of instruction within the classroom. Many educators do not connect instruction with their students' lived experiences and understandings. Culturally responsive teaching practices across all content areas are under researched and more examples of theory to practice are needed (Abdulrahim & Orosco, 2019; Aronson & Laughter, 2016). The areas of mathematics and science are among the least studied comparatively to language arts (Abdulrahim & Orosco, 2019; Aronson & Laughter, 2016). As culturally responsive teaching practices grow within schools across the country, educators need to share what supports they use and what limits it.

Definition of Terms

Key terms used in this research include:

Culture

Students' values, beliefs, motivations, and social groups and norms. It's dynamic, complex, interactive, and changing, yet a stabilizing force in human life (Gay, 2010). Culture can also be a system of knowledge shared by a large group of people.

Culturally responsive teaching

Geneva Gay (2010) defines it "as using the cultural knowledge, prior experiences, frames of reference and performance styles of ethnically diverse students to make learning encounters more relevant to and effective for them" (p.31). Culturally responsive teaching is a way of teaching that connects a child's ethnic and cultural experiences to the instruction for deep learning opportunities.

Ethnically, Culturally, and Socio-economically Diverse Learners

Students who are African Americans, Latinx, Asian and Native American. Although Caucasian students would be socio-economically diverse, they are not included in this definition. In this study they also might be referred to as students of color. This diverse group of learners are also known to be the most marginalized in our US educational system due to systemic racism and other oppressive systems (Gay, 2018).

Study Objective

The purpose of this study is to investigate and explore mathematics teachers' culturally sustaining beliefs and their responsive teaching practices for their students of color. An analysis of these specific strategies contributes to and expands on existing literature on culturally responsive teaching practices within mathematics. By examining the contributions and

limitations that educators encounter in the implementation of culturally responsive practices, the data results will play an important role in engaging more educators in this work. The goal of this study is to explore what is working and what supports are needed to ensure implementation of culturally responsive teaching practices throughout all content areas daily. The contributions of this work highlight the importance of valuing students ethnic and cultural knowledge for deep and powerful learning.

Research Questions

This study's research questions were developed from literature on culturally responsive practices and learning more about teachers who had culturally sustaining beliefs about their students of color. Three research questions informed my inquiry:

- 1) What are teachers' attitudes and expectations about supporting their students' ethnic, cultural, and socioeconomic diversity in mathematics?
- 2) What ways, if any, do teachers who have culturally sustaining beliefs use culturally responsive teaching practices in mathematics?
- 3) What contributes to or limits a teachers' use of culturally responsive teaching practices in mathematics?

Overview of Methodology and Rationale

This research used a mixed methods case study design. The mixed methods case study design involved the use of a core design (explanatory sequential) within the framework of a single case study design (Creswell & Creswell, 2018). Within this framework, the research questions in this study were investigated through one school district. The study was conducted on a suburban school district in the Midwest. The quantitative phase of the study started with mathematics teachers at the 3rd-8th grade level. Unfortunately, the quantitative data from the

survey did not produce enough 6th-8th grade teachers to participate so the focus of the study was on 3rd-5th grade mathematics teachers. The racial/ethnic diversity make-up was 43% Latinx, 32% White, 12% Asian, 3% Black, 2% American Indian, and 8% two or more races/ethnicities. The socioeconomic diversity was approximately 58% of students coming from low-income households. The district had a focus on diversity, equity and inclusion to improve their practices for their students.

The first phase of the data collection process was quantitative. A survey was used to identify teachers who had culturally sustaining beliefs and implemented culturally responsive practices for their ethnically, culturally, and socio-economically diverse learners to take part in the second phase. The survey information was created in Qualtrics for secure and safe data collection. The data were analyzed by calculating for mean, median and standard deviation and tabulated frequencies to identify six teachers. The survey research helped guide the more in-depth follow-up.

The second phase of data collection was qualitative. Individual interviews and documents shared by the teachers were used to further analyze and compare to interpret results. The interview information was transcribed verbatim, peer-reviewed, and approved by the participants. Three participants shared documents of their lessons and student samples. The details of the interviews and documents were closely examined and coded. Coding categories were developed and refined on an ongoing basis, guided by the study's Culturally Responsive Framework.

The key component of this method was having one group to study with both quantitative and qualitative data. It gave a better understanding of the three research questions and yielded more complete evidence. The case study allowed insight for transferability with similar districts

in size and demographics. The detailed information of the single case allows readers to make connections in the study with their own experiences. It brought about an understanding that in turn can affect and perhaps even improve practice within the field.

Significance of Study

Researchers have shown that culturally responsive practices have promoted deep learning experiences for all students, but especially students of color (Darling, 2016; Gay, 2018; Kana'iaupuni et al., 2010; Kisker et al., 2012; Matthews & López, 2018). These practices connect students' cultures, languages, and lived experiences with their learning at school. In this study, it was beneficial to hear from teachers' who have culturally sustaining beliefs and their practices for their students of color in mathematics. A well-known phrase used by educators is *mathematics is universal* which is very deceiving. When teaching an ethnically, culturally, and socio-economically diverse group of students, universality is not the path to deep learning. Mathematics is the least researched and the data from this study illuminated teacher practices in this content area aligned to the Culturally Responsive Framework. Since research supports culturally responsive teaching to improve the achievement of all students, a study that explored using these practices within mathematics was warranted.

Additionally, what was learned from the participants about what limits and contributes to their culturally responsive practices holds the potential to shed some light on how administrators make curriculum decisions and its impact on teachers' use of these practices. From the literature, culturally responsive practices begin with the teachers' attitudes and beliefs. This study highlights those attitudes and beliefs and how professional learning impacts it. This research is significant because it offers guidance for district leaders and teachers on ways to utilize culturally responsive practices more often for students of color.

Chapter 2: Literature Review

Literature Review Process

To discover the current landscape of teaching practices within mathematics for ethnically, culturally, and socio-economically diverse learners, I closely examined literature through a culturally responsive pedagogy lens. I reviewed literature from Pre-K-12th grade from the United States starting in 2001. The literature on which I drew for this review focuses mainly with mathematics. The areas of mathematics and science are among the least studied comparatively to language arts (Abdulrahim & Orosco, 2019; Aronson & Laughter, 2016). From culturally responsive pedagogy, I narrowed my search to focus on the teaching practices within mathematics for students of color. Through this exploration, I found research that supported the use of culturally responsive teaching. The literature supports culturally responsive teaching practices to improve the standardized achievement tests of ethnically, culturally, and socio-economically diverse learners, but the wide scale use of them are limited in scope (Chen, 2015; Civil, 2007; Darling, 2016; Gay, 2018; Kana'iaupuni et al., 2010; Kisker et al., 2012; Lipka et al., 2009; Matthews & López, 2018; Moses et al., 2009).

The literature on which I was inspired by for this review pulled from educators who utilize a culturally sustaining mindset to incorporate culturally responsive teaching practices within mathematics. My findings within the literature can be grouped into three thematic sections, each of which centers a specific research focus. The organization of these three areas are student outcomes, teacher beliefs, and finally teacher practices all centered through a culturally responsive teaching pedagogy. I conclude with an analysis of the major gaps and limitations that I determined within the reviewed literature.

Student Outcomes

Culturally responsive teaching research has shown positive results on students' academics as well as social emotional well-being. As the demographics within classrooms continue to shift away from a majority White monolingual student population, more research continues to evolve around culturally responsive teaching practices with much of the research being qualitative (Abdulrahim & Orosco, 2019). Alternatively, methods less researched like quantitative and mixed methods studies have shown positive standardized achievement results for certain populations such as Latinx and Native American, but more is needed (Boaler, 2008; Kisker et al., 2012; Lipka et al., 2009; Matthews & López, 2018). One large-scale 2012 mixed methods study by Lipka and Adam and expanded in collaboration with Kisker highlighted these positive achievement results conducted on Native Alaskan students. Kisker and team examined the effect of 67 teachers implementing two 2nd grade culturally relevant math modules with 756 Native Alaskan students within a randomized controlled trial (Kisker et al., 2012). A collaboration between educators, university researchers and the community-built modules highlighted the rich cultural and native heritage of the Native Alaskan communities within mathematics. Kisker's team showed results that the modules significantly impacted the mathematics performance of the students on overall test scores, with relatively robust effect size (0.82 and 0.39 standard deviations, respectively, both statistically significant at the .001 level). It showed that the students had an increased understanding of mathematics topics such as measurement, representation of data, groupings, and place value.

A more recent study, similar in scale by Matthews and López (2018), investigated the link between teacher beliefs to their culturally responsive teaching practices in predicting Latinx

students' mathematics achievement. The explanatory sequential mixed methods study included five elementary teachers from six schools with a total of 568 Latinx students. Matthews and López collected and measured data using teacher surveys, interviews, and students' standardized mathematics achievement scores. Their results indicated that high expectations alone were not enough for teachers to utilize culturally responsive practices to impact their students' mathematics achievement. In fact, they found the use of culturally responsive teaching practices to impact Latinx mathematical growth relied upon high expectations *and* critical awareness of teachers' bias and prejudice they held about their students.

The sequential mixed method study started with providing approximately 33 teachers a survey. The researchers ran a basic descriptive statistic on the entire sample and specifically they computed the mean on the key independent variables: teacher expectations and critical awareness. Based on a ranking, they targeted the teachers within the top 25% of scores for follow-up semi-structured interviews. Mediation and moderation techniques were utilized to assess the relation between teacher beliefs, teacher pedagogy, and Latino students' mathematics achievement. Lastly, the researchers made use of semi-structured interviews to probe teachers' perceptions of the value of asset-based pedagogies. The interviews provided an in-depth perspective of the teacher beliefs and behaviors and a powerful enactment of asset-based instructional practices. The in-depth analyses revealed that critical awareness beliefs interacted with teacher expectations for a significant effect on culturally congruent instruction. Then, culturally congruent instruction also predicted use of Spanish language, which predicted students' year-end mathematics achievement. The study is an example of the need for more research that unpacks the relationship between teacher beliefs and student outcomes for ethnically, culturally, and socio-economically diverse learners.

All these studies not only show the achievement benefits of students, but the benefits of validating and honoring a students' rich ethnic and cultural identity. The result of honoring students' identities positively impacted how they perceived themselves as mathematicians (Bonner, 2014; Bonner & Adams, 2012; Raygoza, 2016). Teachers in five studies used their students' native language during mathematics instruction to facilitate the learning and highlight the importance of their bilingualism (Bonner, 2014; Cahnmann & Remillard, 2002; Driver & Powell, 2017; Quintos & Civil, 2008; Matthews & López, 2018). The common thread between these studies is the importance of using students' native language in the instruction to develop strong mathematical skills. In allowing students to use their native language in mathematics, it validates their cultural identity to confidently acquire math.

Likewise, research conducted by Bonner (2014), Bonner and Adams (2012), and Cholewa et al. (2012) found that teachers used culturally relevant ways of teaching with African American students to validate and honor their students and communities which led to students learning complex mathematical ideas. The teachers implemented a variety of strategies such as the use of music, movement, clapping, rhythm, dance, oral storytelling, and choral chants to develop challenging mathematical concepts and most importantly to affirm students' ways of thinking and seeing themselves as mathematicians (Bonner, 2014; Bonner & Adams, 2012; Cholewa et al., 2012).

For example, in Bonner's study (2014) she utilized grounded theory to collect and analyze data from three mathematics classrooms. Each classroom had varied settings, all of which were highly populated by underserved students. The study spanned several years with a data collection process through teacher interviews, classroom observations, and teacher-

developed artifacts for a period of 4-6 weeks each. The goal of the study was for the researcher to analyze practices while conducting inquiry using a comparative and interactive approach. Bonner interpreted each individual teacher and did a cross-analysis to pay close attention to the language, action, and varied realities of the teacher and the students. Through that lens, major themes emerged through comparison and interactions with the data. The data showed that relationships and trust in the classroom not only are a foundation category of Culturally Responsive Mathematics Teaching, but also mediate knowledge and communication within mathematics. All these studies showed positive student outcomes such as mathematics growth and most importantly a positive self-identity by validating and honoring their rich ethnic and cultural heritage when teachers implemented culturally responsive teaching practices.

Teacher Beliefs

Research around teachers' culturally sustaining attitudes and expectations of ethnically, culturally, and socio-economically diverse learners have shown positive effects on students' identity as well as academics (Bartell, 2013; Bonner, 2014; Clark et al., 2013; Darling, 2016; Matthews & López, 2018; Moses et. al., 2009). For instance, in Matthews and López's (2018) study, they examined two key components of asset-based pedagogy of Latino students which were cultural content integration and heritage language. They used an explanatory sequential mixed methods design to assess the effects between teacher beliefs, their asset-based pedagogies, and the mathematics achievement of 568 3rd-5th grade Latino students. The results revealed that honoring students' heritage language is the mediating component through which cultural content integration predicts mathematics achievement for Latino students.

Additionally, Darling's (2016) ethnographic, mixed-methods study took a closer look at utilizing the assets of a Yucatan community in mathematics. The study entailed one rural

indigenous community in the Yucatan and explored three middle school teachers and how they capitalized on the community assets in the classroom. The data collection entailed observations in the classroom and community and interviews with community members, teachers, and students within five months. The results indicated community members have specialized, practical mathematics expertise that can often be overlooked in rural underserved communities. It also showed formal math instruction misses opportunities to tap into the rich cultural assets of a community to deepen mathematical practices. Teachers who acknowledged and integrated students' ethnic and cultural capital in learning positively impacted students' academic achievement and simultaneously did the reverse when eliminating it (Aronson & Laughter, 2016; Gay, 2018; Gonzalez et al., 2005). Teachers' narrow view of students' learning based on standardized achievement scores creates a deficit mindset. Research has shown teachers' beliefs about their students of color matter so when teachers solely focus on students' mathematics skills without acknowledging and using their culture, language and lived experiences, learning is impacted.

Teachers replacing deficit thinking of diverse students and their communities with a culturally sustaining asset-based perspective is essential. For example, a large emphasis in Gay's (2018) work on culturally responsive teaching practices explored the idea of teacher's attitudes and expectations being as important as their pedagogical skill in the quality of instruction for marginalized students. How teachers view and use their students' knowledge when designing and implementing their instruction determines equitable practices for ethnically and culturally diverse learners (Gay, 2018). A few researchers developed theories around teachers' beliefs which are funds of knowledge (Gonzalez et al., 2005; Moll et al., 2005) and asset or strength-based teaching (López, 2017). The commonality amongst Gonzalez, Moll, and López's work is

educators treat the students' homes and communities as valuable resources in which they potentially will be utilized in school, instead of needing to be *fixed*. Teachers intentionally work to unlock their students' learning potential by focusing on their ethnic, cultural, and community strengths and talents.

Similarly, to Gonzalez, Moll, and López, a small ethnographic, mixed method study by researcher Felicia Darling (2016) provided a window into the importance of teachers who viewed marginalized communities as assets and the effect it had on their students. Her work demonstrated that capitalizing on the strengths of a Yucatec Maya community to teach problem-solving concepts to Mayan students may improve math outcomes. The study consisted of two middle school teachers working with approximately 62 students. When students had the opportunity to complete real world tasks within their Yucatec Maya community and the autonomy on how to complete the math task, students engaged and enjoyed math. From Darling's interview with the students on the different math tasks, they responded to not liking the math tasks that entailed single-solution, single-method problem solving closely aligned to the national math curriculum. She also found through interviewing, when students were afforded the opportunity to open-ended, multiple solution problems connected to their ethnic and cultural community, students enjoyed and connected with the math. This research study speaks to the importance of teachers' viewing students' ethnic, cultural, and socio-economic identity as an asset and implementing it within instruction for their learning.

Teachers' viewing their students' ethnic and cultural knowledge as an asset has been explored differently by researchers but have found similar results. For example, Bonner's (2014) research took a closer look at the practices of three mathematics teachers who had a high population of underserved students through utilizing a grounded theory approach. Data was

collected over a three-year timeframe and found the benefits of using culturally responsive teaching practices. The multi-year qualitative study examined three mathematics teachers' practices and how they served their diverse population in their classrooms. A strong theme emerged in the teachers' purposeful planning of instruction in which lessons were built on their students' cultural strengths and lived experiences (Bonner, 2014). In two similar studies, teachers engaged in professional development to reflect on their thoughts and behaviors related to their ethnically and culturally diverse learners (Aguirre & Zavala, 2013; Timmons-Brown & Warners, 2016). In both the qualitative and mixed methods research studies, professional learning focused on valuing and using students' culture and lived experiences in an authentic way. In both the studies, there were teacher discussions, artifacts, and interviews. A lesson analysis tool guided their reflection. Lastly, professional development fostered more teacher reflective practices to continually improve their mathematics lessons for all their students.

Teacher Practices

One of the difficulties of culturally responsive pedagogy stems from understanding what it looks like in practice for teachers. The more studies done on what culturally responsive teaching practices looks like, teachers will have new ideas and ways of teaching the most marginalized students across content areas. Gay (2018) describes the importance of these practices by stating, "when instructional processes are congruent with the cultural orientations, experiences, and learning styles of marginalized African, Asian, European, Latina, and Native American students, their school achievement improves significantly" (p. 240). There are several studies that provide some insight in taking theory to practice. Teachers use strategies that connect with students' ethnic and cultural identities, going beyond the textbook and into the

communities, and capitalize on students' ethnic and cultural experiences to enhance the mathematics curriculum.

To demonstrate teacher practice, Moses and Cobb's Algebra Project (2001) is a great example. The researchers used the everyday knowledge and activities of students and communities of color including African, Latinx, and Native Americans to bridge the concepts of school-based mathematics at the secondary level. A few examples of the practices entail using the strengths of the students' homes and communities to teach algebra. Students' familiarity with their local public transportation allowed teachers to use this knowledge within math. Students took rides on public transportation within their community and created math problems from their observations. Teachers implemented mathematical concepts like distance, time, and money through these authentic real-world experiences. Also, teachers used dialogue scripts in all of their math experiences to model mathematical discussions and capitalize on the importance of conversations and collaboration with peers in their communities. The quasi-experimental design study tracked seven cohorts of graduates in the middle school who received these practices in Algebra and tracked how it impacted the students in high school. There were many positive academic and social emotional results found from the study. A few significant results were 70% of students of color were entering geometry in grade 9 compared to their non-Algebra project peers. Also, students were tracked and found taking and passing higher math courses in 9th and 10th grade at about twice the rate of graduates from demographically similar middle schools. The data also showed students having an increased interest in algebra, math and learning in general (Moses & Cobb, 2001; Moses et. al., 2009).

Culturally responsive teaching practices emphasize the importance of collaboration because it fosters student empowerment and voice within their learning. It allows for many

diverse ideas to be shared and validates the contribution of others in their thinking. In many cultures, collaboration and group work are highly regarded for learning to occur. Learning does not occur in isolation and supporting one another in the community is essential. In similar studies to Moses and Cobb's Algebra Project, teachers integrated collaborative learning experiences for students of color (i.e., pair work, group work) into mathematics instruction. These qualitative and mixed methods studies showed positive results for students of color in mathematics achievement as well as seeing themselves as mathematicians (Boaler, 2006; Boaler & Staples, 2008; Cholewa et al., 2012; Gutierrez, 2002; Jackson, 2013).

In one study, Boaler and Staples' (2008) longitudinal mixed-methods case study researched school tracking practices in mathematics. The researchers focused on three diverse California high schools with a participation of 700 students. The schools had a mix of curricular programs and varied student populations. The data collection process entailed, teacher observations, teacher and student interviews, and student achievement data. Data analysis was through statistical techniques for the student achievement and attitudinal data, the teacher and student practices were analyzed through a technique of coding. The results indicated that one of the schools which had a high population of ethnically, culturally, and socio-economically diverse students who did not track students in mathematics had the highest achievement scores, students enjoyed mathematics more and they progressed to higher levels of mathematics. Much of the research has been done with high school students, but Cholewa (2012) and Jackson (2013) found similar results with elementary students. The researchers found teachers' use of collaboration and group work encouraged students to respect and value each other's ideas from their communities as well as support one another to acquire the mathematics concepts and skills needed for success (Boaler, 2006; Boaler & Staples, 2008; Cholewa et al., 2012; Gutierrez, 2002; Jackson, 2013).

In several studies, teachers promoted their students' cultural and linguistic backgrounds in various ways to connect old and new mathematical knowledge. These included integrating interdisciplinary content (Quintos & Civil, 2008), making links to human experiences and drawing on cultural activities (Bonner, 2014; Kisker et al., 2012; Lipka et al., 2009; Rubel & Chu, 2012) as well as incorporating stories with relatable characters within math problems (Corp, 2017). For example, one prominent study with Native Alaskans originated by Lipka and Adam and expanded in collaboration with Kisker resulted in positive student outcomes when they used Yup'ik culture within the math curriculum (Kisker et al., 2012; Lipka et. al., 2009). The researchers designed math lessons and modules around fish racks, berry picking, drying salmon and star navigation to teach mathematics skills. Teacher use of diverse content within the curriculum allowed students to think critically around the mathematical concepts and positively affected their cultural identity in mathematics. When the researchers examined the impact on Math in a Cultural Context (MCC) modules and students' mathematics performance with schools who were using the modules and schools who were not, they found the MCC students performed higher on common pre and post mathematics assessments. Students in both rural and urban schools who learned through ethnic and culturally diverse curriculum consistently outperform those who used conventional curriculum with standard math concepts and skills on mathematics assessments (Darling, 2016; Demmert & Towner, 2003; Kisker et al., 2012; Lipka et. al., 2009; Sternberg, 2006; Moses et. al., 2009). The studies clearly showed that teachers who honored and implemented students' ethnicity and culture into the math curriculum created a deeper understanding of mathematics for their students.

In summary of the review on student outcomes, teacher beliefs, and teacher practices, there were more smaller scale research studies which entailed a shorter timeframe and smaller

group size (Bonner, 2014; Corp, 2017; Darling, 2016; Quintos & Civil, 2008; Rubel & Chu, 2012) compared to larger studies (Boaler & Staples, 2008; Kisker et al., 2012; Lipka et. al., 2009; Moses et al., 2009). Each of these studies within mathematics consider a variety of learners such as African Americans, Latinx, and Native Americans to support the work of culturally responsive teaching practices. There is a need for more studies on students of color, but specifically around Native and Asian Americans which were less studied overall. Qualitative research dominates within the field of culturally responsive teaching, but continued ways of researching this population through quantitative and mixed methods approaches provides more understanding and support for these practices within education. Specifically, mixed methods studies would allow for a robust description and interpretation of culturally responsive practices. It would allow for a deeper understanding around the quantitative data results. Teachers are searching for ways to best instruct their students of color and there is still a need to expand the research on best instructional strategies that align with students ethnic and cultural ways of learning and integrate it within the curriculum. The work being done to validate and integrate students' culture within mathematics is evolving and becoming clearer within education on the importance of this work.

