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Reconceptualizing Mathematical Word Problems to Reflect Social Justice Principles and Culturally Relevant Teaching

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Reconceptualizing Mathematical Word Problems to Reflect Social Justice Principles and Culturally Relevant Teaching

by
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Approval Page

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Statement of Original Work

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Abstract

Reconceptualizing Mathematical Word Problems to Reflect Social Justice Principles and Culturally Relevant Teaching. Michelle A. Jackson, 2022: Applied Dissertation, Nova Southeastern University, Abraham S. Fischler College of Education and School of Criminal Justice. Keywords: mathematics education, social justice, culturally relevant pedagogy, professional development, in-service teachers, word problems, critical theory

As currently developed and written, mathematical word problems lack cultural relevance for an increasingly culturally diverse population in elementary schools in the United States. The design and context of mathematical word problems promote the norms, values, and beliefs of the dominant culture while potentially negatively influencing students from non-dominant culture engagement and achievement in mathematics.

The purpose of this sequential, explanatory mixed-methods study was threefold: to (a) examine in-service teachers' preexisting beliefs about the relevance of social justice and culturally relevant teaching related to their mathematics instructional practices before receiving a synchronous online professional development program; (b) assess the impact of the synchronous online professional development program on teachers' beliefs and classroom practices related to social justice and culturally relevant teaching in mathematics; and (c) understand in-service elementary math teachers' perception of infusing culturally relevant contexts in mathematics on student engagement. Thirty elementary mathematic teachers with more than one year of teaching experience participated in the study. Quantitative data was collected via the Dispositions for Culturally Responsive Pedagogy Scale and the Learning to Teach for Social Justice – Beliefs Scale and qualitative data was gathered through interviews.

Analysis revealed that although teachers did not score significantly higher on the DCRPS, or LTSJ-BS posttest compared to the pretest they felt that reframing word problems using culturally relevant and social justice topics would increase student engagement in the mathematics classroom. They expressed that utilizing these contexts would create word problems that are more relevant and relatable to students. A consensus amongst participants was that the synchronous online professional development program increased participants' awareness of the messages word problems could potentially send to students. One of the study's key findings is that teachers feel more comfortable using culturally relevant contexts than social justice contexts in mathematics. Teachers pointed at the lack of student maturity, parental conflicts, and state laws banning controversial topics as some of the reasons for not feeling comfortable using social justice contexts in their classroom. The synchronous online professional development was instrumental in teacher understanding and ability to reframe mathematical word problems.

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Chapter 1: Introduction

Statement of the Problem

The changing racial makeup of the United States is most evident among children. The year 2020 marked the first time in U.S. history when a majority of the population under 16 years of age nationally identified as non-White. The U.S. Census projections indicate that by 2060 about two in three children will be of a race other than non-Hispanic White (Vespa et al., 2020). Furthermore, the National Center for Education Statistics (NCES) reported that non-White students made up 45% of the population in PK-12. Meanwhile, 79% of public-school teachers are White (National Center for Education Statistics [NCES], 2020).

Despite the increase in ethnic diversity that the United States faces, the dominant culture, based on western European values, continues to influence the education system (Flintoff et al., 2015), particularly the curriculum (Apple, 1993). As Apple (1993) stated, "The curriculum is never simply a neutral assemblage of knowledge, somehow appearing in the texts and classrooms of a nation. It is always part of a selective tradition, someone's selection, some group's vision of legitimate knowledge" (p. 222).

A consequence of the dominant culture controlling the curriculum is the bias contained in instructional materials (Bright, 2016a; Yeh & Otis, 2019). Sadker and Sadker (1982) identified seven forms of bias in instructional materials. These are invisibility, stereotyping, imbalance and selectivity, unreality, fragmentation and isolation, linguistic, and cosmetic bias. Curriculum bias robs minority students of the opportunity to learn about their own cultures, thus perpetuating the societal status quo (Flintoff et al., 2015).

In mathematics content, curriculum bias is evident in the context of word problems. Most word problems found in textbooks and other instructional materials are carriers of the dominant culture's values (Bright, 2016a; Yeh & Otis, 2019). These word problems help to promote and normalize the White middle-class cultural values (Bright, 2016a; Yeh & Otis, 2019) while limiting the non-dominant groups' access to mathematics and consequently future opportunities (Bright, 2016a; Yeh & Otis, 2019). As curriculum's enactors, teachers must recognize bias in the curriculum and disrupt the status quo for students to receive a quality education, preparing them to participate in a diverse democratic society (Bright, 2016a; Yeh & Otis, 2019).

A teacher's role is central in disrupting the status quo, but the disparities between a predominantly White middle-class profession and a diverse student population call for professional development engaging teachers with topics of the race (Flintoff et al., 2015). Through social justice and culturally relevant mathematics professional development, this study intends to increase teachers' capacities to identify bias in the mathematics curricular materials and guide them in transforming the context they use to teach mathematics. When teachers can identify bias in the curriculum, they can disrupt the status quo by challenging it or replacing it with culturally relevant material (Kumar et al., 2019; Woodley et al., 2017). A culturally relevant curriculum supports student achievement and increases cultural capacity (Allen et al., 2017) for the success of all students.

The Research Problem

As currently developed and written, mathematical word problems lack cultural relevance for an increasingly culturally diverse population in elementary schools across

the United States. The design and context of mathematical word problems promote the norms, values, and beliefs of the dominant culture while potentially negatively influencing students from non-dominant culture engagement and achievement in mathematics.

Background and Justification

Traditionally conceptualized as neutral, mathematics education is rarely considered a factor in reproducing dominant ideas, beliefs, and norms (Yeh & Otis, 2019). Furthermore, researchers have found that many teachers and students believe textbooks and curricular materials impartially convey just the facts (Yeh, 2017; Yeh & Otis, 2019). Like other institutional tools involving mathematics (e.g., standardized tests, accountability system, curricular tracking), textbooks and a prescribed curriculum perpetuate inequities in mathematics education (Yeh & Otis, 2019). For example, disparities exist in the number of African American students who enroll in high-level math courses versus their White peers (U.S Department of Education, 2018). The Civil Rights Data Collection reported that in the school year 2015-2016, of all eighth graders in the United States who took Algebra I, 58% were White, whereas 11% were African American, 18% were Latino, 8% were Asian, 3% students of two or more races, 1% were American Indian or Alaska Native students, and 0.4% were Native Hawaiian or other Pacific Islander students (U.S. Department of Education, 2018). The trend is similar for student passing rates, with 85% of White students compared to 65% of African American students and 72% of Hispanic or Latino students passing Algebra I (U.S. Department of Education, 2018). While these groups had passing rates below 50%, students of two or

more races, American Indian or Alaska Native students, and Native Hawaiian or other Pacific Islander students (U.S. Department of Education, 2018).

Students learn more than reading, writing, and math in schools; they also learn "what is valued and whose knowledge and experiences are deemed important" (Yeh & Otis, 2019, p. 85). Therefore, in an education system that favors a dominant White culture (Battey & Leyva, 2016), re-evaluating instructional materials to disrupt current hegemonic narratives in mathematics education and replacing them with equitable and varied perspectives is crucial to empower students (Freire, 2012; Rubel, 2017). According to Stinson (2004), empowering students through mathematics can potentially create more equitable and just educational opportunities. Stinson (2004) defines *empowerment* as providing students with educational experiences to identify structures of oppression and develop a sense of agency concerning social injustices.

Teaching mathematics using a social justice context is not only about substituting dominant narratives on race with those of the oppressed and marginalized, but it is also about disrupting the current narratives in hopes of using mathematics as a tool to uncover social injustices and as a driver of future educational opportunities (Gutierrez, 2002). Additionally, researchers have seen how students develop better attitudes and dispositions towards mathematics education after they use mathematics as a tool to uncover social injustices (Brelias, 2015; Gutstein, 2003, 2006; Wade, 2007). Bright's (2016a) study exploring mathematic textbook word problems as transmitters of hegemony found that more than half of the problems selected by teachers endorsed middle-class citizens' values and morals, such as competitive consumerism, leisure time and activities, and white-collar work. Moreover, the researcher established that many

problems referred to upper-class lifestyle activities of the dominant culture, such as inheriting large sums of money, owning a vacation home, having multiple horses, and arranging parking for one's yacht. Word problems send not only the wrong message about the culture, norms, and beliefs of the dominant culture, but they are biased and promote stereotypes early on in student's education (Greer, 1997; Ladd, 2011; Reusser & Stebler, 1997). Therefore, it is crucial to engage mathematics educators in recognizing the hidden curriculum in mathematics education and provide opportunities to engage in dialogue to develop strategies that will help them reframe contexts used to teach mathematics.

Deficiencies in the Evidence

There is research analyzing pre-service and beginning teachers' perceptions of social justice education (Garii & Appova, 2013; Reagan et al., 2011; Simic-Muller et al., 2015). These studies have addressed teacher perceptions about challenges implementing teaching for social justice practices (Garii & Appova, 2013; Reagan et al., 2011). Additionally, numerous studies have been conducted on teaching mathematics for social justice to help minority students at the secondary level identify social injustices affecting their communities and develop a sense of agency (Gutierrez, 2002; Gutstein, 2003). However, there is limited research on experienced elementary mathematic teachers' beliefs on the relevance of social justice, and culturally relevant teaching practices have in their classrooms/professional practices. There is also limited quantitative research on assessing the impact of synchronous online professional development program on teachers' beliefs and classroom practices related to social justice and culturally relevant mathematics teaching at the elementary level.

Audience

The intended audience for this research study includes researchers and educators seeking to understand in-service teachers' perception of culturally relevant and social justice perspectives in mathematics. This study provides insight for mathematics teachers, teacher educators, curriculum developers, district leaders, and policymakers on transforming curricula and promoting social justice in the elementary mathematics classroom.

Setting of the Study

The study took place with elementary school teachers and math tutors and coaches in the United States. Participants in this study met the following criteria: teach, tutor or coach mathematics at the elementary level and have one or more years of teaching experience. This study occurred virtually; teachers were recruited via social media platforms (e.g., Facebook and LinkedIn).

Purpose of the Study

The purpose of this sequential, explanatory mixed-methods study was threefold: to (a) examine in-service teachers' preexisting beliefs about the relevance of social justice and culturally relevant teaching related to their mathematics instructional practices before receiving a synchronous online professional development program; (b) assess the impact of synchronous online professional development program on teachers' beliefs and classroom practices related to social justice and culturally relevant teaching in mathematics; and (c) understand in-service elementary math teachers' perception of infusing culturally relevant contexts in mathematics on student engagement.