Gaps in the Literature

The ongoing opportunity gap within schools for ethnically, culturally, and socio-economically diverse students suggest that more studies are needed to provide an increase in dialogue regarding the value and utility of their rich ethnic and cultural capital within instruction and curriculum. Although the reviewed studies and other studies establish various examples of culturally responsive practices, limitations to these studies exist. These limitations are around culturally responsive practices at the elementary level within mathematics. My study addresses

these gaps with a focus on 1) elementary teachers' attitudes and expectations of the students' ethnic and cultural capital; 2) ways in which they use culturally responsive teaching practices within mathematics; and 3) analysis of teachers' identified limitations or contributions of culturally responsive teaching practices.

Teachers' Attitudes and Expectations

Several studies explore teachers' beliefs and attitudes toward culturally responsive teaching, but many of the studies focus on their beliefs about teaching social justice or culturally responsive practices (Bartell, 2013; Biafora & Ansalone, 2004, 2008; Gonzalez, 2009; Parker et al., 2017; Timmons-Brown & Warner, 2016) and not necessarily on student outcomes.

Specifically, the research focuses on professional learning courses around culturally responsive practices and teachers' beliefs about students after engaging in the course (Parker et al., 2017; Rubel & Chu, 2012; Timmons-Brown & Warner, 2016). Literature on teacher beliefs and attitudes primarily addresses secondary and high school teachers (Bartell, 2013; Gonzalez, 2009; Parker et al., 2017; Timmons-Brown & Warner, 2016) with fewer studies addressing elementary teachers (Kisker et al., 2012; Matthews & López, 2018).

One significant mixed methods study explored elementary/secondary teacher beliefs and expectations about their students and how those beliefs translated into culturally responsive teaching practices (Matthews & López, 2018). Matthews and López (2018) found positive results within the data on Latinx students in mathematics. Current studies, such as this study, need to explore more elementary teachers' attitudes and expectations of their students' ethnic and cultural capital to implement within their instruction and curriculum. If deep and powerful learning for students through culturally responsive teaching is going to reflect the vision of researcher Geneva Gay (2018), the work starts with the teachers' attitudes and expectations of

their learners. My study will further examine teachers' culturally sustaining attitudes and expectations of their ethnically, culturally, and socio-economically diverse learners and how that translates into practice.

Teacher Use of Culturally Responsive Teaching Practices within Mathematics

Although the research supports the value of culturally responsive teaching practices, more needs to be understood about how to take theory into practice (Celedón-Pattichis et al., 2018; Gay, 2018; Leonard, 2008; Nasir et al., 2008). The daily application of this work as well as drawing on more voices of educators who successfully implement culturally responsive teaching is needed (Bonner, 2014). The culturally responsive teaching research at the secondary and high school level (Boaler & Selling, 2017; Bonner, 2014; Clark et al., 2013; Parker et al., 2017; Raygoza, 2016; Rubel & Chu, 2012) predominantly draw from urban areas. The studies at elementary (Aguirre & Zavala, 2013; Kisker et al., 2012; Matthews & López, 2018) are a mix between urban and rural communities. Based on my review, continued studies within rural communities could be expanded, but suburban schools are an area of needed research. Suburban communities are becoming more ethnically, culturally, and socioeconomically diverse similarly to urban areas. There is a great need for culturally responsive practices in suburban schools.

It is important to understand the extent to which teachers find ways to uphold culturally responsive teaching ideologies, practices, and values. Studies like Lipka et al. (2009) and Kisker et al. (2012) on building mathematics lessons based on the cultural experiences of their students need expansion within more communities. Research suggests it is important for educators to understand how instructional practices such as collaboration and group work benefits students of color (Boaler, 2006; Boaler & Staples, 2008; Cholewa et al., 2012; Gutierrez, 2002; Jackson, 2013). Continued research on more specific strategies for students of color to highlight and

implement in the classroom would benefit teachers' instructional practices. Teacher planning for learning experiences that validate and connect students' ethnic and cultural knowledge and obtaining a strong understanding about the content are important factors in culturally responsive teaching. These two indicators display the intricacies of elementary teachers' work in teaching multiple content areas. Furthermore, a remaining area of inquiry involves focusing on elementary educators' insight into the factors that contribute to and limit their use of culturally responsive practices to expand it throughout the day and within multiple content areas.

Factors that Contribute to and Limit Teachers' Use of Culturally Responsive Practices

As presented in the previously reviewed studies, there is strong evidence of effectiveness of culturally responsive teaching for students of color. The literature reviewed presents examples of culturally responsive teaching practices in a mathematics classroom, characterized by culturally sustaining thinking (Darling, 2016; Matthews & López, 2018) coupled with curriculum and instruction (Civil, 2007; Chen, 2015; Kana'iaupuni et al., 2010; Kisker et al., 2012; Lipka et al., 2009; Moses et al., 2009). These studies have shown positive effects on students' ethnic and cultural identity as well as achievement. My research does not examine the effectiveness of culturally responsive teaching, but instead, I explored teachers who have culturally sustaining beliefs and learn about their practices within mathematics. Additionally, I investigated what contributes to and limits teachers' use of culturally responsive teaching from inside and outside of the mathematics classroom. My overall findings of recent research on culturally responsive teaching, teachers strongly understand and respect their students' ethnic and cultural identity and the communities they come from, more needs to be known about what supports are in place in order to utilize those ethnic and cultural strengths (Civil, 2007; Clark et al., 2013; Darling, 2016; Gutiérrez, 2012; Lipka & Adams, 2005; Lemons-Smith, 2008;

Matthews & López, 2018; Thomas & Berry III, 2019; Turner et al., 2009). The benefits of knowing what limits or contributes to these practices provides opportunities to district administrators to assist future and veteran teachers to become more culturally responsive to their students of color throughout their day.

Summary

The research show teachers' who use culturally responsive practices for their students of color have academic and social emotional benefits (Boaler & Selling, 2017; Bonner, 2014; Kisker et al., 2012; Lipka et al., 2009; Moses & Cobb, 2001; Moses et. al., 2009). The continuously changing demographics within education suggest that the predominant White middle-class educators must lean toward the kind of awareness and validation of the rich sociocultural identities of their students. Teachers should use those identities to influence their daily instructional practices for growth and learning. Students' identities and the knowledge they bring to learning need to be central to the educators' instructional decision-making for a more equitable schooling experience (Civil, 2007; Darling, 2016; Gutiérrez, 2012; Lipka & Adams, 2005; Lemons-Smith, 2008; Turner et al., 2009). The gaps addressed in the current literature are an interest to me in my study. My research investigates suburban elementary teachers' culturally sustaining mindset regarding their ethnically, culturally, and socio-economically diverse learners. The research takes a closer look at the specific culturally responsive teaching practices used within mathematics and what limits or contributes to teachers' use of them.

Theoretical Framework

To gain insight into how teachers can use students' ethnic and cultural identity in the mathematics classroom, my study will be guided through the theoretical lens of culturally responsive pedagogy. Culturally responsive pedagogy started with a movement to effectively

teach students of color in the 1960's and 1970's when school desegregation efforts were on the rise and shifts needed to occur within the educational system. After this period, many concepts and terms emerged in the academic literature for utilizing a students' culture within learning such as *culturally appropriate*, *culturally congruent*, *culturally responsive* (Jordan, 1985; Brown-Jeffy & Cooper, 2011; Sleeter, 2012). All these terms came into focus around multicultural education.

My research study is built upon one of the two foundational strands manifested from multicultural education. According to Aronson and Laughter (2016), the first strand, culturally relevant pedagogy, focused on the teacher's stance and paradigm on student learning, cultural competence, and critical consciousness expressed in the work of Gloria Ladson-Billings. The second strand, culturally responsive teaching, focused on teacher instructional strategies and practices. My study will utilize the second strand from the work of Geneva Gay (2010, 2013, 2018). Gay's work emphasizes teachers' having an asset-based mindset around students' culture and identity.

Gay (2010) defines culturally responsive teaching "as using the cultural knowledge, prior experiences, frames of reference and performance styles of ethnically diverse students to make learning encounters more relevant to and effective for them" (p.31). The key purpose of using the culturally responsive teaching framework is to provide all students with highly engaging and rigorous learning experiences, regardless of their race, gender, ethnicity, language, or socio-economic status. Teachers who are culturally responsive appreciate and incorporate culture, language, heritage and home/community experiences into their instruction to foster higher-level thinking skills, but most importantly to value, foster and sustain their identity. Learning becomes more accessible, relevant, and meaningful for their diverse students (Gay, 2018).

Gay (2018) refers to teaching and learning being mutually embedded in culture. Gay (2018) states, “If teachers are teaching and students are learning, the common reciprocal thread is *culture*” (p.8). Culturally responsive teaching should be happening all the time and everywhere. Culture strongly influences the attitudes, values, and behaviors that teachers and students bring to the instructional process (Gay, 2018). Gay (2018) explains culturally responsive teaching is anchored on four foundational pillars of practice (p. 53). Based on the four pillars of what constitutes culturally responsive teaching, I used this theoretical framework throughout my research. The four pillars are shown (see Figure 1.1).

Figure 1.1: *Foundational Pillars*

Foundational Pillars of Culturally Responsive Teaching (Gay, 2018)

1. Teachers’ attitudes and expectations
2. Cultural communication in the classroom
3. Ethnically and culturally diverse content in the curriculum
4. Culturally congruent instruction

Foundational Pillars of Culturally Responsive Teaching

Teachers’ Attitudes and Expectations

The first pillar is the core to my research study, highlighting the importance of the teacher lens in creating and designing instruction for their students of color. For educators to be aware of their attitudes and expectations of their students, Geneva Gay (2018) suggests there is a needed understanding that our educational system was built on a cultural norm of a White European American ideal. Although the norm was built on White European American ideals, the reality is that our society and culture are composed of a multitude of multiethnic and multi-varied peoples,

contributions, and influences. Educators need to acknowledge and rebuild our educational system to include more than a White European American culture for equitable opportunities.

To explain, Paris and Alim's (2014) culturally sustaining pedagogies speak to this predominant White European American lens outcome of learning. Through their research on the conceptualization of asset-based pedagogies, their work extends our thinking on understanding, validating, and using students' identities in their learning, but pushing back on fitting their identities into a White monolingual educational norm. The outcomes need to be more varied with a basis of educators and students having linguistic and cultural flexibility throughout the learning process. Students' linguistic and cultural identities are used beyond a resource, but more as a guiding foundation to create new ways of deep and powerful learning. Paris and Alim (2014) states, "culturally sustaining pedagogy seeks to perpetuate and foster—to *sustain*—linguistic, liter-ate, and cultural pluralism as part of the democratic project of schooling and as a needed response to demographic and social change" (p. 88). The idea of using language and culture as a central component in all stages of learning instead of as a starting point is the big shift from asset-based to culturally sustaining pedagogies.

Culturally sustaining pedagogies highlight the importance of sustaining students' linguistically and culturally in both the traditional and evolving present ways they are lived and used by them. Student voice is imperative and must be valued. If we only use language and culture in ways of the past and not understand that every generation of learners shift our ways of practicing and create new culture within them, we will continue to oppress groups of learners.

Classroom examples of teachers' attitude and expectations on the valuing and sustaining use of students' linguistic and cultural identities to create outcomes that are multilingual and multicultural are still evolving and much more research is needed. To give an example, a case

study by McCarty and Lee (2014) on sustaining Native American students' identities and their communities within learning showed ways in which teachers' attitudes and expectations were the foundation to it all. Using two ethnographic cases as their foundation, researchers gathered data by collaborating with local stakeholders such as teachers, students, parents, and community elders through in-depth interviews, focus groups, recorded observations of classroom instruction, and collections of artifacts such as photographs. The overall outcome of the work showed teachers and staffs' attitudes and behaviors affect positive change emotionally and academically for Native American students.

The results indicated the core values of the school and their teachers' instructional practices were based on the students' tribal communities. The staff and community engaged and confronted overgeneralizations and stereotypes of Native American people being one culture and one people (McCarty & Lee, 2014). The importance of engaging the full community such as students, parents and tribal community to develop these core values for the school respects traditions of the past, but also the experiences of the youth. The teachers' attitudes and expectations were displayed through these core values such as designing activities to integrate those values within their curriculum and instruction.

Moreover, a teacher at this school used her Monday morning ritual which included Native songs and communal gathering practices with a drum. The teachers' attitudes and behaviors are seen through these core values which are complex and are constantly negotiated with the students in their learning environment. A teacher in this study shared the importance of countering the past actions of her ancestors to colonize their communities based on the devaluing of any language or culture besides English. Teachers' personal reflections with students on their experiences of learning only English and erasing their culture in order to fit in was unhealthy.

The teachers highlight the importance of their students' multilingualism and multiculturalism and how to counter the past lived experiences are crucial. Though both case studies were not intended to focus on academic achievement, the students in this study met or exceeded state and federal academic standards. This study demonstrated that teachers' attitudes and expectations create positive results academically, but more importantly sustain students' language and culture (McCarty & Lee, 2014).

Similarly, Gay (2018) refers to teachers' attitudes and expectations in terms of culturally responsive caring. A caring teacher is characterized by patience, persistence, facilitation, validation, and empowerment for their students. Gay (2018) also extends the idea of teacher expectations being the manifestations of their beliefs and assumptions by stating, "Caring and expectations are mutually connected by having high teacher expectations for their students of color, they have a sense of caring that translates into the belief and facilitation of the maximal development of their potential" (p. 69).

Teachers' attitudes, beliefs and expectations have been shown to either positively or negatively impact students' academic self-efficacy and performance. Studies have shown that if students think their teachers see them as capable learners and treat students' identities as central components to learning, students will see themselves similarly, and act accordingly (Garcia & Chun, 2016; Harlin, Sirota, & Bailey, 2009).

Cultural Communication

Students' communication abilities are a factor in the many instructional decisions made by the teacher throughout the day. When students are developing their proficiency at school, some teachers misinterpret the developing language use as having a lack of academic knowledge and can make misguided instructional decisions. Students may not be open to share what they

know, or the teacher does not acknowledge what a student brings to learning, due to this communication mismatch. Unfortunately, within our educational system, many teachers function under the assumption that there is only one acceptable mode of communication across audiences and content. These assumptions need to be deconstructed for culturally responsive teaching to occur.

Communication is strongly rooted in cultural influence. Listening, speaking, and writing is the conduit for teaching and learning within the classroom. It is important for teachers to know the discourse styles of their students from a cultural perspective to support and bring that into the learning. Teachers need to reflect on their own communication style patterns and learn about their students and the communities they come from to bridge into the learning environment. For instance, Gay (2018) states that communication is multidimensional and multimode and is shaped by many different influences. Culture is a predominant feature, but other critical influences include ethnic affiliation, gender, social class, personality, individuality, and experiential context. Recognizing, appreciating, and using different cultural methods to approach communication is imperative for teaching and learning.

Classroom examples of using culturally responsive teaching practices for communication include approaching conversations and interactions with students, families and communities with self-reflection and cultural humility. Teachers who can genuinely seek out, listen, and ask questions to learn more about their students, families and communities are able to build strong communication networks within the learning community. The teacher will use the knowledge from their students and their families to connect home to school. A project called Math in a Cultural Context (MCC) provides an example of this strong cultural communication. The study had positive achievement results for Alaskan Native students due to a strong collaboration

between mathematicians, math educators, Yup'ik community elders, Yup'ik teachers and Alaskan school district officials (Kisker et al., 2012; Lipka et al., 2009). Math curriculum modules were created for the students by teachers and university-based teacher educators who observed demonstrations and listened to explanations presented by Yup'ik elders. Through these demonstrations and listening sessions, educators'-built trust and engagement within the community. The sessions created historical and cultural contexts that educators used in teaching a deeper understanding around mathematical skills and concepts such as measurement, numeracy, estimation, patterns and more (Kisker et al., 2012; Lipka et al., 2009).

Teachers with a high level of understanding that culture has an impact on communication and education will be mindful of the way they communicate and accept their students' communication styles. With the US educational system only prioritizing speaking and writing over other forms of communication creates a deficit lens in learning for ethnically, culturally, and socio-economically diverse learners. Teachers who are culturally responsive in their teaching practices around communication will see their students flourish in their growth and learning achievement through strong ethnic and cultural identities (Civil & Khan, 2001; Darling, 2016; Kisker et al., 2012; Lipka et al., 2005; Moses et al., 2009).

Diverse Content in the Curriculum

Culturally diverse content in the curriculum is an important pillar in culturally responsive teaching emphasizing the teacher as a critical consumer of information, while also having a deep knowledge of their students. Curriculum does not come alive until students can see themselves in it in a positive way and are allowed to take ownership of it. Gay (2018) refers to the curriculum content as a tool to help learners assert and highlight their present and future powers, capabilities, attitudes, and experiences. Ethnically and culturally diverse students unfortunately

are often portrayed in literary books, history books, television programs, news media and other social media outlets in a negative light. It is critical for teachers to analyze the content distributed for instruction to ensure that what is presented is an accurate representation of the students they serve. Teachers and students should take an active role in this analysis to improve the quality of instructional materials.

Curriculum content that is relevant to ethnically, culturally, and socio-economically diverse students include information about their histories, cultures, contributions, and experiences of their communities. To illustrate this connection, Gutstein's (2003) study on teacher instructional practices that present real-world community math problems with middle school Latino students, showed the importance of teachers knowing students and their communities. The results of these teaching practices showed students had a deeper understanding of mathematical skills (Gutstein, 2003). Knowing students and their communities and bringing that learning into the school setting facilitates deeper mathematical thinking.

An example of knowing students and their communities and bridging it into school is in Civil's (2007) Funds of Knowledge of Teaching (FKT) project. Her work with Mexican American students and families from underserved communities provides examples of students using their own personal stories for story problems or having students share their thinking around algorithms that might be common in their communities. The lived experiences of students such as ranch life and international travel from Mexico to the US are critical in creating a math curriculum that will bridge home to school (Civil, 2007). The connection between the two has positive implications on the mathematical knowledge and understanding of the learners in the classroom. Teachers who know their students and use that knowledge within the curriculum

make a positive impact on student relationships and academic outcomes (Civil, 2007; Gutstein, 2003; Moses & Cobb, 2001).

Culturally Congruent Instruction

The final pillar is the one that takes all these components and puts it into action for learning. Culturally congruent instruction is not something you can list and replicate. As Gay (2018) describes, “it is the *engagement*, the *interaction*, the *dialogue* of students and teachers in the process of teaching and learning” (p. 203). It is knowing how students learn best, while also creating a strong partnership with the learner in the classroom. A teacher with a strong knowledge of the skills and standards is not the only beneficial component of teaching. Culturally responsive teaching should be practiced with care with students sitting in front of them. Understanding students' learning styles and cultural knowledge, helps the teacher and the student partner in facilitating deep and powerful learning experiences.

To take a closer look at culturally congruent instruction, the Hawaiian Cultural Influences in Education (HCIE) study reviewed aspects and effects of culturally responsive teaching for Native Hawaiian high school students. The combination of instructional practices that meets the needs of the learners such as the use of the Hawaiian language and authentic experiences in sacred places or community outdoor learning laboratories, created positive impacts on socio-emotional well-being and strong mathematical skills as shown on math test scores (Kana'iaupuni et al., 2010). The curriculum and instruction focused on the lifestyles, knowledge and values of Native Hawaiians while also teaching mathematics skills. Studies such as this provide ways of using culturally congruent teaching practices.

There are common threads of learning in educating Latinx, Native, African and Asian American students which are cooperation, collaboration, and community. Using these

instructional practices will increase students' engagement and understanding around mathematics. Take for example, the Calculus Project (TCP) of 2009, which was created to capitalize on the strengths of students of color and their learning styles (Chen, 2015). The project's core is based on a growth mindset mentality. Growth mindset centers around everyone having the ability to develop and grow rather than certain areas of learning being fixed and only if you show talent. With the project having a growth mindset at its' core, students of color are enrolled in high school geometry and other advanced math courses. Students take summer courses to preview the school year's math curriculum and take field trips focusing on STEM careers. The students join a cohort group for the upcoming school year in advanced math classes. The feelings of community, connectedness, and belonging amongst students of color within advanced math courses resulted in astounding results. Students in the first year of the project scored proficient or advanced on the state standardized test (Chen, 2015). Due to its academic success for students of color, TCP has grown a consortium of six school districts in Massachusetts participating and expanding to Florida since 2009. Using the learning styles of students of color alongside mathematics concepts shows not only positive academic results, but a feeling of belonging in the mathematics community (Boaler & Selling, 2017; Chen, 2015; Kana'iaupuni et al., 2010).

Culturally congruent instruction is teaching to the whole child. As Gay (2018) states so well, "nurturing the total human condition of diverse learners is the mission and the ultimate indicator of the success of culturally responsive teaching" (p. 241). When the pillars converge in teachers' attitudes and expectations, cultural communication, relevant diverse curriculum and instruction, students' identities are sustained and flourished which effects school achievement. Culturally responsive teaching is the way to reconstruct the system for our students of color. This

research will explore these practices from teachers who have a culturally sustaining mindset. The data will expand on examples of practices within mathematics around the pillars. Additionally, it will allow more insight into what limits or contributes to using the practices daily. More studies are needed within culturally responsive teaching to enhance the learning for our students of color.

Chapter 3: Methodology

Overview

The daily application of using culturally responsive teaching practices as well as drawing on more voices of educators who successfully implement them is a focus of my study. A pillar of Culturally Responsive Teaching is the teachers' beliefs, attitudes, and expectations of ethnically, culturally, and socio-economically diverse learners (Gay, 2018). Teachers' beliefs and attitudes have been shown to either positively or negatively impact students' academic self-efficacy and performance. Studies have demonstrated that if students think their teachers see them as capable learners and treat them as central components to learning, students will see themselves similarly, and act accordingly (Garcia & Chun, 2016; Harlin et al., 2009). The importance of having a culturally sustaining asset-lens of their students is the starting point for teachers to plan and prepare instruction for their learners. Through this lens, I investigated teachers' planning and implementation of instructional practices for their students of color within mathematics. More importantly, I sought to explore what contributes to and limits teachers' use of culturally responsive teaching practices inside and outside of the mathematics classroom.

Goals and Research Questions

My research aimed to (1) identify teachers who have a culturally sustaining asset-based lens of their students of color; (2) investigate how they implement culturally responsive teaching practices; and (3) collect information on what contributes to or limits their implementation. The benefit of this study provides opportunities to address classroom realities to assist future teachers who venture to become culturally responsive and assist veteran teachers with a course of action toward producing more culturally responsive teaching practices throughout their day. For this reason, the following research questions guided this study:

1. What are teachers' attitudes and expectations about supporting their students' ethnic, cultural, and socioeconomic diversity in mathematics?
2. What ways, if any, do teachers who have culturally sustaining beliefs use culturally responsive teaching practices in mathematics?
3. What limits or contributes to a teacher's use of culturally responsive teaching practices in mathematics?

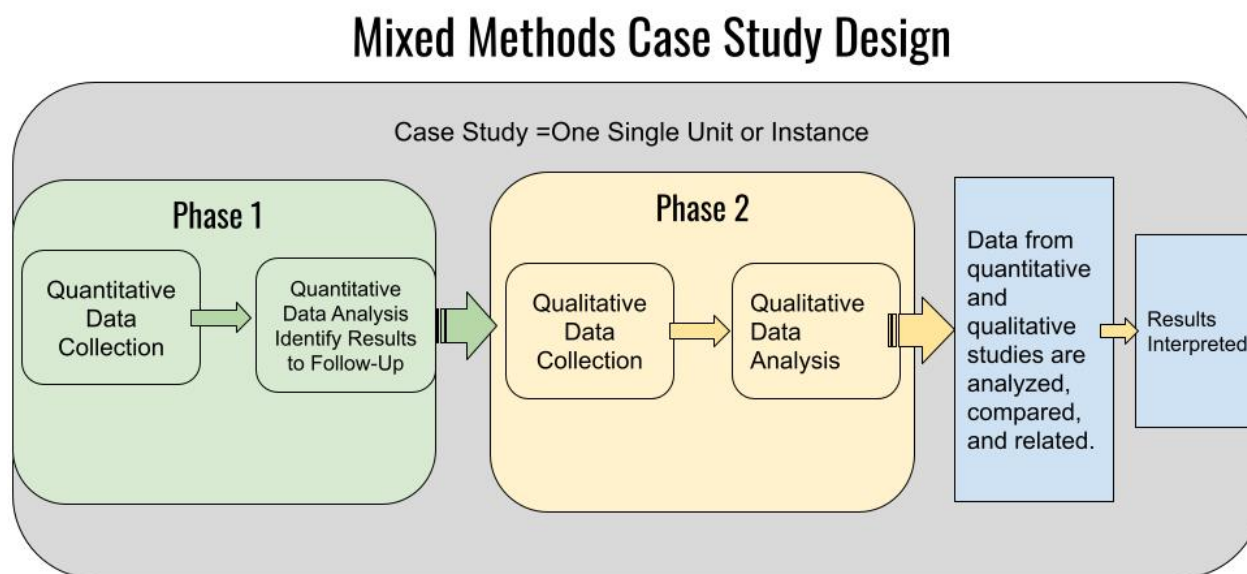
In this chapter, I describe my research design and rationale to address my study questions. I share the research site, participants, and sampling frame and sample. Following with the procedures that will outline the recruitment process, teacher sample, development of instrumentation tools, and report on my data collection and analysis process. Finally, I will share the trustworthiness and researcher positionality of my study.

Mixed Method Case Study Design

Overview

The mixed methods case study design involves the use of a core design (explanatory sequential) within the framework of a single case study design (Creswell & Creswell, 2018). Within this framework, the explanatory sequential mixed method case study is one where one type of data informs the other and the findings are analyzed, interpreted, and integrated to examine a case (see Figure 2.1). Case study researchers collect detailed information using a variety of data collection procedures within one single unit or a single instance (Yin, 2014). The intent of the design is to study a case in depth using both quantitative and qualitative data to answer the research questions. Case studies use the integration of data to make the findings even more robust.

Figure 2.1: Methods Design



Data Source: Adapted from Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (Creswell, J. & Creswell, J.D., 2018)

The complex nature of the mixed methods case study lends itself to strengths that create a study that has detailed rich information. In the design, the use of both quantitative and qualitative data gives a better understanding of the problem and yields more complete evidence. The case study allowed insight to transferability and future research. Key elements and themes emerged from the data. The detailed information of a single case allows readers to make connections between elements from the study with their own experiences. The information brought about an understanding that in turn can affect and perhaps even improve practice within the field.

Alternately, case studies are limited to a specific group or incidence. Due to the complexity of gathering such detailed information and the need to focus in on one group, generalization to a larger population does not apply. It is inappropriate to create any generalizations to the rest of society, organizations, or a larger community. The findings should only apply to other groups with similar circumstances and experiences (Creswell & Creswell,

2018). Also, time is a limitation within such a complex study. With utilizing both quantitative and then qualitative methods, ample time is needed for data collection and analysis which can be challenging due to participants willingness to engage with the study.

Within this explanatory sequential mixed methods case study, the research questions were investigated through one school district. The first phase of the data collection process was quantitative. I used a survey to identify teachers' culturally sustaining beliefs and their implementation of culturally responsive practices for their students of color to participate in the second phase. The quantitative survey research identified participants for the more in-depth follow-up. The second phase of data collection was qualitative. Individual interviews and documents were shared by the participants and were used to further analyze and compare to interpret the findings. The key component of this method is having one group to study with both quantitative and qualitative data to provide a more in-depth analysis of the findings (Creswell & Creswell, 2018). There were strengths and limitations in the use of survey, interview and documents for data collection which will be described in further detail. The rationale on the importance of the instruments and tools for the study will be shared.

Survey Research

Strengths

Survey research has many benefits. There are conveniences in surveys that allows for higher rate of participants due to the efficiency. Participants take surveys quickly and easily from their home or work. This capability allows for a larger participant rate and gathers more data for the study. Another strength of a survey is the broad range of data that is collected such as attitudes, opinions, beliefs, and behavior. From a researcher's perspective, survey data allows for a wide range of data collection on a topic. Lastly, survey data offers a straightforward analysis

and visualization of the data. The data findings can easily be turned into reports, charts, and tables to visually understand.

Limitations

A few notable limitations to survey data relate to length and design. Length of a survey could lead to people not thoroughly reading each question and responding in an authentic way. The amount of time a participant takes a survey does matter. Survey fatigue leads to response bias. It also deters a participant finishing the survey. A survey's strength has flexibility in the design, but also could be a limitation. Developing the wrong questions could lead to inaccurate data.

Rationale

There were a few reasons why survey research was selected for the first phase of this study. Survey data was used to identify teachers who had culturally sustaining beliefs and implemented culturally responsive practices. First, it allowed for a large participant rate and a quick way to identify participants for further study. The study needed a large enough participant rate to narrow the target sample. The research tool provided an efficient and quick way to accomplish that. Also, surveys allowed for a wide sample of questions around a specific topic. To identify the participants, the survey offered a wide sampling of questions around beliefs, attitudes, and practices that addressed the research questions. The variety helped identify teachers who had culturally sustaining beliefs and attitudes about their students of color.

Interviews

Strengths

Interviews have many strengths for a research study. It provides more in-depth information. Interview questions are typically open-ended so that rich information is collected. In

addition, interviews help to explain, better understand, and explore the participants' opinions, behavior, experiences around the research questions. The researcher has control over the line of questioning. If they need more information, they can gather it in the moment. Lastly, when interviews can be face-to-face, it allows for a more accurate screening.

Limitations

While there are many strengths to data collection through interviews, there are some limitations. Above all, it is time consuming with audio recording and transcribing each interview. Depending on if you hire someone to transcribe or manually, it generally is more time intensive. Furthermore, there is less anonymity which for some people creates some hesitancy in sharing information and/or participating in the interview. It can also be challenging to get participants due to the length of time and participation it entails.

Rationale

Interviews were an essential component to this research study. It allowed me to further investigate teachers who had culturally sustaining beliefs about their ethnically, culturally, and socio-economically diverse learners. This specific qualitative data collection tool helped to explain, better understand, and explored the teachers' opinions, behaviors, and experiences of planning and implementing culturally responsive practices. Face-to-face interviews were optimal due to the higher level of engagement, and I strived for this. If for any reason, participants were hesitant due to COVID, Zoom interviews were provided. Additionally, to understand teacher's experiences with culturally responsive practices, interviews had the flexibility in the design to address those practices. I created an interview protocol aligned to the survey responses and the Culturally Responsive Framework to dig deeper into their experiences (see Appendix A-Culturally Responsive Framework). Likewise, I controlled the line of questioning with an

interview protocol. In an effort to decrease bias, the protocol helped to ensure that I did not provide leading questions. A protocol provided focus for everyone involved.

Documents

Strengths

Another way to gather qualitative data was through documents such as lesson plans and student work samples. Documents have a couple strengths to a research study. Utilizing documents are an additional way for a researcher to capture the language and words of participants. The opportunity for participants to select documents to share with an interviewer, allows for a deeper understanding of the participants' values and an illustration of teachers' practices. Furthermore, participants sharing documents for data collection is a time saver for the researcher. It is one less piece of data that needs to be transcribed unlike interviews.

Limitations

Conversely, documents such as lesson plans and student work samples are limiting in knowing exactly how the teacher is using the documents in their practice. To fully understand teachers' culturally responsive practices, documents are one insight. For example, the lesson plan document is a great way to see a teacher's thinking into their planning practices for students of color, but how they are using the lesson plan document for implementation is another factor. Documents can provide one aspect of teachers' classroom practices if observations are not a part of the study. Additionally, documents being shared may be incomplete. This creates difficulties in utilizing data for analysis.

Rationale

The utilization of documents in this study helped focus the interview and provided some additional depth to the conversation around teachers' culturally responsive practices. Teachers

were requested to bring documents and artifacts around a math unit they thought was the most culturally responsive to their students to the interview. It allowed me to understand what they valued and gave attention to when they were planning and implementing instruction for their students of color. Teachers selected sample assignments, lessons/tasks, and student work specifically of their ethnically, culturally, and socio-economically diverse learners to illustrate their culturally responsive practices. This additional data collection piece helped develop stronger themes across the participants. Simultaneously, the interview data and documents provided multiple ways to capture the teachers' language and words. It allowed me to understand teachers beyond just an interview and expanded on how they thought about organizing their plans and implementation of their mathematics lessons.

Rationale

I chose to approach the study through a mixed method case study design for a few reasons. The overall goal of the study was to investigate only teachers who had culturally sustaining beliefs of their students of color and their teaching practices within mathematics. Additionally, the research explored what contributes to or limits teachers' use of culturally responsive practices. To fully understand the research questions, a mixed methods case study allowed for depth of information on this topic.

First, a mixed methods case study, investigated teachers' culturally responsive practices with more depth through one school district. By using one school district, the culture, training, planning and implementation of math units for participants' students of color had similarities unlike using multiple school districts with a different set of culture and training expectations. The similarities in one district allowed me to dive deeper into the research questions without adding other complex variables. Equally important was the need for a mix of quantitative and

qualitative approaches to narrow in on a population of teachers with a culturally sustaining asset-based lens to study and investigate their practices. The survey identified the teachers for the interviews. The interviews and documents collected more information on the teachers' practices and what limits and contributes to their daily use. The strength in choosing this design was the depth of analysis and descriptiveness of one case for transferability purposes. For example, teachers or districts in a similar context could identify elements that might transfer to their own classrooms and districts to increase their use of culturally responsive practices daily. The use of a mixed methods case study design illuminated the complex realities of culturally responsive practices within mathematics.

Research Site

The mixed methods case study was conducted within a suburban school district in the Midwest. The suburban school district consisted of four diverse townships. The large population of ethnically, culturally, and socio-economically diverse learners along with the grade span and size made this a good fit to research. Another reason for the selection of this district was their strategic goal of equity across schools. Their equity journey included implementing culturally responsive practices. In the district's plan for implementation, they consulted with an outside organization to provide ongoing training to all staff. The implementation of culturally responsive practices was a multi-year plan with learning around mindset and skillset.

The school district has approximately 6,000 students across Pre-K-8th grade. The district has one preschool center, 11 elementary and three junior high buildings. The demographics of the school district has over 30 different languages spoken in the home with 44% of students identified as English Learners. The racial/ethnic diversity make-up is 43% Latinx, 32% White, 12% Asian, 3% Black, 2% American Indian, and 8% two or more races/ethnicities. The

socioeconomic diversity has approximately 58% of students coming from low-income homes. Due to the district's size and demographics, it was a right fit in diverse student population and sample size of teacher participation.

Participants

Based on the literature review, culturally responsive teaching practices were less studied at the elementary level. The participants were 3rd-8th grade teachers of mathematics in elementary and junior high buildings that had large ethnic and culturally diverse populations. While the aim of the study was to include junior high teachers, the quantitative survey findings had a low participation rate of 6th-8th grade teachers. Due to the quantitative findings, the focus for the qualitative interviews was on 3rd-5th grade mathematics teachers. This challenge allowed the study to focus more on a group of teachers who teach multiple subject areas beyond math and to dig deeper into their contributions and limitations to implementing culturally responsive practices every day.

Being an insider, however removed since 2021, I was provided easier access to the participants by emailing the quantitative survey through the principals. The connection with the district likely allowed me permission to do the study with the participants. For some of the participants being interviewed, their familiarity with me helped build rapport which is a key element in conducting successful qualitative interviews. An additional factor in analyzing the quantitative data, came down to the participants willingness to participate in a follow-up interview. The quantitative data were narrowed down to six participants who qualified to be invited for the interview. The participants included five females and one male.

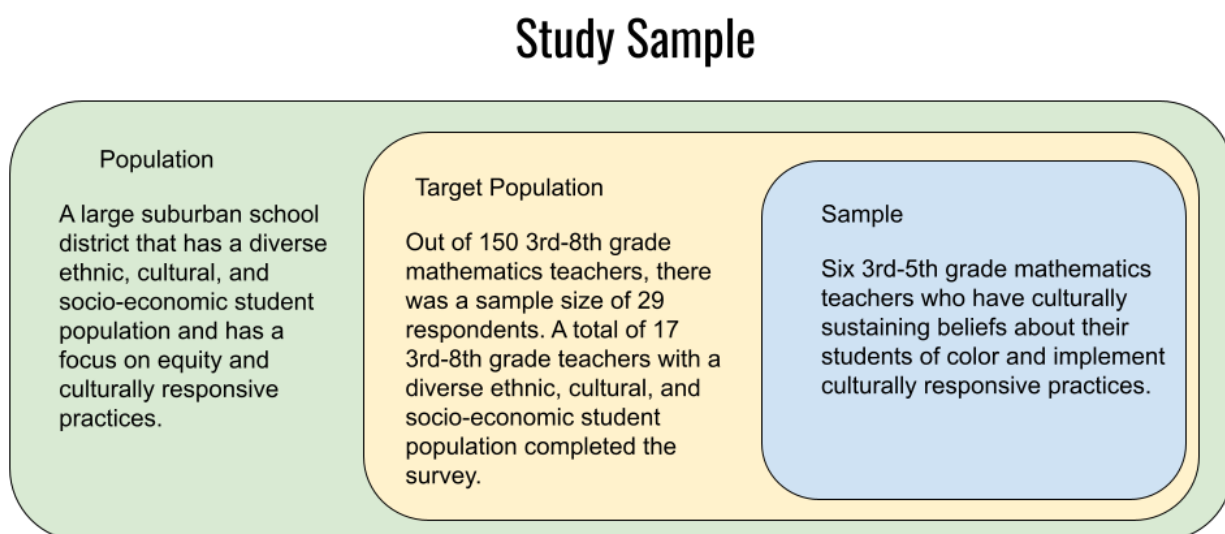
Sampling Frame and Sampling

Non-probability and convenience sampling were used in the first phase of the quantitative data collection process. Out of the 15 schools within the school district, the quantitative survey was distributed to approximately 150 teachers within 14 schools due to the age group of students. Mathematics teachers in 3rd-8th grade voluntarily took the survey due to their interest level in the topic. Since this district had a focus on equity and culturally responsive practices, the response rate was expected to be above average due to interest. A typical survey response rate in educational research and some social sciences is between 20-30% and the actual target sample was 29 respondents with 17 completing the survey. Of the 29 survey respondents, 15% (n=4) were junior high teachers. Unfortunately, the 15% (n=4) did not have high findings in culturally sustaining beliefs about their students of color. The target population generated enough responses for ample representation in 3rd-5th grade while giving a variety of behaviors and experiences to analyze.

Purposeful sampling was used for the qualitative data collection process. To identify teachers who had culturally sustaining beliefs to investigate their practices and understand what limits and contributes to their use, a purposeful sampling was needed. From the 17 teacher responses, a sample of six 3rd, 4th, and 5th grade teachers was selected to be interviewed. The Culturally Responsive Framework was used to identify and select teachers from the quantitative survey data (see Appendix A-Culturally Responsive Framework). Although, the non-probability sampling did not produce enough 6th-8th grade teachers to participate and identify a culturally sustaining mindset in the study, the elementary teachers provided a focus on the practices. Since elementary teachers taught all content areas and have less plan periods than the junior high teachers, the focus on 3rd-5th grade allowed for a deeper insight to using culturally responsive

practices with these complexities. The amount of data collected from six teachers interviews and a few shared documents provided abundant information to analyze, which offered insight to the research questions. In Figure 3.1, the study sample is provided with a description of the sampling frame and sampling.

Figure 3.1: *Sampling Frame and Sampling*



Procedures

Recruitment and Teacher Sample

After identifying the suburban school district to use in the study, a connection with the Superintendent was made to request participation from their teachers. After approval was granted, the building principals sent my invite through email to their 3rd-8th grade mathematics teachers to participate in the survey. It was based on the time they had and their willingness to take part in the study. The survey data findings showed of the 150 3rd-8th grade mathematics teachers within the district, a target sample of 29 respondents and 17 teachers completed the

survey. Originally, the study was to have participants in both grade bands 3rd-5th and 6th-8th. Unfortunately, the survey findings did not indicate many 6th-8th grade teachers with a 15% (n=4) participation rate. The target sample of 17 teachers who completed the survey were entered into a raffle to win one of three \$25 eGift Cards to Amazon. This information was shared with the teachers in the introduction email to encourage higher levels of participation (see Appendix B-Survey). The sample size for the qualitative interviews were six 3rd-5th grade mathematics teachers who were identified as having the strongest responses aligned to the Culturally Responsive Framework.

In the second phase of the study, six teachers were invited to participate in an in-person interview. With the district's strategic goal of equity across schools which entailed implementing culturally responsive teaching practices, a sample of six 3rd, 4th, and 5th grade teachers were interested in the topic and took part. Additionally, my experience working within the district possibly interested a few teachers to participate. Each teacher who accepted received a multicultural math book set for their classroom. The book set was shared within the introduction letter to increase participation.

The next phase was qualitative and included six 60-minute one-on-one interviews to dig deeper into the quantitative data responses provided by the participants. To situate the interview around concrete examples and discussion points, a request was made for the six participants to bring documents and artifacts around a math unit they thought was the most culturally responsive to their students. Sample assignments, lessons/tasks, and student work specifically from an ethnically, culturally, and socio-economically diverse learner were to be used to create clarity on their daily practice. Three out of the six participants brought documents and artifacts around a math unit. The common reason for a lack of artifacts was due to it being summer and not having

access to the documents which were at their school. All interviews were in-person, except for two that were virtual due to COVID symptoms. A secure iPad was used to audio record the conversations in-person and the use of quick time player on a secure Mac device to record audio while on Zoom.

Instrumentation

The development of the research tools started with the creation of a framework to tie the quantitative and qualitative study together. The Culturally Responsive Framework aligned the research questions and the theoretical framework of the foundational pillars of culturally responsive teaching (see Appendix A-Culturally Responsive Framework). These two components were used to provide examples of what the pillars would look like in practice. Most of the pillar examples came from multiple studies in Geneva Gay's work around culturally responsive teaching (Gay, 2018). To build a wide variety of examples on what each pillar looked like in practice, multiple sources were used including a performance rubric from The Center for Collaborative Education (2017). The New York State Education Department created a Culturally Sustaining Framework to provide a guide to teachers in the implementation of these practices (NYSED, 2019). I adapted examples of the different components to provide a robust framework to guide the study. The framework anchored the development of the survey questionnaire, interview protocol, and documents gathered such as sample assignments, lessons/tasks, and student work and created clarity on their culturally responsive teaching practices. A pilot study was used to refine the instrument tools to be used within the research. The survey questionnaire, interview protocol and the pilot study will be described in further detail.

Survey Instrument. The purpose of the survey was to identify teachers who had a culturally sustaining beliefs and implemented culturally responsive practices (see Appendix B-

Survey) of their students of color. The 56-question teacher survey was created in Qualtrics for a secure and safe data collection. The structure and development of the survey was closely connected to the Culturally Responsive Framework. From the framework, the five sections were organized around educational background, teacher beliefs, instructional practices, instructional planning and implementation, and personal background information. For example, within educational background and experiences, questions included racial and ethnic identification, pronoun identification, reasons for entering teaching, additional certifications, years of teaching experience, professional learning around culturally responsive teaching, and personal experience of schooling.

Each section explored different aspects of being culturally responsive and implementing best practices. For instance, the survey included Likert-scale questions and hypothetical teaching scenarios to assess teachers' beliefs and expectations about their ethnically, culturally, and socio-economically diverse students. Participants responded to items such as, "I routinely reflect on my own life experiences and membership in various social groups (such as by race, ethnicity, social class, and gender), and I ask myself about how these factors influence my beliefs about cultural diversity" and "If I have an option, I teach in a place where people have different cultural characteristics different from my own culture" by choosing if they disagree or agree on a 5-point Likert scale. The development of the survey was crafted to address all aspects of the Culturally Responsive Framework to dig deeper on specific questions in the individual interviews. To recruit as many teachers as possible, a 20-minute maximum survey tool was developed in Qualtrics for more engagement around the topic. The participants received it through email in the spring of 2022 to ensure the individual interviews were administered in the summer of 2022.

Interview Protocol. The individual interviews were developed by drawing on the survey questions to learn more about their culturally responsive practices (see Appendix C-Individual Interviews). The Culturally Responsive Framework continually guided the organization and development of questions for the interview. To situate the interview around concrete examples and discussion points, a request was made for teachers to bring documents and artifacts around a math unit they thought was the most culturally responsive to their students. Sample assignments, lessons/tasks, and student work specifically of an ethnically and culturally diverse learner were used to create clarity on their daily practice. To better understand the teachers' background and experiences, questions were created from the survey to further explore their experiences that led them to being culturally responsive to their students. For example, an open-ended question in the survey asked about having a different ethnic and culturally diverse experience than their teacher growing up. If they did, they reflected on a teacher that helped them learn and grow and to share that experience.

The 24-question interview tool was organized in a similar manner as the survey. The first four sections of the interview questions; background experience, teacher knowledge of students and community, instructional planning and implementation, and discussion of tasks and student work samples were tied to sample assignments, lessons/tasks, and student work in one math unit. The last component of the interview tool explored the teacher's perceptions of possible contributions and limitations to implementing culturally responsive teaching practices. To engage the teachers around these questions, a method of sort, rank and discuss cards were used. A list of cards was created with possible throughs on what contributes to or limits a teachers' use of culturally responsive practices, which allowed the teacher to add items to the list, and rank the cards in order of importance. From there a discussion of why each card was of importance and

examples of those were given. The interview tool was designed to gain a deeper understanding around teachers' culturally responsive practices and what contributes to or limits them from using these practices.

Pilot Study. To further develop the research tools, in the winter of 2021, a pilot study was implemented in which a survey was provided to four teachers who taught in an ethnically, culturally, and socio-economically diverse classroom in a suburban school. Additionally, one individual interview was conducted as a follow-up with a teacher as well. This preliminary study refined and revised survey and interview protocols. It gave an opportunity to see where there might be more to learn from the research questions. For instance, some questions were eliminated that did not result in an understanding around their implementation of culturally responsive practices. For example, all four teachers rated a statement as neither agreeing or disagreeing, which determined the need to eliminate the question. Also, the findings of the pilot study indicated that certain questions were confusing and did not produce any significant information for the research. The organization of the questions were revised to help create a deeper discussion around certain areas. For example, some interview questions were spaced out and did not connect with the previous topic. The interviewee did not expand because it was disconnected to the previous topic. It felt more surface level than a deep discussion. Lastly, it allowed me ways to engage teachers in the conversation during the individual interviews to get a clearer picture of their beliefs, instructional practices, and thoughts on the contributions and limitations of these practices.