An ethnographic study by Johnson and Sundstrom (2020) described how teachers

discuss race and culture in computer science professional learning environments. A total of 122 high school teachers from 29 states and the District of Columbia participated in the study. Findings revealed the importance of deliberately including race topics in all professional development opportunities. Further, the researchers concluded that purposeful race-based discussions in professional development can increase teacher competency to teach diverse student populations. More specifically, it was found that professional development provided teachers an opportunity to understand the importance of naming race and racism as they began exploring the implications of a critical race perspective. These findings offer insights on potential implications of a synchronous online professional development program on experienced in-service mathematics teachers at elementary public schools in the United States.

Definition of Terms

Cultural competence "refers to helping students to recognize and honor their own cultural beliefs and practices while acquiring access to the wider culture, where they are likely to have a chance of improving their socioeconomic status and making informed decisions about the lives they wish to lead" (Ladson-Billings, 2006, p. 36).

Culturally responsive pedagogy is "the use of 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" (Gay, 2018, p. 31).

Hegemonic narratives are "the imposition of dominant group ideology onto everyone in society. Hegemony makes it difficult to escape or to resist 'believing in' this dominant ideology, thus social control is achieved through conditioning rather than physical force or intimidation" (Sensoy & DiAngelo, 2011, p. 95*)*.

Privilege is defined as “the rights, advantages, and protections enjoyed by some at the expense of and beyond the rights, advantages, and protections available to others” (Sensoy & DiAngelo, 2011, p. 104).

Social justice pedagogy can be defined as instructional practices that create the conditions for students to recognize current social injustices and act as agents of change (Gutstein, 2003).

Sociopolitical consciousness is the ability “to recognize, understand, and critique current and social inequalities” (Ladson-Billings, 1995, p. 476).

Teaching for social justice involves teaching a particular subject using instructional practices that challenge current social injustices (Stinson, & Wager, 2012).

Teaching with social justice denotes creating a cooperative classroom environment where equal participation is promoted (Stinson & Wager, 2012).

White privilege is defined as “the privileges automatically received by being a member of the dominant group” (Sensoy & DiAngelo, 2011, p. 102).

Chapter 2: Literature Review

The purpose of this mixed-methods study was threefold. First, it examined in-service teachers' preexisting beliefs about the relevance of social justice and culturally relevant teaching relating to their own mathematics instructional practices before receiving professional development. Second, it assessed the impact of professional development on teachers' beliefs and classroom practices related to social justice and culturally relevant teaching in mathematics. Finally, the study sought to understand in-service elementary math teachers' perception of infusing culturally relevant contexts in mathematics on student engagement. Critical theory and critical race theory are the theoretical frameworks for this study. This literature review was organized into 11 major sections: (a) the theoretical framework utilizing Critical Theory and Critical Race Theory; (b) word problems as hegemonic features of the mathematics curriculum; (c) bias in instructional materials; (d) bias in the mathematics curriculum; (e) teacher perception of teaching culturally relevant pedagogy and social justice education; (f) impact of professional development on teachers' beliefs, knowledge, and classroom practices; (g) culturally relevant pedagogy (CRP) influence on student engagement and achievement; (h) social justice and culturally relevant teaching; (i) reframing word problems through critical mathematics and social justice education; (j) measuring social justice contexts and culturally relevant teaching practices; (k) research questions; and (l) summary.

Theoretical Framework

Critical Theory (CT) informed this literature review. Various perspectives on critical theory make it difficult for researchers to succinctly define this theory (Kincheloe et al., 2017). As Kincheloe et al. (2017) advises, a broad definition of critical theory is

beneficial since it allows for “changes, disagreements, and growth” (p. 235). Common amongst definitions is the idea that this theory critiques and questions different facets of the social world (Merriam et al., 2007) keeping a focus on the goal of social justice (Kincheloe et al., 2017). In contrast, an opposing view of critical race theory considers this philosophy as potentially oppressive within itself. With its complex concepts and terms, critical race theory runs the risk of creating a culture of isolation excluding others from the dialogues (Pietrykowski, 1996; Tyson, 2015).

The goal in this study was not to exclude anyone from the dialogue, but to bring to the forefront of educators some of the challenges our less privileged students face in the mathematics classroom. Utilizing critical theory to analyze how word problems are considered carriers of hegemony was appropriate since this approach “assumes it necessary to expose and overcome unjust social hierarchies derived from socioeconomic class, race, gender, sexuality… and other hegemonic factors in society and school” (Schubert, 2008, p. 404).

In a study by Haneda et al. (2017), the authors utilized the lens of critical theory to provide a perspective on how it is possible for teachers to use a critical theory lens to examine the curriculum and change classroom practices after receiving professional development based on critical theory. This study examined the interactions between a kindergarten teacher and a veteran coach using dialogic teaching. The data collected in this study was part of a United States initiative in urban elementary schools where teachers participated in professional development with a focus on enacting critical sociocultural teaching practices. They observed a White middle-class female teacher with 19 years of experience teaching kindergarten in the Midwest area of the United States.

The professional development involved a 30-hour summer intensive training on critical sociocultural teaching strategies and seven cycles of personalized instructional coaching. These instructional coaching cycles were the focus of this study. Each cycle consisted of a 30-minute pre and post conference with the kindergarten teacher, and a 45-minute classroom observation. During the preconference, the teacher discussed the lesson plan to be observed by the coach. During the classroom observations, the authors gathered evidence of student learning and engagement in addition to the interaction patterns between teacher and students and between students. After the observations, the teacher and coach met to debrief the observed lesson and set goals for the next session of coaching.

Through the research, Haneda et al. (2017) sought to understand how teachers can develop understanding of Critical Stance as a pedagogical practice through coaching. The author explains that Critical Stance is "teaching to transform inequities" and it is achieved by intentionally including students in questioning conventional knowledge and practices, reflecting on consequences, and actively looking for ways to interrupt inequities in the classroom and the community (Haneda et al., 2017, p. 52). They found that the teacher started to understand Critical Stance in her practice which led to an increase in student engagement and student participation during the lessons. Moreover, the teacher verbalized having a greater understanding of Critical Stance and recognized questioning students to further class discussions, for example, "asking her students to speculate about the consequences of cutting down trees" (p. 59). The teacher encouraged her students to express their point of views allowing for multiple voices to be heard. Haneda et al. (2017) concluded that a connection was evident between the coaching

sessions and the teacher's changing classroom practices. Critical sociocultural instructional coaching empowered the teacher by positioning her as an agent able to interpret "key pedagogical principles and enact them in a logically contingent manner" (Haneda et al., 2017, p. 53).

Attempting to provide a new way of thinking about change in the field of early care and education, Douglass (2016) employed a critical theory framework, Positive Organizational Scholarship (POS), in his study. Positive Organizational Scholarship studies positive patterns within an educational organization and exposes them with the intent of strengthening its members through change. By highlighting positive attitudes and dynamics, and focusing on the human potential, this critical theory fosters self-efficacy, hope, and resilience in individuals and teams.

Douglass' (2016) study was part of a new initiative of a professional development system in the United States that sought to transform professional development policy and practice. Initial interviews were conducted with 30 professional development providers in the fall of the first year of implementation and secondary interviews were completed with 25 participants in the spring. The researcher also collected data through participant observations and detailed field notes. To analyze data, the researcher used the ATLAS.ti qualitative analysis software. The findings showed participants' capacity to make sense of, adapt to, and positively contribute to change. Douglass noted how a greater sense of commitment to the field was unleashed through establishing positive practices (compassion, mutual support, and ability to positively contribute to change) which resulted in the attention to nurturing, strengthening, and fostering agency. In addition, the

researcher of this study suggested that change efforts can be deliberately planned within PD to empower positive change.

Critical theory is constantly evolving, new perspectives are arising, and new theories are being derived from it (Kincheloe et al., 2017). While this theory originated and is often connected to the Frankfurt School and their philosophers (e.g., Horkheimer, Adorno, Marcuse, and Habermas), a critical theory can be any philosophical approach sharing some of the same goals (Archibald et al., 2018). One of these theories is the Critical Race Theory (CRT) which presents the relationship between race, racism, power, and societal structures. Ladson-Billings and Tate (1995) used CRT to understand school inequalities. According to Ladson-Billings (2014), race "is not a construct of the powerless or the dispossessed. It functions to keep a particular set of power relations in place and to make whiteness hegemonic and positioned as the site of normativity" (p. 261). This theory provides a useful lens in this review because it provides a method to understand how teaching mathematics through social justice contexts can, possibly, disrupt subtle but racially unjust situations.

Through the lens of CRT, Johnson and Sundstrom (2020) conducted an ethnographic study to describe how teachers discuss race and culture in computer science professional learning environments. One hundred twenty-two high school teachers from 29 states and the District of Columbia participated in the study. The findings noted the importance of deliberately including race topics in all professional development opportunities since isolated equity discussions will not elicit in depth conversations about race and racism. The researchers concluded that purposeful race-based discussions in professional development can increase teacher competency to teach diverse student

populations. Professional development gave teachers a chance to realize the significance of naming race and racism as they explored the ramifications of a critical race perspective. These findings offer insights on potential implications of a synchronous online professional development program on experienced in-service mathematics teachers at elementary public schools in the United States.

Similarly, Coles-Ritchie and Smith (2017), conducted a qualitative study using CRT as the theoretical framework because it allowed them to examine racist policies and assumptions that exist in school structures. The researchers noted that examining these policies can provide educators opportunities to uncover the racist practices that exist in schools. They discovered that professional development for elementary in-service teachers encouraged conversations about race and created a starting point to initiate race talks as an expected and transformative process for educators. Coles-Ritchie and Smith concluded that if authentic change is expected to occur for marginalized students in educational contexts, continual support for teacher professional development surrounding race talk is crucial.

Critical research can be understood best as "research that attempts to create conditions for empowerment and social justice" (Kincheloe et al., 2017, p. 237). Both critical theory and critical race theory provide a framework for uncovering and understanding word problems as hegemonic features of the mathematics curriculum and changing it to achieve the goal of social justice.