Data Collection

Quantitative. In the first phase of the mixed methods case study, I obtained quantitative findings from a 56-question survey administered and completed by 17 3rd-8th grade

mathematics teachers. The data from Qualtrics was compiled into excel for analysis. The participants received the survey through email in the spring of 2022 to ensure the individual interviews were administered in the summer of 2022.

Qualitative. The second phase of the study was qualitative, and data was gathered through individual interviews and teacher selected documents. The purpose of the individual interviews was to understand the depth of their culturally responsive practices and what contributes to and limits their ability to implement more regularly. After administering the survey and analyzing the data through excel, six 3rd, 4th, and 5th grade teachers were identified and invited for individual interviews for a deeper analysis of their practices. Each interview was recorded by a software program and transcribed by a professional transcription service.

For the interview, a request was made to the teachers to bring a math unit in which they planned and implemented culturally responsive practices well for their students of color in addition to student work samples. Three out of the six participants were able to provide these documents. The math unit and documents anchored the questions for the discussion and provided more detail around specific planning and implementation practices. For instance, the questions allowed participants to use those documents to explain why the math unit was culturally responsive for their students of color, what did their students of color know going into the unit, and what were the main influences in their planning for the math unit. Regarding their student work samples, they shared a typical and an exemplary piece of work specifically of their ethnically and culturally diverse students. The interview questions explored the samples they chose and why. Lastly, to gather more in-depth conversations around what contributes to and limits teachers' use of practices, a sort, rank and discuss process was used. The data from the

survey identified some initial items for the sort. Having already curated examples and an opportunity to add more, created a deeper discussion around the questions.

Data Analysis

In phase 1, the survey was used to form a descriptive, quantitative profile of the 3rd-8th grade math teachers. From the survey, each question under the teacher beliefs, instructional practices, planning, and implementation were calculated for mean, median and standard deviation and tabulated frequencies to provide a picture of teachers' beliefs and instructional practices. From the data analysis of the reports and graphs, six 3rd-5th grade mathematics teachers were identified based on their strong ratings with an alignment to the Culturally Responsive Framework. The six participants' quantitative survey responses were used in the interviews to discuss with more intimately their beliefs, planning and implementation for their students of color.

In phase 2, the individual interviews were audio recorded and transcribed. Drawing from the written documents, all transcripts were coded with deductive coding strategies. I referred to Tesch's eight steps in the coding process to guide the analysis of the data (Creswell & Creswell, 2018). The eight steps outlined a specific coding procedure that is typically used in research. I developed a coding scheme to align to the Culturally Responsive Framework (see Appendix A-Culturally Responsive Framework). A manual process was used to code the interview transcripts, creating a folder for each round of interviews that included a copy of the interview questions, copies of the audio files of the interviews, and sample documents of the math unit.

Trustworthiness

As a mixed methods case study researcher, the work was approached with the highest of standards for the study and the participants. First, it was important for me to have honesty,

transparency, trust and empathy with the participants. There were multiple ways in which these traits were implemented within the study. It started with using multiple data components for integration. Survey data, interview data and documents were collected for this purpose. Rigorous data collection techniques were used, such as applying safe and secure software programs for the survey and interview audio recordings and use of a transcribing company for accuracy.

Additionally, it was crucial to have interview protocols that entailed a script and a prioritization of questions towards my research questions to ensure to not provide any leading feedback as they responded. Also, the data analysis process was tied closely to Tesch's eight steps to the coding process and aligned to the Culturally Responsive Framework (Creswell & Creswell, 2018). Throughout the study, the findings and elements were reviewed with a critical friends' group. Furthermore, each aspect of the data collection and analysis process was detailed for transferability. Since the research focused on one district, the description of the location, participants, data collection and analysis, allowed for the readers to determine key elements or themes that transfer into their learning contexts.

Researcher Positionality

The dedication to this work stems from having a long-standing, deep commitment to culturally responsive teaching practices for ethnically, culturally, and socio-economically diverse learners. For the past 16 years within leadership, I have worked in the case study district supporting various staff in trying to find the best way to foster deep learning for students of color. Being an insider, however removed since 2021, provided me easier access to participants and there was familiarity of the work on culturally responsive practices. The connection with the case study district likely allowed access to conduct the study with the participants. For some of

the participants interviewed, the familiarity with me helped build rapport which is a key element in conducting successful qualitative interviews.

Nonetheless, it also had some potential drawbacks such as participants withholding information that they assume to be obvious to me or telling me what they think I want to hear or know. To address those limitations, I was aware of the assumptions that stem from personal experiences and beliefs around culturally responsive practices and how it affects the research process. For this very reason, a pilot study was created to share the survey and interview protocols with others inside and outside of the district to reflect on potential biases. As the data were analyzed, I engaged in dialogue around the findings and themes with a critical friends' group to give feedback on the work. This reflective practice provided me with outsider perspectives and challenged possible assumptions. Due to my familiarity with the research topic and the participants involved, I was reflective on the credibility, dependability, and transferability of the study.

Summary

In this chapter, a detailed description of the methods design and rationale was provided on the approach to address the research questions. To gain a deeper understanding about teachers' culturally responsive teaching practices within mathematics and the factors that contribute to or limit their use, this design was the best fit. It was important to design the research tools through a culturally responsive framework that would link the research questions, theoretical framework and what it looks like in classroom practice. As the methodology was developed in more detail, it allowed reflection on the framework to ensure the data gathered would address the research questions. Each component of the study on the development of research tools, location and participants, and data collection process, allowed data analyses

sequentially building off one another. Lastly, I shared the trustworthiness and positionality that contributed to the study. The opportunity for reflection on these two areas solidified the research.

Chapter 4: Findings

Introduction

In this chapter, I present a summary of the findings and an analysis of the data to address and answer the research questions that guide this study. This study and its findings were guided by three research questions:

1. What are teachers' attitudes and expectations about supporting their students' ethnic, cultural, and socioeconomic diversity in mathematics?
2. What ways, if any, do teachers who have culturally sustaining beliefs use culturally responsive teaching practices in mathematics?
3. What limits or contributes to a teachers' use of culturally responsive teaching practices in mathematics?

Based on the explanatory sequential mixed methods case study findings, all participants have an appreciation and value of their students' culture and language. More specifically, a few teachers shared similar lived experiences to their students which in turn gave a deeper level of acknowledgment and understanding. Even though there was an appreciation, being culturally responsive to their students' needs within mathematics had some challenges and disconnects. An unexpected finding when exploring their culturally responsive practices was the effect of adopting a new math curriculum. The study revealed a tension between implementing the new math curriculum with fidelity and pacing expectations and the teacher's ability to provide culturally responsive practices.

Survey Participants and Survey Findings

The quantitative data findings showed of the 17 completed survey respondents, 90% (n=15) of the participants were teachers of dual language classrooms or English Learner

classrooms. Due to the additional endorsements these teachers needed to teach in those classrooms, the average college courses taken on students of color were four-to-five classes. Additionally, 15 survey participants have not participated in additional mathematics classes beyond their bachelor's requirement. A majority of the participants had five years or more of teaching experience with 80% (n=13) having their master's degree. Since this district had a focus on equity, all teachers had engaged in culturally responsive training. The following table contains a sample breakdown of demographic information regarding the 17 quantitative survey participants (see Table 1.1).

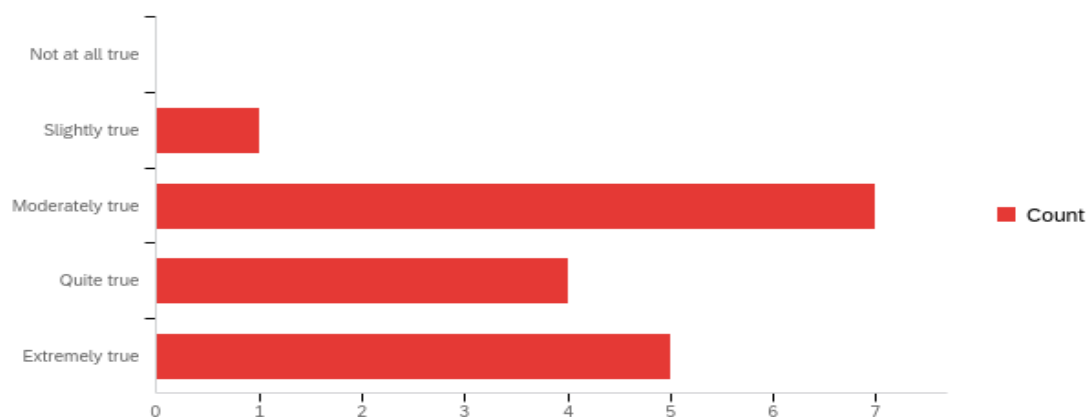
Table 1.1: *Quantitative Survey Participants (n=17)*

Participant Characteristics	Respondents (n=17)
<i>Grade Band</i>	
3-5	13
6-8	4
<i>Years in Teaching</i>	
Less than 5 years	6
Between 5 and 20 years	7
More than 20 years	4
<i>Type of Program</i>	
Dual Language	11
ESL	4
General Education	2
<i>Additional Mathematics Courses</i>	
Yes	2
No	15
<i>Professional Learning on Culturally Responsive Practices</i>	
Yes	17
No	0

The overall quantitative survey data showed a range of teacher response levels from significant to minimal culturally sustaining beliefs and practices for their ethnically, culturally, and socio-economically diverse learners. The quantitative survey data findings identified teachers who had culturally sustaining beliefs for the qualitative study. From examining the teacher responses within the three sections of the survey, the variability became more prevalent when reflecting on beliefs within the context of implementing mathematical practices. For instance, when teachers reflected on beliefs around ethnic and cultural diversity, 16 participants agreed or strongly agreed with statements such as “I routinely reflect on my own life experiences and membership in various social groups (i.e., race, social class, ethnicity, gender)” and 11 participants agreed or strongly agreed with “I feel comfortable having conversations about race with my colleagues and my students.” When the statements shifted to a math focus, there became more of a span within the findings. For example, Figure 4.1 shows a data sample of teachers’ responses on their beliefs about learners in math.

Figure 4.1: *Sample Teacher Beliefs Survey Response About Learners in Math (n=17)*

Reflecting on my cultural identity will positively impact my attitude and teaching practices for my students in math.

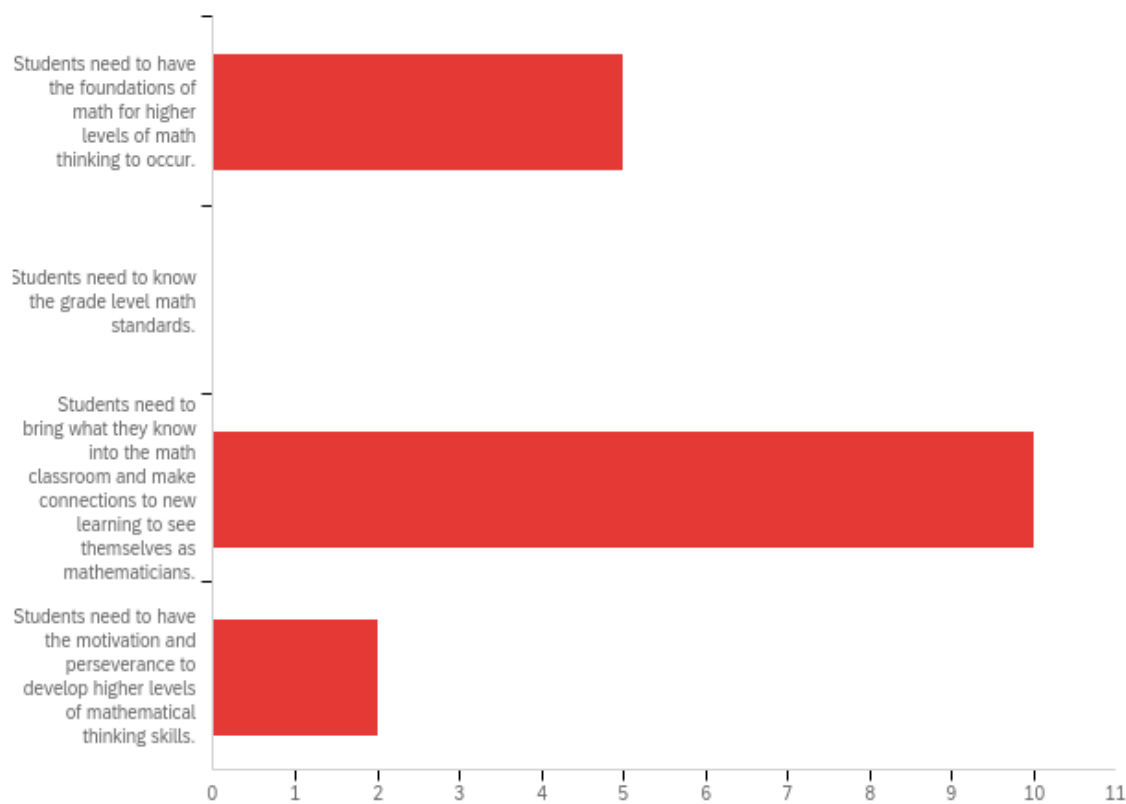


When participants were asked a statement about “Which of the following do you think is the MOST IMPORTANT factor for ethnically and culturally diverse students to be successful in

your math class” the span of responses continued (see Figure 5.1). The findings showed that some participants had a strong belief about students within math, and others have a deficit belief.

Figure 5.1: *Sample Survey Participant Responses About Success in Mathematics (n=17)*

Most Important factor for diverse students to be successful in your math class.



As well as, the data findings showed divergent responses within instructional practices, planning and implementation. Out of a 5-point Likert frequency scale with 10 statements on the planning and implementation of mathematics, the survey findings had a mean range from 2.35-4.25 with a SD of .66-1.13 (see Table 2.1). Planning and instructional practice statements like “I use information about my students' lives outside of school to increase engagement and make my math lessons more meaningful” created a wide spread of findings of implementation from two participants responding *never* to two participants responding *always* with the rest of the

participant responses in between. In contrast, statements such as “I intentionally find ways in my math lessons to bridge academic math language and my students' social language" had the most participants implementing these culturally responsive practices often.

Table 2.1: *Sample Participant Responses on Implementation of Mathematical Practices (n=17)*

How often do you implement the following instructional practices?	Minimum	Maximum	Mean	Standard Deviation
I use information about my students' lives outside of school to increase engagement and make my math lessons more meaningful. I use surveys in math to find out about my students' classroom learning preferences.	1.0	5.0	3.19	1.13
I use books, articles, films, music, audio recordings, and a variety of other resources from the Internet that explain and visualize examples of different ethnic groups' cultures and communication within math.	1.0	4.0	2.75	1.09
I use surveys in math to find out about my students' classroom learning preferences.	1.0	4.0	2.38	0.99
I provide different math problems to students based on their learning needs.	1.0	5.0	3.44	0.93
I use varied modes of communication in teaching and performance assessments to capitalize on students' strengths, including written, verbal, visual, tactile, and kinetic modalities. They have a choice in how they show me what they know in the learning targets.	1.0	5.0	3.88	0.93
I integrate resources from my students' culture into my math lessons.	2.0	5.0	3.31	0.92
I begin my math lessons with what my students already know from their homes, communities, cultures, and school.	2.0	5.0	3.50	0.79
I am the gatekeeper of the lessons and learning targets, I let students use	3.0	5.0	3.88	0.78

manipulatives in the lesson to show me what they know.

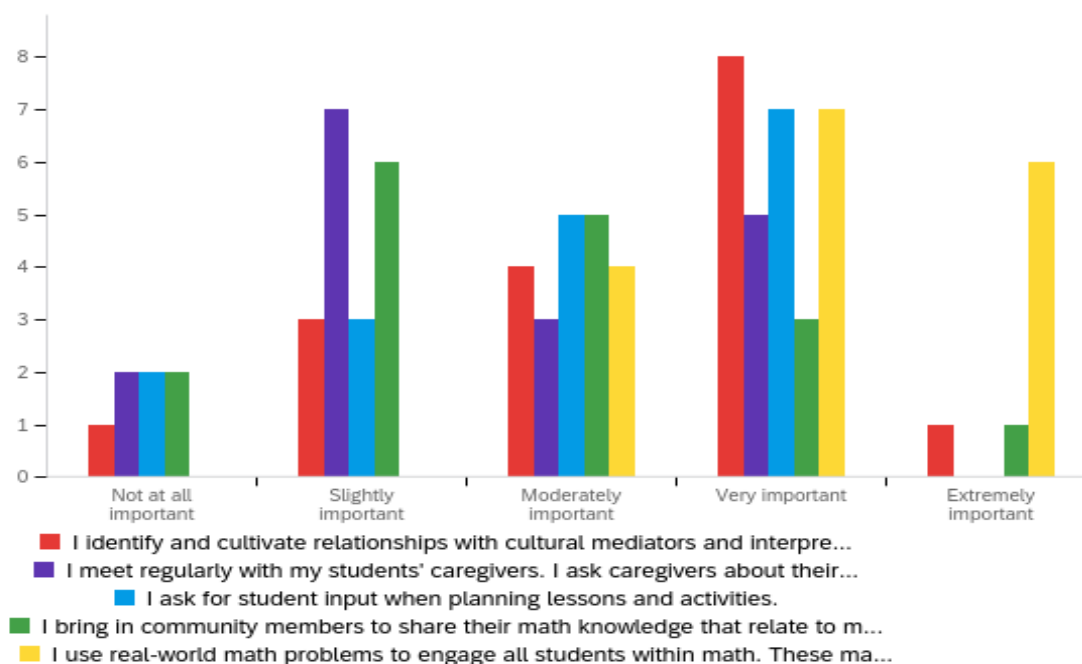
I provide students an opportunity to decide what math strategy they would like to use in solving a math problem.	3.0	5.0	4.25	0.66
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I <u>intentionally</u> find ways in my math lessons to bridge academic math language and my students' social language.	3.0	5.0	3.94	0.66
--	-----	-----	------	------

Overall, at least 10 participants were implementing a variety of practices sometimes and often. Alternatively, there were a few participant responses of never or rarely implementing these practices and it became more pronounced within each survey section. For instance, there were four teachers who said, "I rarely integrate resources from the students' culture into my math lessons." Additional survey section findings on planning and implementation, showed the participants display a range of ways they used their students' culture and language within mathematics. Some teachers were utilizing students' culture and language and others were not. On the one hand, when asked about how important it was to plan and implement for a math unit with real-world math problems to engage all students, all participants agreed it is of some importance. On the other hand, there was mixed responses on the importance (not at all to extremely) of bringing in community members to share their math knowledge that relate to their students' culture and language. Figure 6.1 shows a sample of the diversity in 17 survey responses.

Figure 6.1: Sample Participant Survey Responses on Planning & Implementing Math (n=17)

Q18 - When planning and implementing a math unit, rate how important the followin...



In conclusion to the quantitative survey data analysis, when referring to the Culturally Responsive Framework with the findings, there were survey participants who presented alignment or misalignment to these practices. The quantitative survey participants who showed consistent responses on their culturally responsive practices were identified as strong candidates for the qualitative in-person interview. The survey findings identified six 3rd-5th grade mathematics teachers for the in-person interview. The six 3rd-5th grade participants survey data findings were used to expand on in the qualitative interview. The participants consisted of five females and one male. There were some diversities in participants' ethnicity, age, and years of teaching. The following table contains a breakdown of demographic information regarding the six qualitative participants (see Table 3.1).

Table 3.1: *Summary of Qualitative Participants (n=6)*

Name	Ethnic Heritage	Age	Sex	Years in Teaching
Alex	Caucasian	32	Male	4
Lynn	Japanese	54	Female	10
Catalina	Caucasian/Hispanic	45	Female	21
Rachel	Caucasian/Hispanic	24	Female	1
Venessa	Caucasian/Hispanic	42	Female	2
Lily	Hispanic	23	Female	1

Overview of Elements

Based on all six interviews and a few pieces of artifact data from a couple of participants, the findings were organized around the six major elements tied to the Culturally Responsive Framework. The major elements from the Culturally Responsive Framework that the data highlighted were teacher attitudes and expectations, cultural communication, diverse content in the curriculum, cultural congruent instruction, limitations, and contributions. The findings drew sub-elements and were organized under the three research questions. Overall, the findings illuminated some aspects of the Framework as well as areas of continued growth. This reiterates the complexities in implementing culturally responsive practices. Teaching is multifaceted and each teacher's response and understanding around culturally responsive practices were diverse. It was evident when some teachers shared more responsive practices than others.

Two areas of significance to be discussed throughout the elements were districtwide culturally responsive training and a newly adopted math curriculum. All six participants reported

on these two areas and its impact on their practices for their students. The findings indicated all participants were provided districtwide culturally responsive training and they all reflected on their own identity and practice. Each participant shared one strategy they implemented with mixed results. Another area of high participant response was around the newly adopted math curriculum. The newly adopted math curriculum had a substantial impression on the teachers' practices and created tension in meeting their students' ethnic, cultural, and linguistic needs. The culturally responsive framework elements and sub-elements explored these two areas within more depth.

Evidence of each element of the Culturally Responsive Framework are provided in the sections ahead. An overview of evidence examples across the teacher participants within the elements are shown (see Table 4.1). In the sections that follow, each research question, element and sub-element are explored with a general overview and a subsequent and more descriptive account of each participant's interview and artifacts.

Table 4.1: *Overview of Six Elements and Responses*

Elements	Teacher Response
<i>Teachers' attitudes & expectations</i>	Rachel: I think again just taking the time to build those relationships with students. Getting to know them outside of the academic environment and to know who they are as people I think is very important. You are able to bring that into the classroom and realize what is more engaging or meaningful or fun for them. If those things are more engaging and meaningful then they are being more successful too.

Cultural Communication **Lily:** I have heard my students during break sing Bidi Bidi Bom Bom by Selena the Latina singer. They listen and sing to her songs. So I came up with using the Bidi Bom song in class, I say bidi bidi and they go bom bom. When we chant like this, they know it is my way of bringing them back to class after small group or individual discussion.

Diverse Content in Curriculum **Catalina:** We talked about migration and movement in the math module. A lot of the kids shared their family's immigration stories. And that being I am adopted knowing that my birth father was an immigrant helped me to connect to them and their stories.

Culturally Congruent Instruction **Rachel:** I learned that my students were sportier and more athletic and I realized they needed to move around a lot. So, a lot of times I would try to incorporate movement into our lessons. I remember one of the best lessons I did was this lesson on measurement conversions. The example used in the book was about the broad jump and I think converting from meters to centimeters or something like that. So rather than using the examples given in the book I had the students use a meter stick and do the jump themselves and do their own measurements and conversions. It was really engaging and meaningful for my students.

Contributions **Lynn:** I believe connecting students' home lives to their experiences at school is a contributing factor. You can not just leave home at home in terms of school. You bring everything with you I believe. I think they are bringing their knowledge, their experiences from home, their

feelings from home. What their parents think they are bringing in as well. They know math in their language and their community.

Limitations

Alex: (District Math Adoption) So when students were not responding, whether academically or even understanding the content, like the language of the content, we could not go back. We could not slow down. We had to meet those deadlines.

Research Question #1: What are Teachers' Attitudes and Expectations About Supporting Their Students' Ethnic, Cultural, and Socioeconomic Diversity in Mathematics?

Teachers' Attitudes & Expectations

Teachers' attitudes and expectations are an essential component of being culturally responsive to their students. To further explain, teacher expectations are the manifestations of their beliefs and assumptions. Our beliefs and assumptions have biases and can alter our expectations. The first research question explores this, and three sub-elements evolved from the data which were language and culture, caring teachers, and personal awareness of biases. Overall, teachers value their students' culture and identity, but the transfer was minimal into mathematics learning.

Language & Culture. Students' language and culture are a central component in all stages of learning. A key component to the Culturally Responsive Framework is teachers' personal experiences with language and culture in shaping their attitudes and expectations of their students of color. The findings showed all participants' personal experiences created an appreciation and understanding of their students' culture and language, but there were mixed findings when they planned and implemented it within mathematics. Based on the findings, all

participants responded with a heavy emphasis on math skills when discussing their students and their mathematical practices. The academic math skills appear to be the focus of the math planning and implementation. All teachers know their students' language and culture by inquiring, celebrating, and embracing it within their classrooms, yet it gets lost when they attempt to use it in mathematics planning and instruction.

The findings showed all six teachers relate to their students' culture and language in various ways. A survey question on “the main reason they wanted to be a teacher” spring boarded the discussion. Every participant had a personal story related to the students in their classrooms that inspired them to teach. Lynn shared about the challenges she had as she learned English when her parents moved to the US. She described the experience being more than just learning a language, it was culture too. Lynn said, “Oh, I mean it was more than just the language. You learn about the culture embedded in the language. It is hard. You get ridiculed, you get, you know, people assume because you do not speak the language, you are inferior intellectually.” She continued with passion in her voice around the empathy she feels for her students and the support she wants to give them as they learn a new culture and language. Lily’s experience was similar as she emotionally explained the time when her mom transitioned her from a bilingual classroom to an English only environment. Lily explained:

So, my mom decided to put me in Spanish in kindergarten and first grade. I was doing great. I remember excelling and being like the top student. I remember I would get my work done because my mom would have me work at home as well. She was that mom who was like okay you have school, but you still must work at home. Well things were coming easy to me in kindergarten, and first grade. But then my mom wanted to challenge me, so she changed me to all English second grade. So, for me that was like the

hardest transition. I remember going from like friends to no friends. I mean my English was not the best and I do remember that I still have this moment very clearly when I could not even say “apple” in English. And just thinking about it makes me a little bit teary.

The feeling of loss of culture and language was so profound in Lily’s memory it moved her towards wanting to be a teacher. She never wants students to feel like she did and works hard to celebrate their language and culture in her classroom.

The findings showed that the participants’ integration of their students’ language and culture into math was complex. Some teachers were able to integrate their students’ language and culture with more ease, while others focused more on the math skills than integration of their students’ culture and language. For some participants, there was a disconnect at times between their students’ language and culture and math skills. The focus of the interview discussion shifted to their students’ math skills. Alex and two other participants shared where their students were at towards a particular skill in mathematics. He described his students’ mathematical knowledge as, “Some of my students understand what multiples and factors were. They did not have the vocabulary yet but some of them did come in with some of their multiplication tables ready to go.” In contrast, Rachel and other participants explored ways to integrate her students’ culture & language within mathematics. She said:

When working with fractions, there were a lot of times where I would kind of use students’ concepts from home. Instead of the example that the book gave I would talk about tamales which is a traditional Mexican dish and talk about how we cut up a tamale and how many halves we have. But overall, this unit was just trying to get students to understand three different concepts which were these measurement conversions, and then

adding and subtracting fractions with unlike denominators and then understanding the difference between the size of the products.

When she assessed and provided small group instruction to students based on their fraction knowledge it became more challenging to fully integrate culture, language, and math skill. Rachel described her process:

So, I had actually done a pretest to kind of just gauge where my students would be at, what their knowledge about fractions was, things like that and based off of that I was able to put them into different groups.

The participants valued and appreciated their students' culture and language, but integration into math was an area of growth and exploration for all six participants.

Caring Teacher. According to Gay (2018), a caring teacher is characterized by patience, persistence, facilitation, validation, and empowerment for their students. The data showed that all participants shared the importance of knowing their students' culture and identity with four teachers expanding on how they do that. Through their district's culturally responsive teaching training, all six participants explored a new strategy immediately in the classroom. The training was not content specific, but strategies that can be used within all content areas. The strategy referred to was called "Call and Response." During this time, there is an energetic back and forth between the teacher and the students. The teacher gives a call in the form of a question or statement and the group responds to the teacher. A few participants shared that the strategy provided students' autonomy and ownership. Unfortunately, it was not necessarily integrated in math learning. Similarly, to culture and language, all participants struggled to navigate how to use that information for math learning.

The interview participants value knowing their students personally and academically. Four participants shared explicit ways they seek out to connect with their students through circle time, surveys, and recess time. Rachel reflected on her personal heritage from Mexico and using two languages growing up in her home. She did not think many at school knew that about her home life. She never knew the importance of being bilingual until she was in college and could become a bilingual teacher. That personal experience made her want to get to know her students at home and school. Rachel explained how she does this:

At the beginning of last year, I sent home a survey to kind of just gauge a little bit more about my students. It was to gauge students' interest and to see what they were interested in, what they liked, what language they preferred so that by the time the first week of school was done I kind of already had a little bit more information on my students. And then when parent/teacher conferences came around too I made sure to ask my parents if there was anything I generally needed to know about their child, just general things like that. At the foundation of it I think it is just building a relationship with your students and getting to know them and what their interests are and kind of how you can bring that into your classroom to make it just more engaging and more fun for the students.

Likewise, Catalina described her curiosity of knowing her students by watching them during "free time" every Friday. She would watch them play and observe their interests and interactions with their peers. Catalina noticed differences in students socially compared to the academic setting. She said one student was so quiet in her classroom, but during "free time" she was very social. It is important to her to know her students personally as well as academically.

The participants are curious about their students' cultural values and ways to integrate within their classrooms. Three teachers gave specific examples on how they bring their students'

culture into the classroom by using tik tok, popular games and music. Three teachers shared their beliefs on students working independently and in groups, having curiosity, and enjoying learning math at whatever skill level they are working. Catalina, similar to Rachel and Lily, described how she learns about her students' culture and uses it within the classroom. Her students enjoyed playing the popular game Among Us. This is how she incorporated it within the classroom and the interest level of the students:

We really took time in the beginning of the year to know them. We did a lot of circle time, a lot of carpet time. My theme was Among Us so we did the crewmate of the week and every day they had something to share and they really got into that. When we ran out of time, you know, it was only 14 weeks and they were like, what do we do now? Can we do it all over again?

Alex, Venessa, and Lynn expressed comparable beliefs around their students' capabilities within math. A caring teacher sees students' potential and empowers them to use that potential in the classroom. Alex had pride in his voice when sharing:

The greatest strength of my students was their curiosity. So just being able to work with them and provide the materials and see how they go with it, get them involved in conversations. I had one girl whose family life was terrible. So just knowing all that in the background but still seeing the curiosity, the success in getting items correctly like that little pride moment that she could find for herself is like absolutely what I want.

Personal Awareness of Biases. The participants' expectations are the manifestations of their beliefs and assumptions. The interview data showed the teachers are in varied places in exploring their own identity and how it can impact their lens for teaching and learning with students. All participants reflected and are aware there are growth opportunities for themselves

and their colleagues on biases. With ongoing culturally responsive teaching training, the teachers' belief systems are being challenged and at times can create some dissonance internally. Alex was vulnerable in sharing about the cultural awareness training around biases and the need to continue learning in this area. He shared:

It is not to say anything bad about any of my colleagues in what they do, it is just many of us come from the same background. Middle class, many of us are white so we have a lot of that same crossover that it is hard to pull in more when what we do not know is probably the same in many regards.

Lily shared a perspective that was more personal. The training created a reflective opportunity for her to be open about her experiences as a Latina student and teacher. She reflected:

Each time I got out of those trainings, I just felt more in the same sense as a human, it is just I guess from my end I am a Hispanic teacher. I grew up in the district, right? And even then, it is a challenge, right? Just for the fact of being Hispanic. I already have a bias and that is just a natural thing for us. And just seeing him (the presenter) and hearing how we can overcome those biases. It just made me ponder myself as a student that grew up in the district and as a teacher now. It made me realize certain things that I was doing wrong, and it helped me tremendously. I was doing the same things that I went through when I was younger. So, it is just those things that were eye opening for me.

Additionally, a few participants like Catalina and Lynn openly shared examples of internal conflict by themselves or their colleagues on their biases. Catalina found herself in reflection around a bias that she held about students' chronic absenteeism and families value of education. She realized through a colleague being direct with her that there were other perspectives to the situation and to recognize that her bias was getting in the way. Catalina appreciated the

conversation and the direct approach that her friend took to be a better teacher. Likewise, Lynn shared her colleagues' struggles around new learning within the training:

The presenter would ask us to do “call backs” to kind of say a chant that is popular, that is well known in the culture, you know, in pop culture I guess you could say. And some of the teachers did not want to do that.

She continued to share that it might have been hard for her colleagues to use the strategy because it was different from their experiences in life and school. The data from the participants showed that having professional learning on culturally responsive practices created some reflection on personal bias and its impact on teaching.

In summary, the first research question explores teachers' attitudes and expectations in supporting their students' ethnic, cultural, and socioeconomic diversity in mathematics. The overall findings showed the interview participants' personal experience created an appreciation and understanding of their students' culture and language, but the transfer of it within math was more complex. Some teachers were able to integrate their student's language and culture with more ease, while others focused more on the math skills than integration of their students' culture and language. Also, the data showed many participants seeking out ways to know about their students personally as well as academically. Lastly, through the district's ongoing culturally responsive teaching training, all six participants are growing in their understanding of their biases and exploring new strategies to validate and empower their students. Even though the participants are on a wide continuum of learning in this area, the training allowed for reflection that may have not happened without it.

Research Question #2: What Ways, if Any, Do Teachers Who Have Culturally Sustaining Beliefs Use Culturally Responsive Teaching Practices in Mathematics?

The second research question explores teachers' culturally responsive teaching practices within mathematics. The findings were grouped into three elements of the Culturally Responsive Framework which were cultural communication, diverse content in the curriculum, and culturally congruent instruction. The findings showed all teachers knowing their students' personally as well as academically. Each participant utilized their knowledge of their students' culture and language in various ways within the classroom. The complexity of all participants using each element of culturally responsive practice was varied and stifled at times with the implementation of the new math curriculum adoption. Each area will be explored with findings that aligned or had a disconnect to the Culturally Responsive Framework.

Cultural Communication

One of the ways teachers are culturally responsive to their students is through cultural communication. Communication is strongly rooted in cultural influence. Cultural communication is knowing the discourse styles of students from a cultural perspective to support and bring it into the learning. The findings showed five teachers who shared examples of recognizing, appreciating, and using different cultural ways of approaching communication to bring into the learning environment. They explored ways in which they brought their students' communication style into the classroom. Four teachers engaged in ways to know about their students' culture and interests through circle time, recess, and surveys. Students taught their teachers popular words or phrases through social media and music. They used it for transition time from whole to small group discussion. Vanessa gave a specific example of the ways in which she listens, connects, and acknowledges her students' interests to communicate with them in class. She shared:

All the kids watch TikTok so I wanted to incorporate that within the class. We used it as a way to get their attention and transition into math. I would say TikTok and then they would say change the clock. Meaning, oh it is time to switch to math.

Similarly, Catalina shared her experience in circle time at the start of every day. She used a popular game of her students to facilitate discussion during this time. Knowing it was a favorite game of theirs, it allowed for her students to openly share things about themselves such as their interests in soccer, family experiences, and favorite songs which she said helped her in knowing about her students personally as well as academically.

Lily, Catalina, Alex, Venessa, and Rachel talked about the difference between their students' home language and academic language. They acknowledged and shared ways they bridged the mathematics lesson for their students. Rachel confidently shared ways she provides choice and ownership with her students in their use of language in the classroom. She spoke of a "bridge" and provided information on "Language Bends." These are ways in which she builds academic language from one language (Spanish) to the other (English) through oracy. They would use a strategy called TPR (total physical response). Rachel provided an example of the powerpoint she created in math to support her students in academic vocabulary by using her students' home language within the classroom. In each slide there were visuals, sentences in English and Spanish so teacher and student could state orally, as well as highlighted vocabulary words in green and yellow where teachers would use a physical movement connected to words (see Figure 7.1).

Figure 7.1: *Example of Language Bend*

A fraction is part of a whole.

Una fracción es parte de un entero.

The use of the Language Bend and helping students make the connections from their home language to academic language validated students' linguistic capabilities. Rachel shared the importance of students' home language and school language:

The units in the book in Spanish tended to be more formal Spanish so I wanted to explain to students what the book says, but they might know it as this. I just really tried to build and bridge everything from the formal language to their language.

Venessa reflected on the tension she feels at times around knowing her students' communication style and biases around what is expected. She openly talks about cultural expectations such as eye contact and how it can be perceived differently in some cultures. She knows the cultural differences through the connections she is making with her students. She struggles at times with

knowing all the different cultural nuances and how to create a space for all learners to feel accepted.

Overall, the data showed five participants finding ways to celebrate, acknowledge and use their students' communication styles within the classroom. Some teachers have connected it within math through students' home language. Lily, Catalina, Alex, Venessa, and Rachel had a strong understanding of students' language and culture to validate and bridge to school. Other participants have used their students' culture outside of the math learning such as circle time with success. The interview findings showed five participants using students' cultural communication at times within math, but more depth is needed. The five participants reported their struggles of using their students' culture and linguistic capabilities within math when the expectations of implementing the new math curriculum didn't allow the time or space for it.

Diverse Content in Curriculum

Another culturally responsive teaching practice is using ethnically and culturally diverse content in the curriculum. In reference to the Culturally Responsive Framework, the definition of diverse content in curriculum is when teachers know their students and use that knowledge within the curriculum. They are critical consumers of information and have a deep knowledge of their students (Gay, 2018). The findings from the interviews showed all participants knew their students personally as well as academically. As far as using that knowledge to make curriculum content decisions, outside factors came into play that made it challenging. All participants shared struggles in making curriculum decisions based on having to use a new math curriculum and staying within the pacing guide. District expectations of implementation created uneasiness for the teachers in being responsive to their students. The data around using diverse content in the

curriculum were grouped into three categories of curriculum resource decisions, student choice and interest, and assessments and the findings are shared in each area.

Curriculum Resource Decisions. Although teachers should have autonomy in making curriculum resource decisions that are aligned to the grade level standards, the new math adoption created restrictions in decision making for them. All six teachers knew their students, but the materials and resources provided by the district curriculum were directing their decisions on what to teach. All participants reported various degrees of thinking about the modules or units in the context of connections for their students. Some teachers highlighted pieces of the module due to the cultural connection.

Catalina highlighted one mathematics unit and its connection to her students' lived experiences around migration and movement. Many of her students had shared their family's immigration stories so she wanted to use those experiences to highlight the mathematical practices to deepen their understanding. Similarly, Alex noted his ability to connect the math units to his students' experiences. He explained:

In Unit 6, there is a lesson that talks about reasonableness of numbers. It opens with a question about what we notice about this graph involving indigenous languages that are spoken in the United States. Being able to echo that it is kind of like Spanish for my students.

He added that it helped them see the connection of math with their love of learning languages. Additionally, Rachel expanded on how she would adjust lessons from the math units to fit her students' communities. One example she gave was a unit that had three different concepts which were measurement conversions, adding and subtracting fractions with unlike denominators and the difference between the size of the products. The book gave an example of how to use these

three concepts. Rachel decided to change it and use tamales instead because this was something her students could relate to, and it was a part of their rich Mexican tradition within their homes. Although there were subtle shifts to adjust the lessons for their students, the interview data suggest the newly adopted district curriculum resources were the driving forces of their teaching decisions much of the time.

Student Choice and Interest. Largely, the teachers reported that students have choice at times within the lessons, but overall, not as much as what they would like to give. The choice students received were teacher-directed in the tools they used or a choice between two items for a project. Lily and Rachel shared their reflection with a bit of shame on wanting to give their students more choice. Rachel regrettably shared:

So, I feel like I did not implement student choice as much just because by the time they got back in I was like okay like we have all these things that we need to do and, you know, it almost felt like there was no room to give them that choice. But that is something that I know a lot of times can be helpful to students, too.

She realized the pacing of the curriculum is creating this for her. She would work on this in the future for her students. Alternatively, Alex shared about an optional lesson of art within geometry. He chose this lesson based on the amount of choice and interest for the students. He shared that the end product was amazing with each student having a unique piece of art.

From the adopted math curriculum, teachers chose parts of the units that would highlight interest for their students. Some teachers' provided materials and resources from the district curriculum that showed at times the lessons incorporated real-life connections and representations from various cultures and life experiences with some student choice in approaching their math. Alex shared an example of a lesson on using math with coins. The

lesson represented coins his students were familiar with which were pesos. The directions specifically state students have a wide variety of approaches to solve the problem with no solution approach suggested. Students had the autonomy and choice with regard to how they approached the math problem (see Figure 8.1).

Figure 8.1: Example of Lesson Plan

Activity 1

Stack Centavos and Pesos

Standards Alignments

Addressing 4.NF.B.4.c, 4.NF.C.5

🕒 25 min

In this activity, students solve problems involving tenths and hundredths in a context about coins. Given information about the thickness of some Mexican coins, students compare the heights of different combinations of stacked coins. To complete the task, students need to write equivalent

216

Grade 4

Grade 4, Unit 3

fractions, add tenths and hundredths, and compare fractions. Some students may choose to use multiplication to reason about the problems. Though the mathematics here is not new, the context and given information may be novel to students. Students have a wide variety of approaches available for these problems with no solution approach suggested (MP1). For example, to compare the peso coins of Diego and Lin, students could reason that they each have a 5 peso and a 20 peso coin and then compare the remaining coins, a 1 peso coin and 2 peso coin on the one hand and a 20 peso coin on the other. This method would require minimal calculations. Other students may add the thicknesses of Lin's coins and Diego's coins and compare these values.

Lily and Lynn shared similar pieces of their math lesson structure that highlighted student interest and engagement. They both shared the importance of knowing what students are thinking about the topic. They highlighted the warmups which had sentence starters with “I notice and I

wonder.” This allowed students to share their thinking and helped Lily and Lynn see what interest they had in the math unit.

As stated earlier, Alex’s geometry unit was one example of high interest for the students. Alex shared with excitement and detail the math geometry unit called “Mondrian’s Art.” He described it as the most culturally responsive for his students. It was evident student choice and interest were two areas of strength within the lesson and he saw great success from his students. He provided the lesson artifact as he explained the lesson planning and implementation process (see Appendix D – Mondrian’s Art Lesson). Alex did not note this in the interview, but it was noted on the lesson plan artifact by the curriculum company that this lesson was optional which is problematic. Lessons that had more culturally responsive practices in student choice, interest, creativity, and assessments with performance-based measures were not the primary lessons. Alex shared an example of the unit’s math goal on factors, multiples, prime and composite numbers to create a geometric design. Alex explained the optional lesson:

In this project, there is no right way to do it as long as you are meeting the minimum. Do you have all rectangles or squares? Yes, great you did the minimum. Do you have at least four colors? Great, you did the minimum. How you arrange that is up to you and seeing some of them play with color and play with shape placement it was just awesome to watch them think through. It almost became a puzzle for them, especially those who decided to draw too many big boxes early on and then had to remember that they had a list of composite things that they had to put in. Or they had to put in a couple boxes that were prime numbers, so they had to go back and start slicing it up. It was good to kind of see them make their own decisions and have to take a back pedal on what they were

currently going at. They were able to make a lot more choices than in previous lessons they were not offered. So, it was cool.

Lily, Lynn, and Alex provided examples of selecting and adjusting lessons to increase student choice and interest. Even though the newly adopted curriculum provided a script, a few teachers adjusted and highlighted areas that connected with their students' lived experiences for increased engagement.

Assessments. From the Culturally Responsive Framework, culturally responsive assessments practices are ongoing and beyond a quiz or test. Students show their learning in a variety of ways (Gay, 2018). Based on the interview findings, many participating teachers' assessment practices were tests or quizzes and did not lend itself to culturally responsive practices. There were minimal ways students showed their learning in a variety of ways. The district required teachers to report out through an excel spreadsheet or in a database system their students' math performance through tests or quizzes. The end of the unit assessments from the newly adopted math curriculum provided assessments which were narrowly focused on specific math skills. The teachers were required to implement all the assessments provided by the district and through the math curriculum materials.

All participants reported ways they collected data on their students' learning of math skills. A few teachers spoke more on the confinements of district common assessments students were required to take. The district had a reliance on these types of assessments, so teachers used the focus of these math skills to guide instruction. Rachel shared her example of the narrow focus by sharing the spreadsheet they used across the district. Each line represented a student, and it showed the percentage her students received on a math assessment with yellow highlights determining if students needed additional help in math. There were district expectations that

everyone administers the assessment and put it into a districtwide database system (see Figure 9.1).

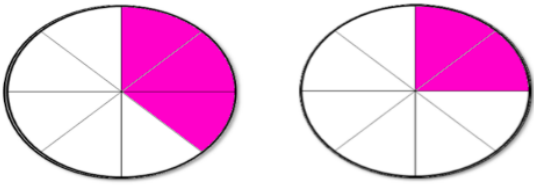
Figure 9.1: *Example End of Unit Assessment Data*

Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Total correct out of 22	Percentage
2	2	3	2	0	6	2	2	19	86%
2	2	3	2	1	5	3	1	19	86%
1.5	2	3	2	1	5	3	3	20.5	93%
1	1	3	2	1	5	2	2	17	77%
2	2	3	2	0	4	1	1	15	68%

In Figure 10.1, Rachel shared an example of one of the assessment questions on fractions that was used on the End of Unit Assessment.

Figure 10.1: *Example of Assessment Questions*

**1.) Add the fractions.
Simplify, if possible.**

$$\frac{3}{8} + \frac{2}{8} = \frac{5}{8}$$


Rachel also expanded on other assessments she used to guide her instruction at the start of the unit. At times she would give her students opportunities to reflect on their learning. Rachel noted:

I would immediately move them into groups based on either the pretest or kind of what I was seeing on their exit tickets. I would then determine what strategy I needed or what

group really needed my support that day. At the end, I would always kind of grade the tests and then put the data in but then give the tests back to the students with either a checkmark or a little X or something and have the students retake the test as a way for them to kind of be a little bit more self-reflective. And it was more for them and their families to kind of show what your student did the first time but then they self-reflected and took it again and this is what they got the second time.