Word Problems as Hegemonic Features of the Mathematics Curriculum

The concept of hegemony is attributed to Philosopher Antonio Gramsci (1891-1937), who used it to explain how powerful groups dominate society by manipulating

them culturally and socially (Eyerman, 1981; Gramsci et al., 1971; Urbinati, 1998). Deriving from the Greek verb *to lead*, the term hegemony denotes domination (Merriam-Webster, n.d.); therefore, hegemonic ideas are those beliefs intended to dominate. Individuals in positions of power use hegemonic ideas, as well as rhetoric and other tactics, to gain and maintain domination over the subjugated classes (Urbinati, 1998). This is accomplished by manipulating the language and culture of a society (Urbinati, 1998), for example, feeding society information that gives them hope to become the elite through hard work and grit, knowing that there are systems in place to prevent this from happening (Eyerman, 1981). Because most people want to achieve a higher status in society, they believe these ideas and develop a false consciousness.

False consciousness is a conditioned state of mind that prevents a person from recognizing that they are participating in their own oppression (Eyerman, 1981; Urbinati, 1998). They inaccurately believe that they can rise to elite status, thus making it difficult for them to see the levels of oppression to which they are being subjected (Eyerman, 1981; Urbinati, 1998). Educational institutions can contribute to the development of false consciousness in its students. Because curriculum is a central component of students' learning of content, the content of those materials impact students' understanding of the world in which they live. Hence, schools may nurture and maintain a false consciousness in students through its curricular materials. In these materials particular ideas and concepts are presented as mainstream, without being challenged and problematized (Bright, 2016a). Certain perspectives (e.g., white, male, heterosexual, Christian, middle or upper class, English-speaking, and patriarchal) dominate the school curricula perpetuating the status quo (Bright, 2016a).

More specifically, in mathematics education, word problems are considered hegemonic features of the curriculum because of the context in which these problems are presented to students (Brelias, 2015; Bright, 2016a, 2016b; Yeh & Otis, 2019). Curricular materials, specifically textbooks and standardized assessments, contain many problematic word problems (Bright, 2016a). In a grounded theory study Bright (2016a) explored mathematic textbook word problems as transmitters of hegemony. Through a two-part exploration, teachers in the study first examined a short clip and identified examples of racism, sexism, linguicism, tokenization, white privilege and Western-faith normativity. Participants then identified word problems they considered transmitters of a particular cultural or social viewpoint. Bright (2016a) found that more than half of the problems selected by teachers endorsed middle-class citizens' values and morals, such as leisure time and activities, competitive consumerism, and white-collar work. Also, over a dozen problems referred to upper-class lifestyle activities of the dominant culture, such as inheriting considerable sums of money, owning a vacation property, having several horses, and arranging parking for one's yacht (Bright, 2016a).

For example, here is a problem a teacher in Bright's (2016b) study found from a textbook in New Mexico:

> It costs $175 to rent a jet ski for 2 hours. It costs $300 to rent a jet ski for 4 hours. Write an equation that represents the cost y (in dollars) of renting a jet ski for x hours. (p. 18)

Problems such as this insult low socio-economic status (SES) students "where the cost to rent a jet ski for four hours is the same amount someone working full time for minimum wage makes in a week" (Bright, 2016b, p. 18). In addition, racism and heteronormativity

were noted as themes. The authors of these word problems targeted the White, middle-class students, and framed their experiences as the norm. Bright (2016a) concluded that when studied closely, word problems "carry specific cultural norms that may privilege some realities while denying or even insulting others" (p. 17). This study demonstrates how educators can broaden their views and analyze word problems included in their curricular materials through collaborative critical analysis.

Word problem contexts are overlooked and unchallenged because of the traditional belief that mathematics education is neutral and value-free (Bright, 2016a, 2016b; Gutstein & Peterson, 2013; Yeh & Otis, 2019). This belief was evident in Garii and Appova's (2013) study, where the researchers studied student teachers and their ability to integrate social justice into the content of mathematics lessons. The purpose of this study was to find out how (if at all) student teachers could differentiate between using social justice to teach mathematics and using mathematics to explore social justice issues. The participants of the study included 18 first semester seniors preparing to be primary school teachers. The researchers found that pre-service elementary teachers were not able to verbalize their understanding of social justice or how to integrate it into mathematics lessons. After taking courses in which social content, context, and social justice pedagogy were explicitly taught, participants still did not realize that mathematics connects to decision-making processes involving economics and politics. This study indicated that implementing social justice contexts within mathematics is not an easy task, and that teachers continue to learn and believe that mathematics is neutral even after they graduate with an education degree. Whether it is due to the way they learned math themselves or the fact that they want to stay away from controversial topics, mathematics

educators continue to teach mathematics as a set of rules and absolute "truths" disconnected from students' lives (Stinson & Wager, 2012).

As long as mathematics educators conceptualize math as neutral, they will not notice or challenge the contexts used by curriculum writers. Similarly, mathematics word problems included in textbooks subtly influence students' perspectives of what is "worthy, valued, and important" (Bright, 2016a, p.7). Therefore, curriculum developers, influenced by political forces, will continue to write curricular materials that promote the dominant groups' values while oppressing non-dominant groups (Bright, 2016a). Those in power continue to ignore non-dominant groups, by ignoring their experiences and disregarding their stories (Ladson-Billings, 2006). Through word problems, mathematics teachers are sending the message that the culture, norms, and beliefs that matter are those of dominant groups (Bright, 2016a, 2016b).

Not only do word problems send the wrong message about the culture, norms, and beliefs of the dominant culture, but they are biased and promote stereotypes early on in student's education (Greer, 1997; Ladd, 2011; Reusser & Stebler, 1997). For example, in one study, Ladd (2011) analyzed sexism in children's picture books containing mathematical problems and problem-solving into the plot. The study found twice as many males as female characters, and the math problem solving was performed by males in the majority of the books (Ladd, 2011). Picture books, which teachers read to young children at formative stages in their development, contribute to the problem and perpetuate the stereotype that girls are bad at math. Ladd (2011) found a 2:1 ratio of male to female main characters. All books except one included female main characters in

partnership with male main characters, and five books featured male main characters carrying the plot on their own.

In solving math problems, only one book portrayed the female main character performing the math independently. Although a small sample size was used, the study confirmed mathematics book authors continue to provide girls with a one-sided view of their mathematical potential. Ladd (2011) concluded that if the characters in these picture books were to act as models, young girls might accept that boys are better at math and problem-solving. This article provided a specific example of how mathematics curricular materials are biased and promote stereotypes very early on in students' education. A study by Makarova et al. (2019) on the effect of masculinity image of mathematics, chemistry, and physics on Swiss secondary students with aspirations to join STEM fields revealed that masculinity images had significant influence on young men's and women's aspirations enrollment in STEM fields in university. Specifically, the study showed that among the female students, strong masculine images of mathematics lowered the likelihood of these student choosing STEM major in the university. Bias found in instructional materials and stereotypes hinder a students' ability to perform in the classroom, limiting future opportunities since mathematics education acts as a filter for advanced mathematics courses, higher education, economic access, and participation within a democratic society (Stinson, 2004).

Bias in Instructional Materials

This section presents the forms of bias in instructional materials. This literature is relevant to the current study as it provides insight on how societal status quo is promoted and reflected in the curriculum.

Seven Forms of Bias in Instructional Materials

Research has shown how instructional materials include countless examples of covert bias and stereotypical representations of race, gender, and sexuality (Deckman et al., 2018; Hawkins, 2007; Sharen & McGowan, 2019). When students engage with these materials, social values and attitudes are transferred. Students can learn to trust the erroneous representations existent in curricular materials (Sadker & Sadker, 1982). Recognizing these types of biases in mathematics curricula, more specifically in the contexts in which word problems are presented, can lead teachers to the realization that the mathematics curriculum is not exempt of biases.

According to Sadker and Sadker (1982), bias in curricular materials manifest itself in at least one of the following seven forms: invisibility, stereotyping, imbalance and selectivity, unreality, fragmentation and isolation, linguistic bias, and cosmetic bias.

Invisibility Bias. This is the total or partial omission of a group or culture. For example, although textbooks have improved since the 1960s, many groups (e.g., women, disabled, and homosexuals) continue to be underrepresented or completely missing from curricular materials today (Sadker & Sadker, 1982).

Stereotyping Bias. This involves assigning members of a group a firm set of qualities disregarding the existent differences within the members of a group.

Imbalance and Selectivity. This occurs when curriculum presents only one interpretation of a situation, an issue or group of people. In particular, the bias occurs when only one side of the story is told therefore omitting the other side's point of view (Sadker & Sadker, 1982).

Unreality Bias. Sometimes instead of completely disregarding the other side's point of view, an important event is quickly mentioned as if it was not important. This type of bias deprives students the information needed to recognize, makes sense of, and possibly change social injustices (Sadker & Sadker, 1982).

Fragmentation and Isolation Bias. These types of bias appear in curricular materials when a group is physically or visually isolated in the text. For example, showing a group interacting with their own culture versus integrated in society. According to Sadker and Sadker (1982), this form of bias present minority groups as outliers or unimportant members of society.

Linguistic Bias. Linguistic bias is the covert or overt choice of words used to communicate stereotypes or prejudices of individuals.

Cosmetic Bias. Cosmetic bias occurs when texts or instructional materials appear to be bias free and inclusive but beyond the pictures representing minorities and common names of non-dominant groups, bias persists.

Instructional materials can provide ways for students to recognize and appreciate their own identities and those of others (Stringfellow, 2019). When students identify themselves in the curriculum, they feel worthy and validated at school and can comprehend their place in society (Stringfellow, 2019). Furthermore, it is important for teachers to understand the bias that may exist in mathematics instructional materials, which will determine how students can be engaged with the mathematics curricula. More specifically, these types of bias can be seen in mathematical word problems continuing to promote the norms and beliefs of the dominant culture thus perpetuating the societal status quo (Flintoff et al., 2015).

Bias in the Mathematics Curriculum

A variety of cultures are represented in contemporary elementary classrooms. Therefore, it is crucial that today's mathematics educators can identify cultural norms embedded in mathematical word problems (Bright, 2016a; Correa et al., 2008; Yeh & Otis, 2019). Teachers should analyze word problems in textbooks and other instructional materials focusing on identifying culturally biased problems and problems that ignore the ethnic diversity of the classroom (Bright, 2016a; Carroll et al., 2009; Leonard et al., 2009; Yeh & Otis, 2019). Once teachers recognize and identify these biased word problems, they must adapt them to afford all students the opportunity to understand the mathematics presented in the problem rather than struggle with not being able to identify with it (Bright, 2016a; Carroll et al., 2009).

In their study, Carroll et al. (2009) implemented a series of questions mathematics teachers should refer to when examining word problems. Although this study conducted a cultural analysis of textbooks and instructional materials with a focus on improving English Language Learners (ELL) and immigrant student's academic achievement, these questions can be useful when analyzing and tailoring word problems for other non-dominant groups.

Carroll et al. (2009) grouped the questions into three categories, content, language, and item structure and format bias. Each category included a series of questions to guide the examination of word problems. To examine the content of the word problems, Carroll et al. recommended that teachers should ask whether or not the problem contains mathematical content that is different or unfamiliar to their students; whether or not diverse students get the problem correct or incorrect for the wrong

reasons; and if the problem reflects context that may be unfamiliar and unrelated to the educational background of certain students.

To examine the language of word problems, the researchers recommended that teachers must find out whether or not the problem contains words that have different or unfamiliar meanings; whether or not the problem includes difficult vocabulary; and whether or not the problem is free of culture-specific language, vocabulary, or ideas. Finally, teachers must examine the item structure and any format bias present in word problems. To do this, Carroll et al. suggested that teachers must find out if the problems include any information that would benefit one cultural group's achievement over another; if there are any insufficiencies or ambiguities in the problem; and whether or not the problem could be confusing to some students.

A study by Newkirk-Turner and Johnson (2018) provides another view of bias in the mathematics curriculum where the researchers emphasized language diversity among mathematics learners. This systematic review explored studies that have focused on bias emanating from cultural diversity and especially language-related in mathematics learning. Newkirk-Turner and Johnson used seven databases to identify the sources based on their relevance to the current study. They prioritized studies focusing on the United States learning environments. In this study, the researchers used themes to analyze facts gathered from different studies and form a summarized view.

Newkirk-Turner and Johnson (2018) found that in the United States, linguistic bias favoring white non-Hispanic learners characterizes the mathematics curriculum. In light of this bias, teachers, mostly white non-Hispanic teachers, do not always realize the challenge, causing them to implement learning practices that do not always reflect the

language needs of learners from minority groups. The study revealed that Hispanic and African-American students are affected the most by the bias as many books and other instructional materials are essentially based on linguistic aspects. Newkirk-Turner and Johnson concluded that a speech-language therapist is needed during curriculum development to minimize bias.

Moreover, a study by Riegle-Crumb and Humphries (2012) provided a unique perspective on describing the mathematics curriculum's bias. The researchers based this mixed-methods study on the data gathered by the Educational Longitudinal Study the National Center of Education Statistics carried out in 2002. It focused on 15,000 high school students in their sophomore year. The sample comprised of Hispanic, African-American, and White Non-Hispanic students and data were collected from students, parents, and teachers and basic descriptive statistics and themes were used to analyze the data. Riegle-Crumb and Humphries (2012) pointed out that the student's gender and race influence teachers' opinions regarding the application of the mathematics curriculum requirements. Specifically, the study revealed that African-American and Hispanic students are likely to be viewed by the teacher as being in a challenging course. In addition, the findings indicated that female students are likely to be perceived as being in a course that does not align with their capabilities.

Riegle-Crumb and Humphries suggested that student success in mathematics is dependent upon a bias free curriculum and instructional practices. They also concluded that the mathematics teachers' biases are a threat to achieving learning goals among minority learners, especially of Hispanic, African-American, and female students. The

researcher noted that teacher's professional development should emphasize teachers have unbiased opinions of learners regardless of race and gender.

Teacher Perception of Teaching Culturally Relevant Pedagogy and Social Justice Education

Ernest (1989) demonstrated that teacher instructional practices are influenced by beliefs and perceptions far more than by content-specific knowledge. Consequently, researchers continue to emphasize the significance of continuing to work with classroom teachers to support them in identifying and confronting their beliefs in order to reinforce principles of teaching for social justice (Barnes & McCallops, 2019; Reagan et al., 2016).

Although there is a growing body of research analyzing teachers' beliefs and dispositions about culturally relevant pedagogy (CRP) and teaching for social justice (TfSJ), most of this research focuses on preservice teachers (PST) over the course of teaching preparation courses (Barnes & McCallops, 2019; Mette et al., 2016; Reagan et al., 2016; Samuels et al., 2017; Simic-Muller et al., 2015). Based upon the above research, program developers recognize the necessity to prepare future teachers in CRP and social justice teaching. However, the research is exposing the need to continue developing and supporting teachers beyond teacher education programs (Simic-Muller et al., 2015). Teachers understand and recognize the value of utilizing CRP frameworks and teaching for social justice but are uncertain how to apply these pedagogies in the classroom (Samuels et al., 2017; Simic-Muller et al., 2015).

Reagan et al. (2016) conducted a mixed-methods study to examine the beliefs and articulations of teaching for social justice of 37 participants divided into two cohorts of teaching residents of an urban teacher residency program. The researchers stressed that

teachers' beliefs and articulations of social justice are integral parts and strong arbiter of teaching practice (Reagan et al., 2016). The findings of the study provided evidence that teachers can transform their beliefs of what social justice is to what is needed to teach for social justice. Through their social justice beliefs and articulations, preservice teachers in this study became advocates for social justice (Reagan et al., 2016).

Samuels et al. (2017) conducted an action research study to increase student teachers' exposure to social justice through culturally relevant contexts, and to investigate preservice students' perception concerning how teachers can use the CRP framework in their future classrooms. The researchers discovered that upon conclusion of the program, teachers' understanding of CRP increased as demonstrated by their ability to define CRP, articulate their understanding using a more complex vocabulary, and expand on advantages in the approach.

Despite these gains, participants in this study struggled with implementation of CRP in the classroom context. Furthermore, they were not able to provide specific content-based strategies for implementation of CRP in the classroom. Samuels et al.'s (2017) results revealed the disconnect that continues to exist in the field of education between theory and practice (Gay, 2018) and the importance of providing professional development of practical application in the classroom (Gay, 2018). This is important to the topic under study because it provides background on the state of culturally relevant pedagogy, the importance for incorporating CRP in the professional development program, and the ways professional development can impact how teachers teach and students learn mathematics.

Simic-Muller et al. (2015) conducted a mixed-method study surveying 92 preservice Pre-K-8 teachers and interviewing nine survey participants enrolled in a mathematics course for preservice teachers. The purpose of this study was to explore preservice teachers' beliefs about teaching real-world contexts, including topics associated to social injustices, controversial issues, and students' cultural backgrounds in their future mathematics classroom. Simic-Muller et al. (2015) discovered that preservice teachers genuinely value the use of real-world contexts but their views of what real-world contexts entail are limited to trivial daily life scenarios. In other words, Simic-Muller et al. (2015) found that while teachers agree in using real-world contexts to teach mathematics and recognize the importance of providing contexts in which students can relate to, they are not comfortable using controversial issues. Furthermore, they were not able to provide concrete examples of non-trivial real-world contexts for teaching mathematics. Simic-Muller et al.'s (2015) results are consistent with Samuels et al.'s (2017) findings where teachers were unable to provide examples of practical applications and therefore could not integrate culturally relevant pedagogy or social justice principles within educational contexts in the classroom.

In contrast, Barnes and McCallops (2019) argued that schools are in need of support and professional development on how to use culturally relevant practices as a foundation and complete it before any social emotional learning (SEL) interventions or professional development in SEL strategies is attempted. Barnes and McCallops' (2019) results emphasized the need for continuing professional development targeting culturally responsive pedagogy as the use of this pedagogy "has a place in all instruction" (p. 78).

Impact of PD on Teachers' Beliefs, Knowledge, and Classroom Practices

Several studies have provided insights on how teachers' professional development can support effective learning (Gupta & Lee, 2020; Lee et al., 2017; Liang et al., 2020; Polly et al., 2017; Valiandes & Neophytou, 2018). However, beliefs, knowledge, and classroom practices are core areas of a teacher's competence that substantially impact the learning outcome. A systematic review of 72 peer-review journals by Santos and Miguel (2019) revealed that many studies focus on enhancing the learner's competence and fail to provide insights into how the teacher's competence can improve an effective learning environment. Specifically, this study highlighted the importance of teachers' beliefs and personal backgrounds in determining the learning outcomes. The authors examined different studies that focused on teacher's beliefs and concluded that professional development plays a central role in inculcating the correct beliefs in teachers. Based on the analysis conducted in Santos and Miguel's (2019) study, they concluded that the existing studies do not clearly show the relationship between teacher's beliefs, classroom practices, and professional development courses.

A contrary qualitative study by Teng (2016), using a sample of 20 language teachers, linked professional development, teacher's beliefs, and classroom practices. Increasing concerns of language learners about the effectiveness of teaching practices triggered this study. The focus was on learning writing skills and specifically examining how innovative strategies improved language students' goals. The study linked the teacher's beliefs with the application of innovative learning strategies in the learning environment. The author posited that the success in applying innovative writing learning strategies depends on the teachers' nature as opinions of innovative learning vary across

teachers. Teng (2016) demonstrated that exposing two teachers to professional development on teaching practices transformed their beliefs regarding the ideal teaching practices. As a result, they started aligning teaching practices to reflect the realities of the learning environment and specifically considering the learner's attributes when making decisions on teaching strategies.

Similarly, qualitative research by Wilkinson et al. (2017) revealed that professional development plays a vital role in shaping teacher's beliefs. Thirty elementary school teachers were videotaped while teaching and interviewed at the beginning and end of the school year. To analyze the data, the researchers transcribed and scored interviews using a scoring manual to classify responses into pre-reflective, quasi-reflective, and reflective judgements. Additionally, the researchers scored the videos using an Argumentation Rating Tool (ART). The authors investigated the role of the teacher's beliefs in promoting argument literacy which requires developing the learner with reading, writing, speaking, and listening skills. The importance of inquiry dialogue talk, which is essential in teaching argument literacy, was investigated. The researcher discovered that the epistemological beliefs of the teacher determined the effectiveness of teaching inquiry dialogue. As a result, Wilkinson et al. (2017) proposed that professional development should focus on shaping epistemological beliefs to empower teachers to train learners on inquiry dialogue which is the foundation to argument literacy.