The data around assessments were predominately tests and quizzes and did not allow for students to show their learning in a variety of ways. These types of assessment practices showed a narrow view of students' mathematical potential. Rachel and a few other participants shared examples of common assessments like tests and quizzes to measure their students' math learning.

Vanessa had similar experiences as Rachel with her math assessment. Vanessa shared samples of her students' work and talked about the expectations of the final assessment. The assessment was the same for each student (see Appendix E- Student Assessments). Vanessa elaborated on the details of the assessment and the choice students were given within the test. Her students had choice in the tools to measure items like a pencil, desk, or a classroom. Vanessa provided student artifacts to share the different levels of learning.

Alternatively, Alex shared an assessment within the Mondrian Art math unit. The assessment was flexible, creative, and had student choice on how they performed their geometry skills. There was a set criterion all students needed to meet within their performance assessment but had the autonomy to show their learning in different ways. This performance assessment was more culturally responsive to his students than other ones he had given. Again, this unit was optional within the curriculum.

In summary, there were some aspects of using ethnically and culturally diverse content in the curriculum, but most of the practices were stifled through the strict expectation of using a curriculum program. All six teachers had challenges in making curriculum decisions based on the math adoption and following a strict pacing guide to complete lessons. At different levels teachers were making decisions about lessons and content connections related to their students and their identities. Teachers had ideas on how they wanted to connect the math to their students' culture and language and adjusted within what they were allowed to do. They would give student choice and interest when it would fit within the lesson. The assessments were the least culturally responsive when utilizing the culturally responsive framework. The focus on the math skills through quizzes and tests did not allow for performance-based assessments. The findings showed, district expectations of implementation created uneasiness for the teachers in being responsive to their students.

Cultural Congruent Instruction

Teachers implementing culturally congruent instruction is the final culturally responsive teaching practice within the Framework. This is teaching to the whole child. It is the *engagement, the interaction, the dialogue* of students and teachers in the process of teaching and learning (Gay, 2018). Culturally congruent instruction allows teachers to take the knowledge of their students and use it within their math lessons to deepen their understanding. The instruction allows for students to share their diverse thinking, incorporate resources from students' culture, and bridges the use of their home language to academics. The interview findings found all participants were able to use various ways of using their students' culture and linguistic knowledge to engage and have them interact with one another. Some teachers were able to take their students' learning styles and cultural knowledge into the math instruction, but the depth of

each of these areas of practice were restricted with the new math curriculum. The data findings were organized within two categories of culturally congruent instruction which were student engagement & interaction and student learning styles & cultural knowledge.

Student Engagement & Interaction. The interview findings showed that teachers found various ways for students to work in groups within their math learning. At times, the math curriculum provided these opportunities and when it did not some teachers created the opportunity. The focus for all participating teachers was mathematical thinking. Whether the lesson had whole group or small group work, all six teachers reported ways they engaged their students in discussion with each other. They encouraged students to talk within their math lessons to share their thinking. Alex and Lynn shared the importance of group work to engage students in learning from one another. Alex shared his lesson plan and showed different ways they grouped students to share their mathematical thinking (see Figure 11.1). He discussed the parts of the lesson that got students excited to talk with one another such as what do you notice, what do you wonder questions.

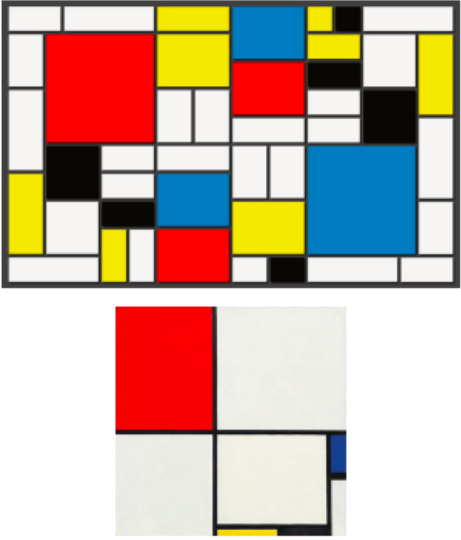
Figure 11.1: *Example Lesson Plan with Groupings*

Instructional Routines

Notice and Wonder

Student-facing Task Statement

What do you notice? What do you wonder?



Launch

- Groups of 2
- Display the images.
- “What do you notice? What do you wonder?”
- 1 minute: quiet think time

Activity

- “Discuss your thinking with your partner.”
- 1 minute: partner discussion
- Share and record responses.

Synthesis

- “These are digital copies of famous paintings by a Dutch artist named Piet Mondrian. He lived from 1872 to 1944. A little more than 100 years ago, he became known for painting in a style that relates to the math we have been studying. Many of his paintings hang in museums all around the world.”

Lynn shared the importance of having students do oral presentations together and how comfortable they became in doing it throughout the year. Her students worked in groups to share their tiny house project and their fraction lines. This was not a part of the math lesson, but she felt her students benefited by working in groups and presenting their work to practice their oracy as multilingual learners. She adjusted her lessons to meet her students’ linguistic needs.

Student Learning Styles & Cultural Knowledge. All participants inquired and found ways to learn about their students’ home life, but struggled at times to take what they knew and incorporate it into the math lessons. Teacher lessons were scripted due to the newly adopted curriculum and a few teachers became creative in ways to connect the lessons with their students’ lived experiences. Even though there were barriers, the findings showed some teachers

practices aligned more within the Culturally Responsive Framework. For example, a couple of teachers, Rachel and Lily used different strategies to be responsive to their students' learning styles and culture within the new math curriculum. Alternatively, Catalina like a few others shared their struggles with the transfer of using their students' culture and learning styles within the math lesson.

Rachel discussed the importance of knowing her students and how to get them engaged in the lesson. She adjusted her math lessons based on their learning styles and needs. She shared:

I learned that my students were sportier and more athletic, and I realized they needed to move around a lot. A lot of times I would try to incorporate movement into our lessons. I remember one of the best lessons I did was this lesson on measurement conversions. The example used in the book was about the broad jump and I think converting from meters to centimeters or something like that. So rather than using the examples given in the book I had the students use a meter stick and do the jump themselves and do their own measurements and conversions. It was really engaging and meaningful for my students. They did not want to stop.

Lily talked about different strategies that worked for her students to build their mathematical language. These strategies were not in the lessons, but Lily knew that she needed to provide them for her students to use the language. Anchor charts were made with her students to emphasize important math vocabulary in the unit. Anchor charts displayed words in Spanish and English. She expanded on the strategies she used:

Anchor charts are amazing. I was confident my students knew how to solve the area because I did go heavy on it at the beginning of the year. They always ended up asking questions about area throughout the year from the anchor charts. Something else I did

was TPR (total physical response). I did movements to math academic words. Students were able to recall words when I would do movements with the word.

Catalina, like the other teachers, would seek out ways to connect with her students beyond the classroom. She explained taking time to connect with students during “free time” every Friday. She was able to see their interests and peer interactions. Unfortunately, the problem was taking that knowledge into the math lessons. She shared her frustrations of using a newly adopted math curriculum and relating it to her students’ experiences and home life.

Catalina gave her thoughts:

Very rarely did the content, not the math necessarily, but the content, be the focus of a theme of a unit related to the students. So, for example, one whole unit on measurement related to a farm. Now you would think that a lot of our students have farm knowledge, but it is not the kind of Illinois farm they could relate to like, la gallina, and los burros, but this was not that kind of farm. This was a farm that had different things like an orange grove in California which is, you know, 525 miles. Not to say that they should not be exposed to these things, but I feel a lot of it was detracting from the math and that it was not relevant to their own experiences.

The lesson plans within the math curriculum were very scripted in how to teach mathematical skills and concepts. A few teachers like Catalina shared their frustrations on having to follow the script and recognizing that it did not always connect to their students. The lesson plan script entails sections that give ideas on what teachers should say in approaching different parts of the lesson. They also give ideas on possible student responses as shown in Figure 12.1. This can be misleading when some students might give a different answer than what the

company created response is leading to misunderstandings around students' cultural math knowledge.

Figure 12.1: *Example Lesson Plan with Student Responses*

<p>Student-facing Task Statement</p> <p>Trade artwork with your partner.</p> <p>Using your partner's artwork, look for and describe each of the following:</p> <ol style="list-style-type: none"> 1. Rectangles that have the same area 2. Rectangles with an area that is a prime number 3. Rectangles with an area that is a composite number 4. Which challenge they completed <p>Student Responses</p> <p>Sample responses:</p> <ol style="list-style-type: none"> 1. There is a rectangle that is 3 units by 10 units, and another that is 6 units by 5 units. The area of both is 30 square units. 2. There is one rectangle that is 11 units by 1 unit. The area is 11 square units. 3. There are many rectangles with a composite number for the area: 18 square units, 12 square units, 21 square units, and more. 	<p>Launch</p> <ul style="list-style-type: none"> ● Groups of 2 ● "Switch artwork with your partner." ● "Look at your partner's work and try to find three kinds of rectangles: rectangles with the same area, rectangles with an area that is a prime number, and rectangles with an area that is a composite number." ● "Then, if your partner completed a challenge from the first activity, see which one they did." <p>Activity</p> <ul style="list-style-type: none"> ● 5–7 minutes: independent work time ● 2–3 minutes: partner discussion ● Monitor for students who consider factor pairs of a number as they look for rectangles with the same area in their partner's artwork. <p>Synthesis</p> <ul style="list-style-type: none"> ● Invite 1–2 previously selected students to share how they found rectangles with the
92	Grade 4

In summary, the second research question explored teachers' culturally responsive teaching practices within mathematics. The findings suggest that all participants have knowledge of their students culturally and linguistically; however, this varied regarding how they used that knowledge within mathematics. All participants shared their struggles of using the new math curriculum and being responsive to their students. Although a few teachers found ways to adjust

the lessons to connect it with their students, the district expectations towards the implementation of the newly adopted math curriculum and the pacing guide halted the depth of culturally responsive practices. Within the confines of the curriculum, some teachers found ways to connect and utilize students' communication styles, interests, and cultural knowledge within the lessons. A few teachers adjusted the lessons by using culturally appropriate themes within the units, strategies that fit their learners, and even switching out lessons for optional ones to engage their mathematical thinking. Although all participants had some components of culturally responsive practices aligned to the framework, there was a barrier of fully implementing these practices due to the math adoption.

Research Question #3: What Limits or Contributes to a Teachers' Use of Culturally Responsive Teaching Practices in Mathematics?

To understand what limits and contributes to teachers' use of culturally responsive practices, the participants shared their perspectives in these two areas. The data revealed three major findings from all six teachers that contribute and limit the use of culturally responsive practices. All six participants shared that knowing and responding to their students' cultural and linguistic needs is the highest contributing factor. The next contributing factor by four participants is the strong relationship built between a teacher and a student. The limiting factors were not surprising as the interview findings led up to this discussion. One of the strongest findings shared by all six participants was the newly adopted curriculum materials and the pacing guides for the curriculum.

Factors that Contribute Teachers' Use of Culturally Responsive Teaching

The interview findings showed a few contributing factors to teachers' use of culturally responsive practices. All six teachers reported that knowing their students' cultural and linguistic

capabilities and being able to utilize that knowledge within the classroom is key. It would allow them to use culturally responsive practices more often. A few participants felt that a strong relationship with the student is important in using culturally responsive practices daily. The data showed, for all six participants, that it was important for them to not only know their students as learners, but also outside the school setting. Rachel pointedly shared her strong belief on building strong relationships with her students:

I feel first and foremost, it is got to be those relationships. Then it is connecting home lives and students' lives to what they are learning in school. If you do not have a good relationship with your students or know about your students, then you are not being culturally responsive. Also, if you do not know about your students, you are not able to bring what they know into the classroom and allow it to be more engaging and meaningful for them.

Lynn's reflection sums up the other teachers' sentiments when discussing the importance of connecting home to school experiences. She states:

I believe connecting students' home lives to their experiences at school is a contributing factor. You can not just leave home at home in terms of school. You bring everything with you I believe. I think they are bringing their knowledge, their experiences from home, their feelings from home. What their parents think they are bringing in as well. They know math in their language and their community.

Venessa shared the same view as Lynn and contributed by addressing the aspect of acknowledging a student's mathematical knowledge from home to the school environment. She said, "I think it is part of that validation aspect like making sure they know and believe they have something to offer."

Factors That Limit Teachers' Use of Culturally Responsive Teaching

An additional finding that was shared repeatedly from all participants was the new math curriculum materials adoption. Teachers reported following the newly adopted math curriculum and not being able to veer from the curriculum guide was one of the biggest limitations in using culturally responsive teaching practices. The expectations of assessment, curriculum resources, and structure being outlined by the district in the first year of implementation was a challenge. Due to the district required assessments and curriculum materials, many teachers reported a heavy focus on math skills. Multiple teachers reported that due to pacing and fidelity to the program, there were minimal opportunities to respond to students such as meeting their math skill needs, giving them choice, connecting math concepts to their culture and home environment.

For example, Alex reported the challenges of pacing with the new curriculum adoption and how it was not responsive to his student's needs. He shared the pressures of the pacing guide, "So, when students were not responding, whether academically or even understanding the content, like the language of the content, we could not go back. We could not slow down. We had to meet those deadlines." Rachel had similar sentiments about the pacing and shared her guilt of moving along when students needed more in two languages. She stated:

I think something that I struggled with a lot of times with our curriculum especially because we implemented a new curriculum just this last year is the lack of time that you have as a teacher to teach everything. The expectation that you want to teach these students all these different strategies so that they find what works best for them but a lot of times it was almost like a time crunch and a new strategy every day and I felt that was really confusing for students. Especially those in the dual language program because we

were struggling to kind of keep up with the pacing and the curriculum. It did not really allow for dual language students to raise their Spanish vocabulary to what they were learning in English.

Alex's example was similar to other participants in regard to the strict pacing guide and how it hindered the ability to respond to students' needs. Each teacher shared their frustrations and challenges in meeting their students of color in mathematics due to the expectations of the new curriculum adoption.

Summary of Findings

This chapter provided an analysis of the data within the elements aligned to the Culturally Responsive Framework. The data was used to answer the following research questions (1) *What are teachers' attitudes and expectations about supporting their students' ethnic, cultural, and socioeconomic diversity in mathematics?* (2) *What ways, if any, do teachers who have culturally sustaining beliefs use culturally responsive teaching practices in mathematics?*, and (3) *What limits or contributes to a teachers' use of culturally responsive teaching practices in mathematics?*

The first research question explores teachers' attitudes and expectations about their students of color and what developed from the data was teachers value their students' culture and identity but struggle to navigate how to use that information for mathematics learning. Through the culturally responsive training, they are beginning to explore their biases and how that impacts their planning and implementation of instruction. The second research question explores the teachers' culturally responsive practices within cultural communication, diverse content in the curriculum and culturally congruent instruction. The data findings found these practices by all participants were minimalized in various degrees due to the district's expectations and

implementation of the new math curriculum adoption. Teachers were finding ways to know and understand their students' communication styles, review the content to connect students to the learning, and provide different ways to implement instruction to meet their students' needs all in the parameters of the math curriculum resources. The third research question explored the teachers' limitations and contributions to using culturally responsive practices on a daily basis. The limitation identified by all participants was the tension between implementing the program with fidelity and pacing expectations and their ability to be responsive to their students' cultural and linguistic needs. Lastly, each teacher agreed that contributing factors in implementing more culturally responsive practices was knowing their students personally as well as academically and using students' cultural and linguistic knowledge in the classroom. A few participants expanded on the importance of a strong relationship between teacher and student in order to use culturally responsive practices more often.

Chapter 5: Discussion

Introduction

As the US student population continually increases in linguistic, ethnic, and socio-economic diversity, the demographics of our teaching staff remain the same which is typically female, White and of middle-class background (Cochran-Smith, 2003; McVee & Boyd, 2016; Sleeter, 2012). Many educators struggle connecting instruction with their students' lived experiences and understandings. For years, researchers and scholars praised the tenets of culturally responsive instruction as the solution to meeting the needs of this growing diversity in schools (Abdulrahim & Orosco, 2019; Aronson & Laughter, 2016; Gay, 2010, 2013, 2018).

The purpose of my study was to investigate and explore teachers who are currently using these practices to learn and expand on this knowledge for others. A specific focus was on mathematics which is less researched on culturally responsive practices. The ultimate goal was to explore what is working and what are the barriers. If teachers and leaders know more about the barriers, we can problem-solve and find solutions to those barriers to use culturally responsive practices more often and regularly with our students. In this final chapter, I will share a brief summary of the key findings within the elements of the Culturally Responsive Framework. Then, I will share a discussion around each of the elements, as well as the implications for practice. This chapter concludes by discussing areas of future research around culturally responsive practices.

Summary

The findings of this study showed the complexities of implementing culturally responsive teaching practices for students. In an analysis of the findings, two overarching themes emerged that are worthy of deeper exploration. The first theme was the teachers' attitudes and

expectations. The data showed teachers have a deep appreciation and value of their students' culture and language, particularly when their experiences were similar to their students. A few teachers were more inclined to use their students' home language, culture, and identity within the mathematics lessons. When experiences were not as similar, there was a continued need to become self-aware of personal biases which impacted the way they viewed their students' capacity within learning. Through the culturally responsive training that all the participants in the study referred to, there were various levels of exploration of personal biases and how that impacted their planning and implementation of instruction.

The data revealed tension between using district adopted math curriculum resources and implementing culturally responsive practices. An unexpected finding was the challenges teachers experienced in the district's expectations of following the curriculum and their ability to respond to their students' needs. The research showed that teachers were confined in finding ways to know and understand their students' communication styles, review the content to connect students to the learning, and provide different ways to implement instruction. This was all due to the pacing and fidelity of the new math curriculum resources. These two areas will be further explored to understand the impact.

Discussion

Teachers' Attitudes & Expectations

Through the culturally responsive training that all the participants in the study referred to, they were beginning to explore their biases and how that resulted in their planning and implementation of instruction. This finding creates questions to reflect upon around professional learning. In what ways can educators continuously explore their beliefs and assumptions about their students and the communities they come from? Can districts provide ongoing professional

learning opportunities that will have teachers learn about their own identity and how that shapes their beliefs about their students? The participants in the study shared ways in which they learned about their students and their communities. All six teachers found ways to bring their students' culture and language into the learning environment. The data also found that all the teachers received at least one year of culturally responsive training and that it was a learning moment for all of them. Four teachers reflected on their biases and all of them tried a strategy from the training with some degree of success. Although the culturally responsive training resulted in some reflection by participants on their attitudes and expectations of their students, continued participation in the training may offer more opportunities for reflection in this area.

Understanding our belief systems around our students is the foundational work in being culturally responsive. A large emphasis in Gay's (2018) work on culturally responsive teaching practices explored the idea of teachers' attitudes and expectations as important as their pedagogical skill in the quality of instruction for marginalized students. Researchers such as González, Moll, and Amanti (2005) and López's (2017) work found that educators treat the students' homes and communities as valuable resources in which they potentially will be utilized in school, instead of needing to be *fixed*. Similarly, the findings from this study showed teachers with similar experiences used their students' home language, culture, and identity within the learning environment. The depth of the use was varied and needed some growth. Alternatively, the findings also indicated teachers struggled at times to see the potentiality of students' mathematical thinking due to the new math adoption. There were expectations to implement it with fidelity. One example that highlighted this potentiality concern were the assessments. A majority of the assessments were tests and quizzes, and it limited the scope of knowledge that can be produced from a diverse group of learners. The Culturally Responsive Framework

emphasizes assessments that allowed for students to show their learning in a variety of ways beyond a test or quiz. There was a very narrow view on students' mathematical potential when teachers followed a company-created curriculum. In the study, teachers recognized that the math resources were limiting students' opportunities to connect and engage with the math.

The data also showed when teachers' experiences were not as similar to their students, there was a more pronounced need to become self-aware of their personal biases. It impacted the way they viewed their students' capacity within learning. Through the culturally responsive training that all participants referred to in the study, they were beginning to explore their biases and how that impacts their planning and implementation of instruction. These findings support previous research around teachers engaging in professional development to reflect on their thoughts and behaviors related to their ethnically and culturally diverse learners (Aguirre & Zavala, 2013; Timmons-Brown & Warners, 2016). In both research studies, professional learning focused on valuing and using students' culture and lived experiences in an authentic way, fostered more teacher reflective practices to continually improve their mathematics lessons for all their students. The findings in this study compliment these studies by showing that having a year of culturally responsive training, all participants used a strategy from the training, and some reflected on their own identities and biases. Future training may provide more opportunities for reflection. The data from this study also showed that teachers wanted to know about their students and their communities and bring that knowledge into the classroom. The transfer of using the culturally responsive strategies within content was a challenge for participants in this study. By providing more professional learning opportunities on culturally responsive practices within content areas, it could increase opportunities to bring their students identities and experiences into their content lessons.

Newly Adopted Curriculum

Even though there was an appreciation of the students' identities and culture by the mathematics teachers, being culturally responsive to their students' needs in planning and implementing practices was minimal due to the pacing and fidelity of the adopted math curriculum. Robust culturally responsive practices found in several research studies that included integrating interdisciplinary content (Quintos & Civil, 2008), making links to human experiences, and drawing on cultural activities (Bonner, 2014; Kisker et al., 2012; Lipka et al., 2009; Rubel & Chu, 2012) as well as incorporating stories with relatable characters within math problems (Corp, 2017) were difficult to identify and correlate within this study. This was due to the district expectations of implementation of a new math curriculum. The expectations of implementing math curriculum made by a company and everyone following an expected pacing guide stifled teachers' opportunities to be responsive to their students' cultural and linguistic needs. Which leads me to wonder, can adopting a company created curriculum coincide with culturally responsive practices? Should adopting professional learning and training around culturally responsive practices and implementing these with fidelity take priority over adopting curriculum materials?

The findings from my study revealed teachers were expected to follow lesson plans that were very scripted in how to teach mathematical skills and concepts. When lesson plans are designed as a script, it gives teachers a false assumption that if students do not come up with an answer that is similar to what the writer of the curriculum developed, the student is incorrect, and they need to fix or change their thinking. It devalues the divergent thinking that comes with each individual student's understanding of math that was developed in their home or community. If the materials are scripted and teachers are expected to follow and implement every step, how are

we listening, knowing, and responding to our student needs? Who wrote the curriculum and how do they know the students sitting in front of that teacher? Why are we not questioning companies that are building curriculum materials that promote meeting the needs of all learners, when these companies cannot deliver on their promises?