The findings of this study are consistent with those of another study by Polly et al. (2017), which examined the role of professional development on mathematics learning outcomes in a kindergarten environment. Three hundred kindergarteners participated in this quantitative study which measured the student's achievements before and after a

professional development program. The researchers' analysis of the data demonstrated that a linear growth was achieved, which was directly linked to a change of beliefs on teaching practices that characterized the professional development program. The researchers argued that the professional development program changed the teacher's beliefs, making them lean towards student-centered and connection-focused teaching practices.

In the same way, another study by Thurm and Barzel (2020) revealed that professional development influenced teacher's beliefs leading to practices that create an equitable mathematics learning environment. This quantitative study completed in Germany used quasi-experiments to gather data from a sample of 100 teachers about a short-term teacher's development program. The researchers argued that digital technologies present invaluable capabilities that are not fully exploited to support mathematics learning. The main obstacle for not using digital technologies in mathematics teaching is the absence of supportive beliefs of technology among the teachers, which results in practices that are not anchored on digital technologies. This study also focused on investigating the efficacy of teacher's professional development programs, arguing that most programs do not achieve the intended goals due to an absence of an objective results evaluation criterion. The findings suggest that the professional development program under investigation changed the teacher's technology-related beliefs, resulting in higher adoption of technology-driven teaching practices.

Besides teacher's beliefs, existing studies have emphasized the role of professional development on teacher's content knowledge. Some of the current literature emphasizes mathematics (Hajer & Norén, 2017; Thurm & Barzel, 2020), while most of

them address the general learning environment (Byrd & Alexander, 2020; Edwards et al., 2019). A study by Edwards et al. (2019) explored the role of professional development in improving teacher's knowledge in the area of physical literacy. Using a sample of 50 teachers, this qualitative study was conducted to evaluate a 3-month development program in a primary school. Specifically, the study focused on physical literacy among primary school children and data collected through thematic analysis showed that the fitness of the teaching practices determines the effectiveness of physical education lessons.

Further, the study identified lack of relevance as one of the main factors limiting the effectiveness of physical education learning in the school environment. The main focus of this study was to design and evaluate the effectiveness of a professional development plan for physical education teachers in generating relevant knowledge about physical literacy. The application of principles of professional development was identified as a significant factor that determines the effectiveness of a professional development program. The study's findings suggest that a quality professional development program enables the teacher to acquire vital knowledge that leads to the adoption of effective teaching practices.

Similarly, another study by Hajer and Norén (2017) pointed out the importance of professional development in increasing the teacher's knowledge resulting in improved mathematics learning. This qualitative study used interviews to collect data from a sample of 34 Swedish teachers. Language knowledge was emphasized in this study and revealed that the level of language knowledge was directly linked to the effectiveness of learning mathematics. The researchers identified the curriculum actions needed to

achieve effective mathematics teaching and learning in the Swedish mathematics curriculum. Specifically, Hajer and Norén (2017) suggested that learners should be allowed to enhance their problem formulation, mathematical reasoning, and analysis. According to their study, teachers should improve their learning to improve their language skills, which helps support the necessary curriculum actions needed to make the learning process successful. Based on the study's findings, a language knowledge gap in the Swedish learning environment is a significant impediment to effective mathematics learning processes. Therefore, elaborate professional development programs are needed to enable teachers to acquire language knowledge in support of the achievement of curriculum goals.

In addition to the perspective presented by Hajer and Norén (2017), a mixed-methods study by Byrd and Alexander (2020) provided a more specialized view on teacher's knowledge and professional development. The study targeted three special education schools and used a sample of 50 teachers where quantitative data was gathered and analyzed using SPSS statistical software. The authors sought to provide insight on teacher's knowledge requirements to meet special needs students and the roles of professional development in enhancing teacher's competency. Byrd and Alexander (2020) argued that teaching students with special needs requires specialized knowledge not emphasized in the general learning environment. The authors identified three main competencies that form the foundation for effective teaching of special needs students, informed decision-making, empathy, and communication. According to Anderson et al. (2017), a special education environment is characterized by complex decisions where the quality of learning outcomes is determined by the quality of the teacher's decisions. Byrd

and Alexander's (2020) findings show the complexities of decision-making in special education environments, focusing on the data and key variables. The researchers argued that teachers require knowledge on analysis to help them understand the complex interrelationships among variables. The researchers suggested that special education teachers should have advanced empathy to portray the right level of empathy. Moreover, the researchers identified communication skills as vital to ensure teacher-learner mutual understanding. From these findings they concluded that a professional development program grounded in continuous learning enables special education teachers to enhance their knowledge, improving their productivity. As opposed to Hajer and Norén's (2017) view that supports creating an elaborate professional development program, the study by Byrd and Alexander (2020) advocates for the teacher's initiative to remain committed to continuous learning at a personal level in line with skills requirements.

In addition to the different studies examining teacher's beliefs and knowledge, classroom practices and their relationships with professional development have attracted extensive studies. A quantitative study conducted by Fischer et al. (2018) linked the professional development of the teachers with effective classroom practices. This quantitative study used a sample comprising 7,434 teachers and 133,336 students, and SPSS was used for data analysis. The authors argued that classroom practices are influenced by three factors: school context, teacher-level factors, and professional development. Hence, applying the right classroom practice requires the participation of different stakeholders to ensure practices reflect the prevailing training needs. Based on Fischer et al. study's findings, professional development is an independent variable that influences teacher-level factors that influence the students' performance. The study

concluded that schools need to invest in the best quality professional development programs to ensure teachers are familiar with the right classroom practices.

Similarly, a mixed-methods study by Mathew et al. (2017) recognized a relationship between educator's professional development and classroom instructional practices. The sample included 26 high school teachers, and the purpose was to investigate the role of personal reflection as a tool of professional development on the effectiveness of classroom practices. The researchers used thematic analysis to test the association among the key variables. The study revealed that engaging in personal reflection helps teachers understand the shortfalls in their skills and motivates them to actively participate in acquiring the desired skills needed to optimize their productivity. Specifically, Mathew et al. (2017) revealed that teachers who carry out self-reflection can objectively assess their classroom practices, which provides a basis for improvement. Thus, the researchers concluded that personal reflection should be an integral part of teacher's professional development and should be incorporated in formal development programs.

Online Professional Development

Developing research indicates that online professional development (OPD) is at least as productive as conventional methods of delivering PD and can be more effective than traditional face-to-face approaches for increasing learning (Griffin et al., 2018; Healy et al., 2020; Marquez et al., 2016; Sheridan & Wen, 2020). Additionally, through reform documents, the National Educational Technology Plan encourages increasing the development and use of online teacher PD (U.S. Department of Education, 2018). Responding to this call, Griffin et al. (2018) designed and studied Prime Online, a

mathematics online teacher PD intervention. Using design-based research with a sample of 23 participants, the researchers evaluated teachers' knowledge, beliefs, and practices and teacher satisfaction with Prime Online. Pre and post teachers' beliefs and practices surveys were compared using paired-samples *t*-tests. Griffin et al. (2018) revealed that the mathematics online professional development positively influenced teachers' beliefs and practices and generated high teacher satisfaction ratings.

Similarly, a qualitative study by Sheridan and Wen (2020) examined the effectiveness of an online mathematics professional development model for early childhood educators. Data was gathered through pre- and post-surveys and analyzed using Atlas.ti. The researchers identified six top codes as enjoyment, helpful content, application, conceptual, course components, and course design. In the study, Sheridan and Wen (2020) also gathered individual course feedback from over 5000 participants. They found that many participants indicated the ease-of-use, specific components of the PD such as videos, blogs, and lessons as favorable components of the online PD. Moreover, participants added to the benefits of an online PD the ability to access from home and on their schedule. The course consisted of small sections, which made the overall learning experience less overwhelming for teachers.

These results are consistent with Marquez et al. (2016), who suggested self-paced learning is not feasible to achieve in traditional face-to-face workshops. Face-to-face workshops usually overwhelm teachers with information and do not provide teachers adequate time to process it. In their quantitative study, Marquez et al. (2016) used four critical components of effective PD to develop an online, self-paced professional development course to increase elementary teachers' knowledge and use of classroom

management strategies. The four critical components of the PD were evidence-based content, modeling, practice opportunities and feedback, and coaching support. The researchers assessed the effectiveness of the online classroom management program, teachers' perceived sense of self-efficacy, and improved student behavior. One hundred one elementary teachers participated in the study. Results indicated that the OPD course significantly improved teachers' knowledge of classroom management practices, teachers' self-efficacy, and improvements sustained over time. Moreover, the customer satisfaction survey results showed strong teacher satisfaction scores with the program's content and delivery and a significant increase in teacher's intention of implementation in the classroom.

Contrary to Marquez et al. (2016), teachers in Healy et al.'s (2020) study implemented components from the OPD course into their classrooms. Healy et al. conducted a randomized experimental design study with 44 physical education teachers to determine the effectiveness of an online professional development course. Specifically, 23 participants in the experimental group participated in an asynchronous self-paced OPD course utilizing podcasts to teach physical education teachers to design and implement a peer tutoring program that would ultimately foster the inclusion of students with disabilities in physical education. The researcher used a mixed-design/split-plot analysis of variance (ANOVA) to analyze the pre- and post-survey data. Healy et al.'s (2020) findings revealed that teachers who participated in the OPD course significantly increased their knowledge of peer tutoring.

As a result of the COVID-19 pandemic, online professional development courses for educators have increased. Bragg et al. (2021) argues that professional development

that is offered completely online will be an essential part of this new reality. Additional research is needed to validate the most effective practices of facilitating professional development online that result in productive learning outcomes (Bragg et al., 2021).

Culturally Responsive Pedagogy (CRP) Influence on Student Engagement and Achievement

The relationship between cultural and educational outcomes has attracted many studies to guide teachers in the teaching environment where it influences the key stakeholders in the education sector to be culturally sensitive in policy development. According to Rahman and Alwi (2018), the education environment is becoming increasingly culturally diverse due to the heightening migration across continents. A systematic review used 70 sources to research the problem (Rahman & Alwi, 2018).

Rizvi et al. (2016) identified that the increasing empowerment of indigenous communities in countries such as Australia, Canada, and the USA has resulted in the growth of many indigenous communities. This qualitative study found that a culturally diverse learning environment has specific advantages to minority and majority groups, with the minority groups being the primary beneficiaries. Furthermore, Rizvi et al. (2016) posited that diversity requires teachers to factor in the needs of each group for optimal learning outcomes. These developments warrant culturally responsive pedagogy studies to address the challenges emanating from the increasing diversity in the learning environment.