Another area of disconnect with culturally responsive practices and a newly adopted curriculum is the assessments. In relation to the Culturally Responsive Framework, the diverse curriculum content as well as instructionally congruent instruction showed minimal ways for students to demonstrate their learning in a variety of ways beyond a quiz or test. The data in the study on student assessments lacked performance assessments. Since the district mandated the teachers to use the curriculum materials with fidelity, teachers were expected to use the assessments in the curriculum as well as the district benchmark assessments. These assessment practices lacked the verbal, written, visual and action tools and techniques to assess the quality and levels of students' learning accomplishments and areas of growth. The assessments from the curriculum plans were limited in scope, focused solely on a math skill instead of utilizing different ways to produce mathematical knowledge related to students' home or community environment. Lastly, the pacing of the curriculum moved quickly and did not allow for the depth that performance-based assessments needed to show students learning. Based on the participants' high level of quiz and test usage and the way they referred to their students' math learning around these tested skills, I saw how this allows for misunderstandings around students' math learning potential. The findings in the study could potentially reinforce research that found students not performing as well in conventional curriculum with standard math concepts and skills compared to an ethnically and culturally diverse curriculum (Darling, 2016; Demmert & Towner, 2003; Kisker et al., 2012; Lipka et. al., 2009; Sternberg, 2006; Moses et. al., 2009).

Limitations

As with most studies, the design of the study was subject to limitations. There were two major limitations to this study that could be addressed in future research. The original study had a 6-8th grade group of participants as well as 3rd-5th. Unfortunately, the data from the survey did not produce enough 6th-8th grade teachers to participate as well as those who had an asset-based mindset of their ethnically, culturally, and socio-economically diverse learners. This challenge allowed the study to focus more on a group of teachers who teach multiple subject areas beyond math and to dig deeper into their contributions and limitations to implementing culturally responsive practices every day.

Another limitation within the study was the inability of observing teachers' culturally responsive practices. Since I was unable to observe in the classroom, I asked participants to bring artifacts of their lesson plans and student work samples. The artifacts provided a richer context to the interview data. Unfortunately, many of the participants were unable to get access to those documents in the summer. Some of the documents were received from the participants and were used to align and support the interview data to provide a richer and more descriptive finding. The ability for me to observe the participants in their classroom on culturally responsive practices would have added to the rich data in the study. This will be discussed in future recommendations for research.

Implications

Theoretical Implications

The findings of this study have theoretical and practical implications. One implication is the use of the theoretical framework of culturally responsive practices in a study with elementary mathematics teachers. Through the theoretical framework I was able to identify elementary

teachers who had a culturally sustaining lens of their students of color to learn from their mathematical practices. It also identified teachers who were not a good fit for the study. This is significant since the literature on teacher beliefs and attitudes primarily addresses secondary and high school teachers (Bartell, 2013; Gonzalez, 2009; Parker et al., 2017; Timmons-Brown & Warner, 2016) with fewer studies addressing elementary teachers (Kisker et al., 2012; Matthews & López, 2018). The areas of mathematics and science are among the least studied comparatively to language arts (Abdulrahim & Orosco, 2019; Aronson & Laughter, 2016).

Based on the findings of this study, the culturally responsive framework highlighted areas within mathematics that teachers focused on more than others. One area that highlighted the framework were some teachers using students' home language to bridge to English within mathematics. Rachel shared a lesson using a language bend to validate her students' home language to help them build vocabulary in English. Although the district adopted a curriculum that confined the teachers in using culturally responsive practices, the findings indicated that a few teachers were trying to implement components such as connecting math topics to students' lived experiences. For example, Catalina utilized the knowledge of her students' immigration experience within the math lesson. The study showed the need for more opportunities to utilize the culturally responsive framework within mathematics. An example of this would be teachers going beyond math skills focus and engaging more of students' lived experiences into the lessons. By pulling in students' culture, identity and mathematical understanding from their communities, the students could develop a stronger sense of mathematics. Unfortunately, the adoption of a common mathematics curriculum tool confined that deeper look into the culturally responsive framework. When districts are deciding on adopting a new curriculum, they should pause and think about whether a company developed curriculum will allow teachers to meet their

students' cultural and linguistic needs when planning and implementing mathematics instruction. Teachers showed minimal levels of implementation of the culturally responsive framework when following the newly adopted curriculum for pacing and fidelity.

Practical Implications

The research is promising from a practical lens for district office administration. The case study showed the challenges of a districtwide initiative of implementing culturally responsive professional learning and adopting a new math curriculum simultaneously. It highlighted the dichotomy which the mixed messages district-wide initiatives may unintentionally have on teachers. It is challenging for teachers to be responsive to their students when they are expected to use the math curriculum materials the way it was written, to not add any additional resources, and to keep pace with other classrooms with very diverse needs. The findings may provide guidance to district leadership on district initiatives and the alignment with other areas of focus. District leadership may reflect on the following questions before adopting curriculum materials. Can district curriculum adoptions meet the needs of our students of color? Who developed the curriculum materials and how do they know the needs of our learners? Are there other ways to develop curriculum to have high expectations of the standards, but allow for flexibility in the resources, tools, and assessments? What ongoing professional learning can be built into our work to reflect on our attitudes and beliefs around our students of color? The findings showed that fully implementing culturally responsive practices is nearly impossible when expecting teachers to implement curriculum materials with fidelity and pacing expectations. This is an area of reflection within education since the research has showed positive student outcomes such as achievement growth and positive self-identity by validating and honoring students' rich ethnic and cultural heritage when teachers implement culturally responsive teaching practices (Bonner,

2014; Cahnmann & Remillard, 2002; Driver & Powell, 2017; Quintos & Civil, 2008; Matthews & López, 2018).

Another promising finding is the importance of strong student/teacher relationships. Each participant reflected on the importance of knowing students personally as well as academically. They all felt that this was a contributing factor in being able to utilize culturally responsive practices more often. Educators wanting to deepen their knowledge around culturally responsive practices can focus on relationships with every student to be able to utilize what they know within the classroom.

Along the same lines of forming deep relationships with our students, the findings also showed the importance of professional learning on culturally responsive practices. To have deep relationships with all our students in the classroom, we need to understand our own identity to make lasting relationships with those who have different experiences from us. Moreover, the evidence in this study suggests that when teachers are provided training on culturally responsive teaching, they reflect on their own identity and biases and practice using new strategies within their classrooms. The implications are for district administration and teacher leaders to provide opportunities for staff to engage in reflective experiences on their identity and biases to impact their lens on the students that they serve. Creating culturally sustaining beliefs around our students starts with understanding who we are and how that impacts our decisions for students who are similar or different. Professional learning should develop our mindset and our skills to help all our students grow and achieve.

Recommendations

There is a need for further research on teachers' belief systems on their diverse students and the implementation of culturally responsive practices. There has not been a significant

change in diversity in staff in the public school system from 2011-2018 and more than half of our students in public education are non-white. Culturally responsive practices will be key for student success. For more educators to improve their practices for their ethnically, culturally, and socio-economically diverse learners, I have noted a few recommendations for research.

A key recommendation for future case study research is on schools who focus on culturally responsive practices and do not use an adopted curriculum and the impact it has on student learning outcomes. The findings in this study would give support to this work due to the challenges teachers experienced in following an adopted curriculum. A continued focus on research with culturally responsive practices within mathematics for elementary schools is needed. The Culturally Responsive Framework used within this study can guide a deeper look into mathematics practices. Mathematics in elementary schools tend to have a heavy focus on skills and strategies. The findings from this research showed that teachers valued and appreciated students' culture and linguistic ability but transferring it into mathematics was more challenging. Additionally, case study research on elementary teachers who have been successful in making those transfers into mathematics learning and its impact on student learning would be powerful.

Lastly, more qualitative, or mixed method research with a focus on diverse students' perspectives on their learning is desirable. It would be additional data to collect on teachers who are implementing culturally responsive practices. My findings focused on the teachers' perspectives and their practices, but adding student perspectives would create a deeper understanding. Further study around the students' perspectives would identify what is working and what needs to be improved in mathematics classrooms. Additionally, mixed methods studies that look at student outcomes alongside their perspectives of mathematics learning is an area of

exploration. The more student voices within the research, the greater possibility for impact inside the classroom.

Conclusion

This study suggested a few factors that could contribute or limit teachers' use of culturally responsive practices on a more regular basis. The research aimed to investigate and explore teachers culturally sustaining beliefs and their responsive teaching practices for their students of color. Overall, the contributions of this work highlighted the complexity of implementing culturally responsive practices and the importance of professional learning for educators. My use of the culturally responsive framework guided this study to a deeper analysis of areas of strength and areas of focus for further research. The framework is a tool that would be helpful for future studies.

First, the findings around teachers' culturally sustaining beliefs suggested that future professional development for teachers on culturally responsive teaching practices is warranted and powerful. Participants in this study started to reflect on their biases through the professional development training offered by the district, but more learning needed to happen to further develop this area. Second, the study highlighted the adoption of district curriculum materials with a strict pacing and implementation which is problematic for teachers when using culturally responsive practices. This has the potential to create a new perspective for district leaders and curriculum directors on the adoption, implementation, and expectations of curriculum materials. Since district curriculum adoptions are very prevalent in school districts with a curriculum cycle review every 3-5 years, this warrants further analysis on the impact on culturally responsive practices for their students.

Finally, this study adds to the current discussion in education around diversity, equity, and inclusion. Culturally responsive practices have been at the heart of curriculum, instruction, and assessment work for equity. This mixed methods case study can allow for districts with similar size and demographics to gain some insight to their own practices that will impact their students of color's growth and learning. Educators are always talking about research-based programs and strategies to use with their students. We need to continue research on culturally responsive practices so a new narrative will form around this work. The shift might be teachers saying culturally responsive practices are the "go-to" research-based strategy that works for their students of color and are far more impactful than a company-created program.

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Appendix A: Culturally Responsive Framework

Research Questions	Culturally Responsive Teaching Pillars	Culturally Responsiveness looks/sounds/feels like: <i>Teacher lens</i>
<p><i>What are teachers' attitudes and expectations about supporting their students' ethnic, cultural, and socioeconomic diversity in mathematics?</i></p>	<p>Teacher attitudes and expectations</p> <ul style="list-style-type: none"> ● Core understanding that we need to acknowledge and rebuild our educational system to include more than a White European American culture for equitable opportunities ● Teacher expectations being the manifestations of their beliefs and assumptions ● Caring teacher is characterized by patience, persistence, facilitation, validation, and empowerment for their students ● Student voice is imperative and must be valued. ● Language and culture as a central component in all stages of learning instead of as a starting point is the 	<ul style="list-style-type: none"> ● I feel comfortable interacting with people from different cultures. ● I believe that our educational system should be structured to reflect the cultural diversity from pre-school to the university. ● If I have an option, I teach in a place where people have different cultural characteristics different from my own culture. ● I actively work to understand, be sensitive, and appreciate the history, values, experiences, and lifestyles of others. ● I feel comfortable having conversations about race with my colleagues and my students. ● I believe there are institutional inequities and I regularly reflect on my personal biases.

	<p>big shift from asset-based to culturally sustaining pedagogies</p>	<ul style="list-style-type: none">● I understand everyone has biases.● I understand my biases can shape the nature of my interactions with students, families and colleagues.● I routinely reflect on my own life experiences and membership in various social groups (such as by race, ethnicity, social class, and gender), and I ask myself about how these factors influence my beliefs about cultural diversity.● In knowing my cultural identity, it will positively impact my attitude and teaching practices for my students in math.● I am not an expert in knowing all the cultures and values in my community. I seek out and engage students, families, community members for this rich resource of information.● It's important that my students know me personally as well as professionally. I reflect with them on my cultural identity and how it has shaped my practices.● I am curious about the cultural values of the
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		<p>students in my class.</p> <ul style="list-style-type: none">● I am aware of my students' interests outside of the classroom or school setting.● I would like to increase the interactions in and out of the classroom by learning vocabulary and sentences from my students' home language.● I spend time outside of class learning about the cultures and languages of my students.● I pronounce my students names' correctly.● I believe that all students and families have important strengths I can draw on as an educator.● I know my students are very capable learners. Together we work hard to make sure my students understand concepts.● I am responsive to the needs and interests of my students. My students share in decision-making about what they learn, how they learn it, and how they demonstrate their learning.● As a teacher, I am not an expert, but rather a guide for my students' learning. My goal is
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		<p>that they take increased agency and ownership of the learning process.</p> <ul style="list-style-type: none"> ● I think that while I guide my students' learning, I need to consider their cultural values. ● I think that students should be encouraged to give examples specific to their own culture in the course of the lessons. ● I regularly ask for feedback from my students on my teaching.
<p><i>What ways if any do teachers use culturally responsive teaching practices in mathematics?</i></p>	<p>Cultural communication</p> <ul style="list-style-type: none"> ● Communication is strongly rooted in cultural influence ● Know the discourse styles of their students from a cultural perspective to support and bring that into the learning ● Recognizing, appreciating and using different cultural ways of approaching communication is imperative for teaching and learning 	<ul style="list-style-type: none"> ● I observe and listen to my students in a variety of situations and when interacting with different audiences. ● I practice active listening for unfamiliar words, phrases, and nonverbal nuances exhibited by my students, and take time to understand them. I restate comments and ask frequent questions to ensure clarity of meaning and understanding of observed communication behaviors. ● I teach students the language of school and the academic language of different subjects.

	<ul style="list-style-type: none">● Approach conversations and interactions with students, families and communities with self-reflection and cultural humility● High level of understanding that culture has an impact on communication and teacher will be mindful of the way they communicate and accept their students' communication styles	<ul style="list-style-type: none">● I use varied modes of communication in teaching and performance assessments to capitalize on students strengths, including written, verbal, visual, tactile, and kinetic modalities.● I identify and cultivate relationships with cultural mediators and interpreters in the classroom, school, and community who can serve as mentors about ethnically diverse cultures and communications of my students.● I use books, articles, films, music, audio recordings, and a variety of other resources from the Internet that explain and visualize examples of different ethnic groups' cultures and communication.● I teach my students the value of and skills in code-shifting.● I have my students teach me and each other the most popular words and phrases among the members of their various cultural and social groups.
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	<p>Ethnically and culturally diverse content in the curriculum</p> <ul style="list-style-type: none"> ● Teacher being a critical consumer of information and having a deep knowledge of their students ● Teachers analyze the content being distributed for instruction to ensure that what’s being presented is an accurate representation of the students they serve ● Teachers and students should take an active role in content analysis ● Relevant to ethnically, culturally and socio-economically diverse students include information about their histories, cultures, contributions, and experiences of their communities ● Teachers know their students and use that knowledge within the 	<ul style="list-style-type: none"> ● I develop shared class norms with my students that fosters an inclusive environment ● I choose resources and materials that make sure all the voices of my students from different cultures, genders, classes, sexualities and with differing abilities are heard, not just talked about by others. ● I evaluate the materials and resources regularly to make sure the dominant culture is not consistently portrayed in the math learning of my students. ● The lesson assignments for my math units have lots of choices for students and to work together cooperatively or share their learning experiences, strengths, backgrounds, interests, and needs. ● My math lessons and units incorporate real-life connections and representations from various cultures and life experiences.

	<p>curriculum</p>	<ul style="list-style-type: none"> ● Assessments of learning in math are ongoing and beyond a quiz or test. Students show their learning in a variety of ways.
	<p>Culturally congruent instruction</p> <ul style="list-style-type: none"> ● The <i>engagement</i>, the <i>interaction</i>, the <i>dialogue</i> of students and teachers in the process of teaching and learning ● Knowing how students learn best and creating a strong partnership with the learner ● Understanding students' learning styles and cultural knowledge ● Teaching to the whole child 	<ul style="list-style-type: none"> ● I consistently begin my lessons with what my students already know from their homes, communities, cultures, and school. ● I know the cultural backgrounds of my students. ● I integrate resources from my students' culture into my lessons. ● I understand the differences between academic language and my students' social language and I intentionally find ways in my lessons to bridge the two. ● I encourage my students to talk about their culture and values, both positive and negative. ● I meet regularly with my students' parents of their choosing and it depends on their schedules. I will ask if they prefer to use a

		<p>language other than English and offer those services when we meet.</p> <ul style="list-style-type: none">● All students come to school with valuable knowledge and experiences. I use that knowledge and experience within my lessons to create agency.● I seek out ways of being responsive to my students and provide new ways of instructional strategies from my colleagues, agencies and organizations who have successfully taught ethnically diverse learners.● It's essential that I understand my students' lives outside of school. I use this information to increase engagement and make my math lessons more meaningful.● I incorporate teaching about race, ethnicity, and cultural diversity within my math class. It's not a stand alone event or special time within the year.● I use symbols, signs, images, and icons in my math classroom to personify value
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		<p>commitments to cultural diversity and equality.</p> <ul style="list-style-type: none"> ● I celebrate my students' individual differences and we encourage diverse mathematical thinking in my classroom. ● We use real-world math problems to engage all students within math. These math problems stem from our communities and students' home life. ● I use a wide variety of verbal, written, visual, and action tools and techniques to diagnose my students' needs and assess the quality and levels of their learning accomplishments. Performance assessments are key within my instruction.
<p><i>What limits or contributes to a teachers' use of culturally responsive teaching</i></p>		<p>There is limited research on these areas. In review of the literature, these items were self-reported by educators. These items will be used in the interview protocol with the sort, rank, and discuss process.</p> <p>Contributions</p> <ul style="list-style-type: none"> ● Positive beliefs and high expectations of

<p><i>practices in mathematics?</i></p>		<p>their students</p> <ul style="list-style-type: none">● Knowing your students AND knowing the learning standards● Knowing yourself and reflecting on your biases● Having opportunities to reflect personally and professionally● Personal learning and interest around culturally responsive teaching● Various ways to professionally learn about culturally responsive teaching● Time for teacher planning with a culturally responsive lens <p>Limitations</p> <ul style="list-style-type: none">● Time for reflection● Daily tasks that are required and mandated which provides less time for creativity and autonomy● Following the curriculum and not being able to veer from the curriculum guide● Elementary teachers teach all content areas. Difficulty in finding time as well as energy
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		<p>to learn, apply, and self-reflect on something new.</p> <ul style="list-style-type: none"> ● New packaged resources to align to the curriculum takes a lot of the time and space to learn ● Access to materials and resources ● Lack of professional development
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Resource

Aguilar-Valdez, J., (2015). *Rubric for Culturally Responsive Lesson*. Portland State University.

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<http://www.nysed.gov/common/nysed/files/programs/crs/culturally-responsive-sustaining-education-framework.pdf>

Appendix B: Survey

Code Number__ 1

SURVEY**Email**

My name is Susan Ejma, a doctoral student in the College of Education at DePaul University. I am conducting a research study on teacher's culturally responsive teaching practices within mathematics for their diverse students at the 3rd-8th grade level. The purpose of the research is to investigate teachers' attitudes and expectations of their diverse learners and explore teaching practices being used within mathematics.

Your participation in this survey is completely voluntary. There will be no negative consequences if you decide not to participate or change your mind later after you begin the study. You can withdraw your participation at any time. Your answers will be kept strictly confidential. Findings of the survey will be reported in either summary or statistical form so that individuals cannot be identified.

The survey should take approximately 15-20 minutes to complete. All teachers who decide to participate and complete the survey will be entered into a drawing to win one of three \$25 eGift Cards to Amazon. Thank you in advance for your willingness to contribute to this important study.

Some individuals may be contacted about the possibility of participating in further study. Your contact information will not be used for any other purpose.

PLEASE NOTE:

**ALL INFORMATION ON THIS SURVEY WILL BE KEPT STRICTLY
CONFIDENTIAL.**

The information sheet will be the first page of the Qualtrics survey that participants read and click past to start the survey measures.

Directions: Unless otherwise specified, please CHECK your response.

SECTION I: YOUR EDUCATIONAL BACKGROUND

1. Which grade level do you teach?
 1. 3rd
 2. 4th
 3. 5th
 4. 6th
 5. 7th
 6. 8th
 7. Other
2. What type of classroom do you teach?
 1. Dual Language Classroom (A classroom that teaches in Spanish & English)

2. English Language (EL) Classroom (A classroom that teaches in English but there are students who speak another language at home besides Spanish)
 3. Other
3. How many years have you been teaching?
 1. 1-4
 2. 5-10
 3. 10-20
 4. 20 and higher
 4. What is the highest degree you have earned?
 1. Bachelors
 2. Masters
 3. Doctorate
 4. Other
 5. Do you have an additional certification beyond the general education teaching certificate?
 1. ESL endorsement
 2. Bilingual
 3. Special education
 4. Other
 6. Have you taken any additional mathematics courses beyond your bachelor's degree?
 1. YES
 2. NO
 7. How many college classes did you have that addressed meeting the needs of diverse learners in your classroom?

1. 0 classes
 2. 1-2 classes
 3. 3-4 classes
 4. 5 or more
8. Have you had any professional learning around culturally responsive teaching practices?
1. YES
 2. NO
9. Which of the following describes the MAIN reason you want to be a teacher? (please choose one)
1. Enjoy working with kids
 2. Enjoy mathematics
 3. Enjoy the process of teaching and learning
 4. Teaching is a way to make a difference in society.
 5. Other (please specify)

SECTION II: YOUR BELIEFS ABOUT TEACHING

How much do you agree with the statements on ethnic and cultural diversity?

	1	2	3	4	5
	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

10. I feel comfortable interacting with people from different cultures.					
11. I don't have any biases. I treat all my students equally.					
12. I routinely reflect on my own life experiences and membership in various social groups (such as by race, ethnicity, social class, and gender).					
13. If I have an option, I teach in a place where people have different cultural characteristics different from my own culture.					
14. If I have a bias, it doesn't impact my interactions with students, families and colleagues.					
15. I feel uncomfortable and know it's wrong when I hear statements of stereotyping and					

prejudice, but I struggle with speaking up against it.					
16. I seek out and connect with others who are different from me to understand, be sensitive, and appreciate the history, values, experiences, and lifestyles of others.					
17. I feel comfortable having conversations about race with my colleagues and my students.					

When you think of teaching math for your ethnically and culturally diverse students, how true do you think the following statements are?

	1 Not at all true	2 Slightly true	3 Moderately true	4 Quite true	5 Extremely true
18. Reflecting on my own cultural identity will positively impact my					

attitude and teaching practices for my students in math.					
19. I need to be knowledgeable and have some expertise about various cultures in order to teach an ethnically and culturally diverse group of learners in math.					
20. It's important to know my students' personally as well as how they learn in math.					
21. Sometimes my students' names can be hard to pronounce so it's okay to use a different name as long as they give me permission.					
22. I understand some of my students have difficult home lives so I give them a pass on some of their math work due to different levels of support at home.					

23. I am responsive to the needs and interests of my students. I provide my students various math strategies to show what they know in math.					
24. Not all math experiences can be real world. When it makes sense in the math unit, we will connect math to students' personal life experiences.					

25. Which of the following do you think is the MOST IMPORTANT factor for ethnically and culturally diverse students to be successful in your math class?

1. Students need to have the foundations of math for higher levels of math thinking to occur.
2. Students need to know the grade level math standards.
3. Students need to bring what they know into the math classroom and make connections to new learning to see themselves as mathematicians.
4. Students need to have the motivation and perseverance to develop higher levels of mathematical thinking skills.

SECTION III: INSTRUCTIONAL PRACTICES

How often do you implement the following instructional practices?