A quantitative study by Ragoonaden and Mueller (2017) examined the role of culture in the teaching practices adopted in Canadian higher learning. This study used structured interviews to collect data from a sample of 100 teachers and analyzed data

using SPSS software. The study recognized that cultural diversity in the student population puts the interests of the minority groups at risk if educators do not consider their students' cultural aspects when designing teaching practices. The researchers argued that the aboriginal communities had been historically marginalized in the Canadian education system, needing culturally responsive pedagogy to ensure educators meet their cultural needs in the learning processes.

Culturally responsive teaching at the University of South Carolina and the University of British Columbia were evaluated to determine their impacts on the communities' learners. The researchers concluded that the use of CRP allows learning institutions to meet students' emotional and social well-being, optimizing learning outcomes. Also, the findings revealed that the culturally responsive teaching practices adopted by these universities have standard features such as peer mentoring, close learner-instructor relationships, and learning circles.

The researchers concluded that the above features are essential in realizing whole learning in a culturally diverse environment. These elements align with the findings of another qualitative study by Cornelius et al. (2016) that cited good relationships between the learner and the instructor and peer mentoring as core requirements in the learning environment that directly impacts the achievement of learning goals.

In addition, a study by Warren (2018) presents a more detailed view that portrays the current state of affairs in the education sector on matters responding to the learner's cultural backgrounds. This case study examined the learning trends of youths and how teaching practices impact them through the lenses of cultural responsiveness. A sample of 300 learners was used, and SPSS software was used for data analysis. This study

identified the factors that evidence the existence of CRP in the learning environment at different levels. Empathy and perspective taking are some of the key elements that confirmed the presence of CRP in the learning environment.

The researchers concluded that empathy helps the teacher understand the learners' cultural expectations, which provides the basis for designing and adopting culturally responsive teaching practices. Furthermore, they recognized that the absence of reliable models for guiding teachers on CRP makes it difficult to respond to culturally challenging diversity trends in the learning environment, limiting the optimization of learning outcomes. The study's findings revealed that responding to culture in the learning environment requires behavioral, physical habits, and tendency change to align with the cultural realities.

Similarly, a mixed-methods study by Brockenbrough (2016) highlighted the role of culturally responsive teaching approaches in addressing the difficulties of minority learners in the United States. Thematic analysis was applied to data gathered from the target population comprising a sample of 30 African Americans and Hispanic learners. Specifically, the researchers discussed the discrimination issues facing the target population and cited that failure to address these issues threatens the learning process. The researchers revealed that learners from marginalized communities in the United States do not relate to the education system as it does not incorporate their specific cultural experiences, which threatens the systems' effectiveness.

In contrast, Harrison and Skrebneva (2020) showed that culturally responsive pedagogy in the United States is more developed than in Australia. The researchers used a systematic review methodology to analyze 65 peer-reviewed journal articles.

Specifically, the researchers sought to identify how CRP can be transferred from the USA and New Zealand to Australia. The learning environment in Australia has an inadequate response to the cultural needs of the Aboriginal and Torres learners.

The findings of this study align with research by Bennett et al. (2018) who argue that the current teaching models adopted in Australia's education system seek to assimilate the indigenous learners to conform to the majority cultures. The quantitative study by Bennett et al. (2018) used a sample of 100 indigenous learners and used SPSS for data analysis. Such practices are counterproductive as they fail to incorporate the emotional and social rights of the indigenous learners.

Social Justice and Culturally Relevant Teaching

A variety of studies present varying perspectives to understand social justice and culturally relevant teaching practices. Francis et al. (2017) suggested that achieving social justice in education is faced by identifying what constitutes a just education system and practices. This qualitative study used a sample of 40 high school teachers and thematic analysis on data acquired through unstructured interviews. These researchers noted that society comprises many social groupings whose interests are competing, making it challenging to create learning models that capture the expectations of specific groups.

On the contrary, Gorski, and Dalton (2020) state that the ability of an education system to meet cultural demands provides an objective perspective to evaluating its compliance with social justice. Their systematic review included 57 peer-review journal articles. Gorski and Dalton (2020) argued that a country’s learning population is divided into cultural groups, making it crucial to emphasize adopting culturally relevant teaching practices. Emphasis is placed on mathematics and the race-based inequalities

characterizing teaching and learning math in the United States. Gorski and Dalton's study revealed that governments and key stakeholders at all levels have initiatives to increase the enrollment of highly underrepresented minority groups. However, these initiatives do not lead to social justice since the teaching practices do not reflect minority students' cultural backgrounds.

In addition, a mixed-methods study by Landi et al. (2020) recognized the importance of social justice in the education arena. Using thematic analysis to analyze the data, this study highlighted key obstacles to social justice such as tight budgets, increases in teacher responsibilities, and declining teaching personnel. The study focused on physical education and argued that educators should promote social justice in education despite the obstacles. The researchers recommend applying a culturally relevant teaching model based on moral values, which would be the ultimate solution for social injustice in physical education learning.

Most recently, additional obstacles to social justice education have emerged with several states (Idaho, Oklahoma, Tennessee, Texas, Iowa, New Hampshire, and Arizona) passing legislation banning the discussion, training, and any indication that the United States is inherently racist (Ray & Gibbons, 2021). The states have also forbidden teaching about bias, privilege, discrimination, and oppression (Ray & Gibbons, 2021). Additionally, state school boards in Georgia, Utah, and Florida have new guides forbidding critical race theory discussions in classrooms arguing the protection of children from curricula that could potentially alter historical events (Calvan, 2021).

The above literature review provides a sound basis for understanding the existing knowledge related to the impact of professional development on teachers' beliefs,

knowledge, and classroom practices. Based on the review, the existing studies do not delve deep into professional development and provide its clear link with knowledge, beliefs, and classroom practices. Additionally, the existing studies do not provide clear guidance on how teachers can engage in culturally responsive pedagogy leading to social justice. This gap needs to be filled by conducting detailed research to provide advanced knowledge on creating an effective learning environment by applying the right teaching practices.

Reframing Word Problems through Critical Mathematics and Social Justice Education

Elementary mathematics educators can broaden their views and analyze word problems included in their curricular materials through collaborative critical analysis. Through the lens of critical theory, teachers can reveal unjust social hierarchies and other hegemonic influences in society and school. By looking closely at word problems, teachers can discover whose experiences the word problems valorize, develop consciousness about them, and transform them to reflect the students in their classrooms (Bright, 2016a; Yeh & Otis, 2019). Yeh and Otis (2019) described how teachers guided students through the process of developing consciousness about word problems.

The researchers collaborated with kindergarten to sixth grade students and teachers at a school serving low-income Black and Latinx populations to analyze the supposed neutrality of mathematics word problems. In the study, they described the close reading strategy (Say-Mean-Matter) that a fifth-grade teacher used "to help students question word problems, search for deeper meanings, and make connections between text and their lives" (Yeh & Otis, 2019, p. 89). More specifically, guided by their teacher,

students analyzed their grade level textbook word problems. Students start the analysis by studying what the text says mathematically, what it means to them from their perspective, and why it matters to them, to mathematics, and to the world. The teacher guided students to discover the "silences" in word problems including whose experiences are not included and what experiences other than mathematics are necessary to solve the problems. Findings of the study indicated that students were able to reframe mathematics word problems to reflect their identities, experiences, and values. The researchers concluded that the close reading strategy, Say-Mean-Matter, is a powerful tool to raise students' awareness of social issues while at the same time studying mathematical concepts.

Questioning is a powerful tool a teacher can use to help develop students' critical thinking. In a study completed by Bright (2016b), teachers used questioning to guide students into thinking critically about the word problems and reframing them. These findings suggest that "our students know or can learn how to call out toxic thinking in our materials and can generate new and more progressive content with the same rigorous mathematics content" (Bright, 2016b, p. 19). Although word problems included in textbooks promote the norms and beliefs of the dominant culture, through critical pedagogy, teachers and students can learn to recognize the hidden messages that perpetuate the status quo and change the narrative by reframing them (Bright, 2016a, 2016b; Yeh & Otis, 2019).

Reframing mathematical word problems to reflect social justice principles has proven to empower students to use math as a tool to recognize and address the oppression they witness in the world around them (Gutierrez, 2002; Gutstein, 2003). Although social justice educators have documented successful experiences they have had with their

students (Gutstein, 2003, 2006; Gutstein & Peterson, 2013), other research (Brantlinger, 2013) shows that the selected social justice topics do not engage all students.

In a qualitative, practitioner-researcher study, Brantlinger (2013) explored the power critical mathematics has to alter how students usually participate in classroom discourse and student engagement. Participants in this study were remedial geometry students in the night school program at a high school. Participants had either failed geometry once or were not allowed at school during the day due to behavior problems. The researcher recorded and transcribed over 16 hours of spoken discourse to determine the patterns of discourse in critical math and reform activities and whether the trends changed over the course duration. Additionally, students' pre and post interviews were recorded, samples of student written work collected, and pre and post exams analyzed.

This study showed that developing students, of any race or class, can achieve critical consciousness through teaching and learning critical mathematics but social justice contexts do not engage all students. Some social justice topics engaged students, while others did not (Brantlinger, 2013). For example, topics of reform activities hardly engaged students, while issues of school racism and economic fairness in society engaged students who were considered hard to reach (Brantlinger, 2013).

Additionally, students were not able to recognize social problems that did not directly affect them. This study shows the importance of getting to know the students in the classroom and providing them with a safe space to bring their life experiences to class (Gutstein, 2003). Only then, teachers can tailor the curriculum so that all students benefit from social justice contexts in mathematics (Gutstein, 2003).

The design and context of mathematical word problems promote the norms, values, and beliefs of the dominant culture contributing to current inequities in our society (Bright, 2016a, 2016b; Yeh & Otis, 2019). In their studies, Bright (2016a), Ladd (2011), and Yeh and Otis (2019) discovered many problems endorsing sexism, racism, linguicism, White privilege, consumerism, and Western-faith normativity. There is evidence to support that a critical mathematics approach can lead students to analyze and question word problems they encounter throughout their mathematics education (Bartell, 2013; Brelias, 2015; Gutstein, 2006; Yeh & Otis, 2019). Students can then change the context of word problems to reflect issues of inequity, thus using mathematics education to uncover social injustices in the United States. This process illustrates the dual obligation of mathematics education proposed by Gutstein (2006) and Bartell (2013): to arm students with mathematical power to succeed in the system they live and to use math to make visible current inequities and injustices impeding their success.