	1 Never	2 Rarely	3 Sometimes	4 Often	5 Always
26. I begin my math lessons with what my students already know from their homes, communities, cultures, and school.					
27. I provide students an opportunity to decide what math strategy they would like to use in solving a math problem.					
28. I integrate resources from my students' culture into my math lessons					
29. I <u>intentionally</u> find ways in my math lessons to bridge academic math language and my students' social language.					
30. I am the gatekeeper of the lessons and learning targets, I let students use					

<p>manipulatives in the lesson to show me what they know.</p>					
<p>31. I use varied modes of communication in teaching and performance assessments to capitalize on students strengths, including written, verbal, visual, tactile, and kinetic modalities. They have a choice in how they show me what they know in the learning targets.</p>					
<p>32. I provide different math problems to students based on their learning needs.</p>					
<p>33. I use information about my students' lives outside of school to increase engagement and make my math lessons more meaningful. I use surveys in math to find out about my students' classroom learning preferences.</p>					

34. I use books, articles, films, music, audio recordings, and a variety of other resources from the Internet that explain and visualize examples of different ethnic groups' cultures and communication within math.					
35. I use surveys in math to find out about my students' classroom learning preferences.					

In a typical week, how often do you implement the following instructional practices?

	Less than 1 time per week	At least 1 time per week	At least 3 times a week	Daily
36. Provide learning choices for students that include ones they came up with.				
37. Provide students with written, verbal, visual, tactile, and kinetic modalities of math learning.				

38. Get feedback on your teaching from your students.				
39. Use peer tutors or student-led discussions in math.				
40. Provide opportunities for students to work cooperatively to share their learning experiences, strengths, backgrounds, interests and needs in math.				

In three teaching scenarios A, B & C, rate their level of culturally responsiveness.

Teacher Scenarios	1 Not at all aware	2 Slightly aware	3 Very aware	4 Extremely aware
41. Teacher A: I don't see culture or ethnicity; I see all my students for who they are. I think it's important to know my students academically, but also their likes and dislikes outside of school. I connect with each and every child to help them				

<p>grow as a learner. I believe all students can grow and learn at high levels. Teaching to the standards for all my students is important, although I know some will not be there just yet. The way we teach the standards should be fun and engaging. Parents are a critical component to my students' learning. I want them to be involved and I provide them opportunities to participate such as coming in and reading to the students or helping at classroom parties. I encourage my parents to contact me if they have any questions about their child's education.</p>				
<p>42. Teacher B: I actively work to understand, be sensitive, and appreciate the history, values, experiences, and lifestyles of my students and families. I like to seek out various ways to connect with my students and families throughout the year based on their input. In order for me to best instruct my students, I need to know who they are and how they best learn. My students help create the norms and culture of our classroom. Every year is a different year and there is little I can</p>				

<p>recreate from previous years due to my students in the classroom. When reviewing the resources I will use to teach the standards, I make sure my students are accurately represented. Caregivers will actively participate in my classroom. I'm constantly seeking feedback from my students and families on how we can improve the learning experiences of my students. They choose how they would like to participate, but it's an integral piece of our learning environment.</p>				
<p>43. Teacher C: I learn about each and every student at the start of the year through a survey. It's important for me to know my students not only academically, but personally as well. I create a safe and nurturing learning environment by having my students create the norms and give them ownership within the structures and procedures of the class. I believe every student can achieve academically, but they might need a little something different along the way. I give students' choice within the learning. For example, the math end of the unit project was to plan a family</p>				

<p>vacation within an allotted budget. Students had a choice in where they wanted to go and how they were going to show their learning around the math standards. A common rubric was used for the project. Parents are actively involved within our classroom. Parents are welcome anytime, there is no sign-up. We've had parents read, share their cultural experiences, share experiences in their jobs, and participate in math projects with their students.</p>				
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SECTION IV: INSTRUCTIONAL PLANNING & IMPLEMENTATION

When planning and implementing a math unit, rate how important the following tasks are for the process.

	1 Not at all important	2 Slightly Important	3 Moderately Important	4 Very Important	5 Extremely Important
44. I identify and cultivate relationships with cultural mediators and interpreters in the classroom,					

<p>school, and community who can serve as mentors about ethnically diverse cultures and communications of my students.</p>					
<p>45. I meet regularly with my students' caregivers. I ask caregivers about their family and community math experiences and bring it into the classroom.</p>					
<p>46. I ask for student input when planning lessons and activities.</p>					
<p>47. I bring in community members to share their math knowledge that relate to my students' various cultures and life experiences.</p>					
<p>48. I use real-world math problems to engage all</p>					

students within math. These math problems stem from our communities and students' home life.					
--	--	--	--	--	--

SECTION V: BACKGROUND INFORMATION

49. Age:

50. What is your race/ethnicity?

51. What pronouns do you go by?

52. When you were growing up, did you have a different cultural experience as your teachers?

1. YES

2. NO

53. If you answered YES to question 49, was there a teacher who stands out to you in your life who helped you learn and grow? It could be from elementary, junior high, high school or college. Please share why this teacher stands out and what they did to help you learn and grow.

54. What helps you in implementing culturally responsive practices to your students?

55. What are the barriers inside or outside of the classroom in implementing culturally responsive practices?

56. Would you be willing to be contacted about possibly taking part in an interview in the summer? (Participants would receive a set of math books for their classroom libraries)

1. YES
 2. NO
57. If you would like to be entered into the drawing for one of three \$25 Amazon eGift cards and/or willing to be contacted about an interview in the summer, please enter your email and phone number.

Thank you for taking the time to complete the survey!

Appendix C: Individual Interviews

Individual Interviews 1

Susan Ejma

TEACHER NAME:

GRADE:

DATE of INTERVIEW:

Individual Interviews (Summer 2022)

Before interview:

- Send email with questions about sample assignments, lessons, and student work assignments.

Email re: assignments, lessons, student work samples

I am asking you to take part in an interview because you meet the criteria for this research which focuses on 3rd-8th grade mathematics teachers who have culturally sustaining beliefs and implement culturally responsive practices for their diverse learners.

As a participant, you will be asked to complete an in-person 45-60 minute interview. In order to understand more about your culturally responsive teaching practices, I ask that you prepare to discuss and show examples of one math unit with accompanying assignments, assessments, and

two samples of students' work. The student work samples that you bring must not have any names or information linked to a particular student. Please bring the following:

- One math unit that you think was the most culturally responsive to your students.
- In order to help me be clear on what you are asking your students to do, please include any materials that show your planning or implementation of culturally responsive practices for your students to understand the math tasks and how you assessed those tasks.
- A typical sample of work from an ethnically and culturally diverse student (no names on the document)
- An exemplary sample of work from an ethnically and culturally diverse student (no names on the document)

VERBAL SCRIPT

(INTERVIEW)

Thank you for taking the time today to talk with me about your mathematics instruction for your diverse learners. As I have shared in the email, I am conducting a research study on teacher's culturally responsive teaching practices within mathematics for their diverse students at the 3rd-8th grade level. The purpose of the research is to investigate teachers' attitudes and expectations of their diverse learners and explore teaching practices being used within mathematics.

Your participation in this interview is completely voluntary. There will be no negative consequences if you decide not to participate or change your mind later after you begin the study. You can withdraw your participation at any time. Your answers will be kept strictly confidential.

With your permission, I will audiotape and take notes during the interview. The recording is to accurately record the information you provide and will be used for transcription purposes only. If you choose not to be audiotaped, I will take notes instead. If you agree to being audiotaped but feel uncomfortable or change your mind for any reason during the interview, I can turn off the recorder at your request. Or if you don't wish to continue, you can stop the interview at any time. I will remove all data that you have provided. Do you give me permission to audiotape and take notes?

Start recording now.

Pseudonyms will be used to maintain confidentiality of all recorded materials and transcripts.

What name would you like to use?

Today I'll start by asking you about your background and experience working with your students. Next I'd like to ask you about the math unit you selected that you felt your students learned from the most. At the end of the interview, I'll ask a few final questions about what has helped you or limited you in implementing culturally responsive practices. And, when we're finished, we can talk about ways in which you think education can be improved to be more culturally responsive to our diverse student needs.

BACKGROUND & EXPERIENCE

I would like to ask you some questions and learn a little bit more about your experiences from your survey responses.

1. Share what I know about their teaching experience from the survey.
 - Is there something you would like to expand on that helps me understand you more as an educator?
 - Ask them to expand on their main reason for wanting to be a teacher.
 - i. Explain more: You shared that your main reason was *Teaching is a way to make a difference in society*. Can you share a time when this happened?
2. You had shared that you participated in some professional learning on culturally responsive teaching.
 - Can you share a memorable professional learning experience that engaged, inspired and you implemented right away for your students?
 - What did you learn the most from that experience?
 - What are you still learning?
 - What is the best way for you to continually grow in this area?
3. You shared that there was a teacher that inspired you to learn and grow when you were younger.
 - Can you share a little more about what you remember about that teacher?
 - How did they connect with you, your family and your community?

- What did the teacher do in the classroom that connected you to the learning?
 - What did you learn the most from that teacher?
4. Let's talk about your math experience.
- Do you like teaching mathematics? Tell me why or why not.
 - How did you learn how to teach mathematics?
 - Do you consider yourself to be a strong mathematician? Tell me why or why not.
 - What would you like to know more about in teaching mathematics to your students?

ABOUT THE SCHOOL, STUDENTS & COMMUNITY

5. Tell me about your students.
- Who are they and what are their strengths as learners?
 - How did you learn this information about them?
 - What more would you like to know about them?
 - What cultural knowledge has allowed you to connect with your students?
 - In what ways do you engage with your students and families?
6. Tell me about the other teachers and people you work with at the school.
- Do your colleagues have similar cultural values and beliefs as you?
 - What have you learned about your colleagues in working with ethnically and culturally diverse students?
7. Tell me about the community.

- What do you know about your students' community?
- How do you engage with your community?
- What are the strengths and challenges of your community?
- How do you connect the school to your students' home and communities?

INSTRUCTIONAL PLANNING & IMPLEMENTATION

I'd like to ask you some questions about the math unit and artifacts you brought to share.

8. Tell me why you think this math unit was culturally responsive for your diverse learners?

9. What did your ethnically and culturally diverse students already know before the math unit started?

- How did you know this information?

10. What were the main influences on the way you planned for this math unit?

- What resources were selected for the math unit?
- How did you decide on these resources?
- When planning for the individual tasks/lessons, did you create them, did someone else create them, or is there another source?

11. How did you decide to structure the math time on a typical day (ie whole group, small group, individual)?

- Which students did it work for and why?
- Would you have done anything differently?

12. When implementing culturally responsive practices, what did you notice from your students in their math learning?

- Can you share any specific examples of what they learned and how you knew they learned it?

13. Within each lesson building up to the summative in the math unit, what opportunities for student choice were given?

14. How did this math unit connect to the students' lives or communities?

15. Was there anything you learned from your students or their communities while teaching the math unit?

16. How did you know your ethnically and culturally diverse students' were learning the math goals of the unit?

- In what ways did students' show you they had learned the content goals?

17. Were there any lessons that you had to reteach?

- What did you learn from your ethnically and culturally diverse students and your planning by reteaching the lesson?

DISCUSSION OF TASKS AND STUDENT WORK SAMPLES

18. Please describe what your goals were for this task.

- What did you want students to learn from this task?
- Where did the ideas for this task come from?

19. What experiences did students have to prepare them for completing this task?

20. Can you talk about what makes this student work sample typical?

21. Can you talk about what makes this student work sample exemplary?

CONTRIBUTIONS AND LIMITATIONS

As we talked about your culturally responsive teaching practices for your students, I would like to know more about what helps you implement these practices more often and on a daily basis.

22. I have provided a list of possible factors that may contribute to you implementing more often. Can you rank order them from 1 being the most important in what helps you? If you don't see an item on the list that you think should be there, I would like you to make additional cards with those items before you rank order.

- Why did you choose – to be the most important in helping you implement more often?

I am also interested to know what creates limitations for you.

23. I have provided a list of possible factors that may contribute to you implementing more often. Can you rank order them from 1 being the most important in what limits you? If you don't see an item on the list that you think should be there, I would like you to make additional cards with those items before you rank order.

- Why did you choose — to be the most important in limiting you?

24. Last question, in education we hear this phrase often, “There’s so much on our plate, we can not add one more thing.”

- How do you feel about this?
- How do we improve education to be more culturally responsive for our diverse learners knowing this is being felt by educators?

Thank you so much for your time today. Your sharing of practices and understanding of culturally responsive teaching has helped this study.

Appendix D: Mondrian's Art Lesson

Lesson 8: Mondrian's Art (Optional)

Standards Alignments

Addressing 4.OA.B.4

Building Towards 4.OA.B.4

Teacher-facing Learning Goals

- Apply understanding of factors, multiples, prime and composite numbers to create a geometric design.

Student-facing Learning Goals

- Let's make art with rectangles.

Lesson Purpose

The purpose of this lesson is for students to apply their understanding of the area of rectangles and factor pairs to create and analyze Mondrian-inspired art.

This lesson is optional because it does not address new mathematical content standards. It does give students an opportunity to develop mathematical modeling skills while applying the ideas of area, factors, multiples, prime numbers, and composite numbers.

Students create a piece of artwork that is based on area of rectangles and multiplication facts within 100. They begin by learning about Piet Mondrian and analyzing a number of his abstract paintings. They recognize that the paintings are composed of rectangles—some with the same area and some with different areas.

Students then outline their own composition, by dividing a 18-by-24 grid into rectangular spaces with certain requirements. Next, students examine a peer's artwork. They identify rectangles with equal areas and those that represent prime or composite numbers.

When students isolate and describe the mathematical elements in art and adhere to mathematical constraints to create art, they model with mathematics (MP4).

This lesson may take more than 60 minutes, as students may need additional time to color, analyze, and present their designs. Consider modifying the activities or expanding the lesson across 2 days to meet students' needs and any time constraints.

Access for:

Students with Disabilities

- Action and Expression (Activity 1)

English Learners

- MLR8 (Activity 2)

Instructional Routines

Notice and Wonder (Warm-up)

Materials to Gather

- Colored pencils, crayons, or markers: Activity 1, Activity 2
- Glue or tape: Activity 2
- Rulers or straightedges: Activity 1
- Sticky notes: Activity 2

Materials to Copy

- Centimeter Grid Paper - Standard (groups of 2): Activity 1

Lesson Timeline

Warm-up	10 min
Activity 1	20 min
Activity 2	20 min
Lesson Synthesis	10 min

Teacher Reflection Question

With which math ideas from today's lesson did students grapple most? Did this surprise you or was this what you expected?

----- Begin Lesson -----

Warm-up

 10 min

Notice and Wonder: Piet Mondrian's Art

Standards Alignments

Building Towards 4.OA.B.4

The purpose of this task is to introduce students to the artwork of Piet Mondrian. Students may notice that his paintings are composed of rectangles of various sizes. Students will create their own versions of Mondrian art in the first activity.

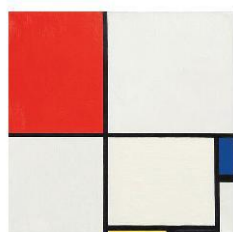
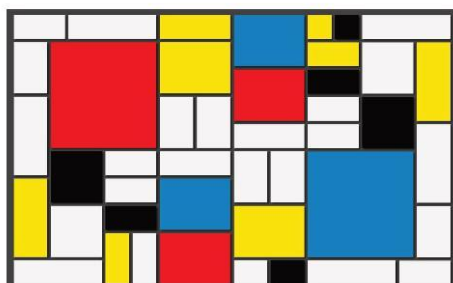
To show students additional artwork by Mondrian, consider visiting a virtual installation of Piet Mondrian's work on the website of Museum of Modern Art (MoMA) or visiting the website of the Tate Gallery.

Instructional Routines

Notice and Wonder

Student-facing Task Statement

What do you notice? What do you wonder?



Student Responses

Students may notice:

- Lots of rectangles.
- The rectangles are all different sizes.
- The paintings weren't of anything.
- There are only 3 or 4 colors.
- There are black lines around all the rectangles.

Student may wonder:

- Are any of the rectangles the same size?
- What is the area of the white rectangles?
- Which colors fill more space on the paintings?

Launch

- Groups of 2
- Display the images.
- "What do you notice? What do you wonder?"
- 1 minute: quiet think time

Activity

- "Discuss your thinking with your partner."
- 1 minute: partner discussion
- Share and record responses.

Synthesis

- "These are digital copies of famous paintings by a Dutch artist named Piet Mondrian. He lived from 1872 to 1944. A little more than 100 years ago, he became known for painting in a style that relates to the math we have been studying. Many of his paintings hang in museums all around the world."
- "How do you think his art connects with what we've been studying? Why are we looking at it during math class?" (He used a lot of rectangles. His art looks very precise. He seemed to have planned for the rectangles to have certain side lengths.)
- If not mentioned by students, highlight that some of the lines go from edge to edge of the painting while others are shorter, and that some rectangles seem to have the same area.
- Considering showing students additional artwork by Mondrian.

Activity 1

🕒 20 min

My Mondrian Outline

Standards Alignments

Building Towards 4.OA.B.4

The purpose of this activity is for students to create an outline for their artwork. In this activity, students draw lines on graph paper, marking out rectangular areas that will be the basis for their Mondrian-inspired artwork.

🗎 Access for Students with Disabilities

Action and Expression: Internalize Executive Functions. Check for understanding by inviting students to rephrase directions in their own words. Keep a display of Mondrian's paintings visible throughout the activity.

Supports accessibility for: Memory, Organization

Materials to Gather

Colored pencils, crayons, or markers, Rulers or straightedges

Materials to Copy

Centimeter Grid Paper - Standard (groups of 2)

Required Preparation

- Each student will need a black marker or crayon.

Student-facing Task Statement

Create an outline for art in the Mondrian style, starting with an 18-by-24 grid.

Your artwork should:

- be partitioned into at least 12 rectangles
- include two different rectangles that have the same area
- include at least one rectangle whose area is a prime number

Launch

- "We are going to create our own art pieces that are inspired by Mondrian's work."
- Read the activity statement as a class.
- Select a student to explain the task in their own words. Invite the class to ask clarifying questions.
- Give students a copy of the blackline master, a straightedge, and black markers or crayons.

Try at least one of these challenges. Make a design where:

- all but two of the rectangles have a prime number for its area
- no two rectangles share a side entirely

Student Responses

Answers vary.

Activity

- “Use your straightedge and pencil to partition your grid. Try at least one of the challenges.”
- “Once you are happy with your design, trace it with a black marker or crayon.”
- 13–15 minutes: independent work time
- Monitor for students who attempt or accomplish one or more of the challenges.

Synthesis

- “Compare your work with a partner. What is alike or different about your outlines?” (They are alike because they show only rectangles, but the way they are arranged and their sizes are different.)
- “How can you determine if any of the rectangles have the same area?” (See if the sides are factor pairs of the same number. Use the side lengths and multiply them to see if the product is the same number.)

Activity 2

🕒 20 min

Analyze the Rectangles

Standards Alignments

Addressing 4.OA.B.4

In this activity, students use their understanding of factor pairs, prime, and composite numbers to analyze their peers' artwork. They look for rectangles that have the same area and those with a prime number or a composite number for their area. Students practice communicating with precision as they identify rectangles and how they know the rectangles meet these conditions (MP6).

After students share their analyses with their partner and a brief class discussion, give students time to color their artwork and to prepare it for display.

Access for English Learners

MLR8 Discussion Supports. Synthesis: Display the following sentence frames to support whole-class discussion: “To find rectangles with the same area I looked for . . .”, “To find rectangles with an area that is prime, I looked for . . .”, and “To find rectangles with an area that is composite, I looked for . . .”

Advances: Speaking, Representing

Materials to Gather

Colored pencils, crayons, or markers, Glue or tape, Sticky notes

Student-facing Task Statement

Trade artwork with your partner.

Using your partner’s artwork, look for and describe each of the following:

1. Rectangles that have the same area
2. Rectangles with an area that is a prime number
3. Rectangles with an area that is a composite number
4. Which challenge they completed

Student Responses

Sample responses:

1. There is a rectangle that is 3 units by 10 units, and another that is 6 units by 5 units. The area of both is 30 square units.
2. There is one rectangle that is 11 units by 1 unit. The area is 11 square units.
3. There are many rectangles with a composite number for the area: 18 square units, 12 square units, 21 square units, and more.

Launch

- Groups of 2
- “Switch artwork with your partner.”
- “Look at your partner’s work and try to find three kinds of rectangles: rectangles with the same area, rectangles with an area that is a prime number, and rectangles with an area that is a composite number.”
- “Then, if your partner completed a challenge from the first activity, see which one they did.”

Activity

- 5–7 minutes: independent work time
- 2–3 minutes: partner discussion
- Monitor for students who consider factor pairs of a number as they look for rectangles with the same area in their partner’s artwork.

Synthesis

- Invite 1–2 previously selected students to share how they found rectangles with the

4. No two rectangles share a side entirely.

same area. (The sides are factor pairs of the same number.)

- “Now, take a moment to color your artwork with 3–4 colors. Later, you’ll display your work for others to see.”
- Give students colored pencils, crayons, or markers.
- 8–10 minutes: independent work time
- Give students materials needed for the gallery walk: glue or tape for displaying their artwork and sticky notes for writing comments or questions.

Lesson Synthesis

 10 min

Direct students to display their artwork for all to see.

“You will now walk around and look at the art the class has made. As you do so, consider questions that you might ask the artists about their design. Choose at least one piece of artwork and write a question about it on a sticky note.”

5–6 minutes: gallery walk

Monitor for questions that are related to the artist’s intent or mathematics in the design. Invite a couple of students to whom those questions are directed to answer questions about their art.

“Today you had a chance to create artwork and display it like in an art gallery.”

“What was the most challenging part about creating the artwork?” (I was limited to only using rectangles. I had to make sure two rectangles had the same area.)

“What connections do you see between the mathematics and art we experienced today?” (The art we made uses rectangles. We can use multiplication to figure out if the areas are the same or different. We had the same requirements, but our art was different because we chose different side lengths.)

Suggested Centers

- Five in a Row: Multiplication (3–5), Stage 2: Factors 1–9 (Addressing)
- Secret Fraction (3), Stage 1: Building Non-Unit Fractions (Supporting)

Appendix E: Student Assessments

Objeto	Herramienta (regla, metro, cinta métrica)	Estimación	Longitud o distancia real
Escritorio	Regla	60cm	60cm
Lápiz	Regla	16cm	18cm
Libro	Regla	30cm	22cm
Caja de pañuelos	Regla	17cm	22cm
Papel	Regla	17 cm	26cm
Zapato	Regla	30cm	24cm
Botella de agua	Regla	13cm	22cm

Objeto	Herramienta (regla, metro, cinta métrica)	Estimación	Longitud o distancia real
Escritorio	23inches	24inches	distancia
Lápiz	7inches	6inches	Longitud
Libro	8imedio inches	6inches	Longitud
Caja de pañuelos	9imedio inches	8inches	longitud
Papel	1 pie	10	Longitud
Zapato	7	7imedio	longitud
Botella de agua	5	6imedio	longitud