As indicated by Garii and Appova (2013), integrating social justice contexts in mathematics is not easy. Teachers continue to conceptualize mathematics as neutral and disconnected from the real issues affecting our society (Garii & Appova, 2013). It is incumbent upon mathematics educators to teach mathematics to deepen students' understanding of society and prepare them to be critical participants in a democracy (Gutstein & Peterson, 2013).

Measuring Social Justice Contexts and Culturally Relevant Teaching Practices

Social justice measurement has attracted studies seeking to identify objective evaluation standards. A study by Fietzer and Ponterotto (2015) revealed that the existing psychometric social justice evaluation measures have weaknesses that pose a serious

challenge to promoting social justice in a society comprising diverse groups.

The researchers conducted this systematic review to evaluate the effectiveness of four main psychometric evaluation criteria of social justice, which include the Social Issues Advocacy Scale (SIAS), the Social Justice Scale (SJS), Social Issues Questionnaire (SIQ), and Activism Orientation Scale (AOS). They used six databases to identify the suitable sources to support the study. The preferred journal articles were published between 2000 and 2012 as they could provide the most relevant facts. The primary keywords used to extract the desired digital sources from the target database were social justice and scale. The term social justice was substituted with social action, activism, and advocacy to diversify the search results.

Sources targeting specific groups were omitted as they were likely to give biased opinions as issues facing one disadvantaged group may differ from those relevant to other groups. The researchers used thematic analysis to capture the intended facts.

Fietzer and Ponterotto's (2015) study revealed that the four social justice evaluation instruments had similar shortcomings that limit their effectiveness. The researchers revealed that all the instruments relied on test-retest evidence to ascertain their reliability. The authors stated that this approach is weak since it is based on constructs such as attitudes assumed to be relatively stable over time, which is not always the case. Fietzer and Ponterotto (2015) also pointed out that only one instrument, AOS, provided a reliable prediction of actual behaviors, implying that the other three methods were unreliable in predicting behavioral trends in the target groups. The study also revealed that the samples used to test the reliability of each instrument could have compromised their reliability as the researchers did not consider diversity. The study concluded that future researchers

should subject instruments for evaluating social justice to further research and improvement to ensure they provide a reliable perspective to the evaluation.

In contrast, another study by Sebastianelli et al. (2020) revealed that some evaluation instruments provide an objective approach to measuring social justice. Specifically, this study sought to investigate the Social Justice Scale (SJS) reliability as an evaluation instrument for social justice. The researchers conducted this mixed-methods study in a private university in the Northern United States, targeting business students who had been in the learning environment for at least five semesters. The sample size included 328 students, comprising 59% male and 41% female, distributed in the three main business courses, namely accounting, marketing, and finance, representing 23%, 22%, and 17%, respectively. SPSS was used to compare the variables using ANOVA and T-tests.

Sebastianelli et al. study revealed that SJS provides a reliable approach to evaluating social justice among business students. The scale includes four main constructs: attitudes, subjective norms, intentions, and perceived behavioral control. Most of the participants scored high in behavioral control and attitudes, which are key social justice ideals. Female students scored relatively higher than their male counterparts in intentions and attitudes. These outcomes show that the SJS is a reliable instrument for evaluating social justice.

Summary

The review of existing literature provides valuable insight into understanding what other studies have covered regarding the research problem. Nine main topical areas are covered where the researcher evaluated the best quality sources based on their

relevance to the study and their contribution to the research problem. This objective review of the literature has resulted in a conspicuous research gap that warrants this study. In this literature review, the author evaluated critical race theory and critical theory through different studies that have applied these theories. The review of these studies helps to identify the underlying strengths and weaknesses of the theories. Understanding these theories provides a sound basis for understanding social justice in the education environment.

The topic of word problems as hegemonic features of the mathematics curriculum is a persistent problem that students encounter daily in schools in the United States. This review conceptualizes how the contexts used in word problems hinder the successful implementation of mathematics curriculum in schools with culturally diverse backgrounds limiting their effective participation in mathematics, leading to poor performance. The review shares that bias is present within the mathematics curricula.

Existing studies provide facts about the bias in instructional material. Specifically, the literature identifies seven main areas of bias that impact instructional materials: invisibility, stereotyping, imbalance and selectivity, unreality, fragmentation and isolation, linguistic bias, and cosmetic bias. Existing studies show how the current mathematics curriculum fails to incorporate the interests of minority learners. This topical area also helps reveal the ramifications of the bias, including the poor performance of minority learners in mathematics.

Teacher perception of culturally relevant pedagogy and social justice education is essential to this study, and the author has equally emphasized its importance by existing studies. Reviewing these studies has helped build an understanding of how classroom

practices reflect cultural diversity and social justice realities in the learning environment. Evidence from various studies shows the plight of minority learners emanating from practices that do not reflect the cultural aspects of these learners.

Literature also identifies the impact of professional development on teachers' beliefs, knowledge, and classroom practices. The existing studies show a close relationship between teaching programs and improvement in classroom practices. Some studies reveal that proper teacher development makes teachers more knowledgeable and gives them the correct beliefs that align with the learner's needs.

As a result, the existing studies propose the need to implement development programs that reflect the requirements of the learning environment leading to the adoption of best teaching practices. Different studies show varying features of culturally relevant pedagogy (CPR) and reveal that the low application of these practices characterizes the current learning environment.

As evidenced in different studies, CRP influences student engagement and achievement. Some studies show that social justice and culturally relevant teachings are absent in the learning environment, limiting the achievement of learning goals. Social justice evaluation is of great concern where researchers have developed different assessment instruments. These instruments include Social Issues Advocacy Scale (SIAS), the Social Justice Scale (SJS), Social Issues Questionnaire (SIQ), and Activism Orientation Scale (AOS).

Various studies criticize the effectiveness of SJ measurement instruments, while other studies highlight their effectiveness. Evidence from the existing literature discloses a need for reframing word problems through critical mathematics and social justice

education to make learning more effective. Chapter 3 presents the methodology and data collection procedures that was utilized for this study.

Research Questions

Five research questions guided this study:

Quantitative

1. What are in-service elementary math teachers' preexisting beliefs about the relevance of social justice and culturally relevant teaching related to their mathematics instructional practices before receiving synchronous online professional development?

2. How do in-service elementary math teachers' beliefs about the relevance of social justice and culturally relevant teaching related to their mathematics instructional practices change in response to the synchronous online professional development program?

Qualitative

3. What are in-service elementary math teachers' perceptions of infusing culturally relevant and social justice contexts in mathematical word problems on student engagement?

4. What are in-service elementary math teachers' perceptions of how their beliefs changed as a result of the synchronous online professional development program?

Mixed-Methods

5. How do in-service elementary teachers' perceptions of infusing culturally relevant and social justice contexts in mathematical word problems help explain any changes in teachers' beliefs about the relevance of social justice and culturally relevant teaching?

Chapter 3: Methodology

This study investigated teachers' beliefs and teaching practices of in-service mathematics' elementary teachers and how the beliefs and teaching practices were influenced by synchronous online professional development. Data derived from this study contributes to the knowledge base about teaching mathematics for social justice. The purpose of this mixed-methods study was threefold, first, to examine in-service teachers' preexisting beliefs about the relevance of social justice and culturally relevant teaching relating to their mathematics instructional practices before receiving professional development. Second, to assess the impact of a synchronous online professional development on teachers' beliefs and classroom practices related to social justice and culturally relevant teaching in mathematics. Lastly, to understand in-service elementary math teachers' perception of infusing culturally relevant contexts in mathematics on student engagement. This chapter describes the participants, quantitative survey, and qualitative interview guide created for this study, the professional development modules created for this study, and the data collection and analysis procedures.

Participants

The target population for this investigation was North American in-service teachers in grades Kindergarten through fifth grade actively teaching mathematics, math coaches, math tutors, and math curriculum writers. Participants included certified teachers of all ethnicities holding a bachelor's degree or higher, and over 21 years of age. Thirty elementary educators participated in this study. To access the appropriate sample, the researcher used three nonprobability sampling techniques: non-random convenience,

snowballing, and purposive sampling. Convenience sampling and snowball sampling was used for the quantitative portion of the study and purposive sampling was used for the qualitative portion of the study. The elementary school teachers chosen for the sample was a subgroup of K-5 educators who were teaching mathematics during the 2021-2022 school year.

Quantitative

The study utilized a convenience sampling method. In this non-random sampling technique, participants volunteered or were recruited relatively easily (Edmonds & Kennedy, 2017). This sampling technique allowed the researcher to select participants who were willing and able to participate in a synchronous online professional development program (Creswell & Guetterman, 2019). Participants were recruited using social media platforms LinkedIn and Facebook groups and mathematics educators' professional organizations such as the National Council of Teachers of Mathematics (NCTM). Obtaining participants through social media is consistent with convenience sampling because members of these groups formed the participant pool. Simultaneously, snowball sampling was used as elementary mathematics teachers helped identify other elementary mathematics teachers who met the criteria for the study and were willing and able to participate in the online professional development. In this form of sampling, the researcher asked participants to find others who wanted to participate in the study (Creswell & Guetterman, 2019). Both sampling approaches, convenience and snowballing sampling, allowed the researcher to have a large number of participants for the study. Additionally, snowball sampling was used to reach participants who did not use social media platforms; the researcher sent a text message or email with the

appropriate link to complete the electronic surveys and join the online professional development program.

Qualitative

The qualitative portion of this study was conducted using purposeful sampling. A select group of participants was purposely chosen from the original sample. According to Edmonds and Kennedy (2017), purposive sampling is used when the researcher has a predefined group to study. For this study, 10 participants that could provide valuable information to Research Questions 3 and 4 (i.e., What are in-service elementary math teachers' perceptions of infusing culturally relevant and social justice contexts in mathematical word problems on student engagement?; What are in-service elementary math teachers' perceptions of how their beliefs changed as a result of the synchronous online professional development program?) were selected from the original sample based on either one of three criteria. These criteria were as follow: (a) they indicated no change in their beliefs about culturally relevant and social justice education, (b) they indicated changes in their beliefs or mathematical practices as a result of the program, or (c) they indicated a perceived increase in student engagement. These criteria ensured that the interviewees had a platform to explain further the way their beliefs or practices changed as a result of the program, or to explain their perceptions of why their beliefs did not change. The data was gathered via semi-structured individual interviews utilizing a qualitative interview guide.

Instruments

Different instruments were utilized for the quantitative and qualitative parts of the study. The Dispositions for Culturally Responsive Pedagogy Scale (DCRPS) and the

Learning to Teach for Social Justice – Beliefs Scale (LTSJ-BS) provided the empirical data for the quantitative strand of the study. A demographic survey was included in the pretest and was used to collect information regarding the sampling used in the study. This survey gathered participants' age, gender, race or ethnicity, years of teaching experience, grade level currently teaching, school district size, and type of school (private or public). Other questions addressed whether participants had participated in previous workshops related to culturally relevant pedagogy or teaching math for social justice. A semi-structured interview guide was used to gather qualitative information.

Dispositions for Culturally Responsive Pedagogy Scale

The DCRPS survey was developed by Manya C. Whitaker and Kristina Marie Valtierra from the Department of Education, Colorado College in Colorado Springs, United States of America. Dr. Manya C. Whitaker gave the researcher permission to utilize this survey. According to the developers, this survey is the first that measures "teacher's beliefs and attitudes underlying culturally responsive teaching practices" (Whitaker & Valtierra, 2018, p. 1). The instrument contains 19 Likert items across three dispositional domains: disposition for praxis, disposition for community, and disposition for social justice (see Appendix A).

The DCRPS developers used a six-step process to develop this instrument. These steps include "item development, expert review, exploratory factor analysis (EFA), factor interpretation, confirmatory factor analysis (CFA) and analyses for convergent and discriminant validity" (Whitaker & Valtierra, 2018, p. 12). The alpha reliability value for the overall scale was 0.92 (Whitaker & Valtierra, 2018). The developers used the multicultural dispositions index (MDI) for convergent validity. The correlation between

these two scales was 0.62, which, according to the developers, demonstrated moderately acceptable convergent validity. The developers used the teacher attitudes toward inclusion scale (TATIS) for discriminant validity. The correlation between the DCRPS and the TATIS was 0.38, which, according to the developers, indicates that these instruments are intended to assess different constructs. For this study, the survey was given to the same group of participants twice, prior to teachers participating in the online professional development program and upon completion of the online PD sessions.

Learning to Teach for Social Justice-Beliefs Scale

The Learning to Teach for Social Justice-Beliefs Scale (LTSJ-BS) was developed by the Survey Team of the Boston College-Teachers for a New Era (BC-TNE) project (Ludlow et al., 2008). Dr. Larry Ludlow from Boston College has given the researcher permission to utilize this survey. The LTSJ-BS was intended to "define a continuum of questions corresponding to beliefs ranging from a weaker to a stronger commitment to teaching for social justice" (Ludlow et al., 2008, p. 210). According to the developers, this scale provides evidence that teacher preparation programs can quantify the outcomes of learning to teach for social justice. The instrument contains 12 Likert items asking teacher's beliefs regarding teaching for social justice and socially just practices in their classroom (see Appendix B).

The LTSJ-BS uses a 5-point, Likert-type scale ranging from *strongly disagree* (1) to *strongly agree* (5). The scale contains items that are positively and negatively worded. The developers intentionally included negatively worded items. These items addressed concepts that only experienced teacher candidates would have faced. Negatively worded items also help prevent response bias that may result from students answering questions

in a "socially desirable positive manner" (Ludlow et al., 2008, p. 198). The survey contains questions that the developers expected to be positively endorsed by teachers, for example, Questions 1, 2, 4, 7, and 8. The remaining questions (3, 5, 6, 9, 10, 11, and 12) were identified as questions that teachers will not endorse positively. In the original study, the developers integrated the survey's final set of 12 items into the BC-TNE Entry Survey, Exit Survey, One-Year Out Survey, Two-Year Out Survey, and Three-Year Out Survey system as the Learning to Teach for Social Justice scale (Ludlow et al., 2008). For this study, the survey was given to the same group of participants twice, prior to teachers participating in the online professional development program and upon completion of the online sessions.

The LTSJ-BS developers used a conceptual theory-driven approach to develop the instrument through a series of focus group exercises conducted with undergraduate and graduate students. From these exercises, an initial set of 20 questions were created and piloted with 284 Boston College graduate students in 2004. According to Ludlow et al. (2008), after analyzing these items using Classical Test Theory (CTT) and Rasch measurement models, the instrument's developers eliminated eight items lowering the number of questions down to 12 items.

These 12 items were factor analyzed with a varimax rotation to provide construct validity. Because this survey measures change over time, the developers analyzed both the Entry and Exit Surveys. Two factors, positively and negatively worded items, were extracted from the factoring analysis and accounted for 34.1% of the total variance in the Entry survey and 29.6% of the total variance in the Exit Survey. For the Entry Survey, results indicated a significant correlation between factors (.36) compared to a factor

correlation of .15 for the Exit Survey. The Kaiser-Meyer-Olkin (KMO) statistic was high (.755), the determinant was nonzero, and Bartletts's test of sphericity was significant for both surveys. The developers tested the results of both administrations of the survey for statistical equivalency using coefficients of congruence (CC). The comparison met the .90 criterion meaning that the same factors were extracted across samples. These tests demonstrated the stability and consistency of the scale.

The developers also performed a simple, independent *t*-test on the total scores. They reported that the two means differed significantly, with graduating students' scores (students taking the Exit Survey) being statistically significantly higher than students taking the Entry Survey. Rasch analyses were conducted and confirmed the CTT findings. Additionally, the Rasch rating scale analyses "helped in establishing the invariant structure of the LTSJ-Beliefs Scale over the two groups of teacher candidates" (Ludlow et al., 2008, p. 210).

Semi-Structured Interview Guide

The researcher utilized a qualitative interview guide to conduct individual semi-structured interviews. The questions on the interview guide focused on understanding participants' perceptions of infusing culturally relevant and social justice contexts in mathematics on student engagement and learning why teachers' practices and beliefs changed (or failed to change) following their participation on the online professional development program. The interview questions were developed by the researcher in collaboration with a formative and summative committee. The formative committee, composed of the researcher and a higher education professor initiated the process of developing the questions, while the summative committee, composed of the researcher,

two higher education professors, and two elementary math teachers helped in verifying the legitimacy of the questions. During this process, the researcher sought advice from experts in the field and participants similar to those who will be interviewed. The interview questions were critiqued by the summative group and refined after receiving feedback. Mainly, the researcher wanted to know how these participants would feel about answering the questions. The researcher conducted the individual semi-structured interviews face to face using the interview guide through the Zoom online platform. These interviews were an important element to ensure teachers were provided an outlet to explain how their beliefs changed and how they implemented the learning from the professional development sessions in their lessons. The interview guide consisted of 16 questions and additional probing questions (see Appendix C). These questions were designed to capture participants' demographic information, perceptions of student engagement, and experiences implementing culturally relevant and social justice contexts in their classrooms.

Procedures

The researcher collected data for this study through surveys and interviews. The researcher used both quantitative and qualitative methods to provide insights to the five research questions. The mixed methods approach allowed the researcher to gain a more comprehensive understanding of teachers' beliefs about using culturally relevant and social justice contexts in mathematics instruction.

Research Design

An explanatory-sequential mixed methods design was utilized to answer the research questions. This approach allowed the researcher to follow up on the survey

results with semi-structured interviews (Edmonds & Kennedy, 2017). Data gathered from interviews helped explain how the synchronous online professional development program may have changed teachers' perceptions of culturally relevant mathematics teaching practices. It also helped explain how the intervention may have helped students engage in the classroom from the teachers' perspective.

The quantitative strand employed a within-subjects approach utilizing a one-group pretest-posttest design. In this design, the dependent variable is measured before and after the treatment is implemented. In this study, teachers completed a pretest (survey) before starting the synchronous online professional development program and a posttest upon completion. In other words, the participants completed a pretest, received a treatment, and then were given a posttest. Qualitative data was collected post-intervention to gather data from participants who implemented culturally relevant practices in their classrooms. Both, the qualitative and quantitative data were merged to help gain a better understanding of the findings.

Professional Development

Elementary teachers, math coaches and tutors, and math curriculum writers from different districts in the United States were invited to participate in the professional development sessions focused on transforming mathematical word problems to reflect culturally relevant and social justice contexts. Table 1 offers a detailed description and purpose of each session. The researcher planned and scheduled four synchronous online sessions at a convenient date and time for participants. Synchronous sessions, via Zoom, allowed the researcher to use inquiry models of teaching and learning allowing participants to be actively involved in the learning. This type of instruction also provided

participants with immediate feedback as they grappled with new knowledge. The total hours of professional development for this study were four hours. Participants attended one session a week for four consecutive weeks. Each session was 60 minutes long. All sessions were conducted by the researcher. School year 2021-2022 provided the time for the professional development sessions to be implemented and for survey data to be gathered from participants.

Table 1

Synchronous Online Professional Development Program Description

Session	Title	Description	Purpose	Date/Time	Presenter/Delivery Method/Platform
1	Introduction to Culturally Relevant Pedagogy and Teaching for Social Justice in Mathematics	Participants will be introduced to culturally relevant pedagogy and social justice education in mathematics.	To learn the principal tenets of culturally relevant pedagogy and teaching for social justice in mathematics.	Week 1	Michelle Jackson Synchronous Zoom
2	Is Math Neutral?	Participants will learn the political, cultural, social, and economical implications of word problem contexts.	To recognize that math is not neutral and the value in reframing contexts.	Week 2	Michelle Jackson Synchronous Zoom
3	Messages Textbooks Send	Participants will examine math word problems and identify potential hidden messages word problems are sending to students. Teachers will bring word problems found in their curriculum that are possible carriers of hegemony. Participants will work together to transform word problems.	To recognize problematic word problems and the value in reframing them.	Week 3	Michelle Jackson Synchronous Zoom
4	Say-Mean-Matter	Participants will utilize the say-mean-matter strategy to recognize problematic contexts in word problems.	To use the say-mean-matter strategy to discover ways in which word problems can be reframed to make them more relevant.	Week 4	Michelle Jackson Synchronous Zoom

Quantitative Data Collection

After IRB approval, the researcher started recruiting K-5 mathematics teachers, coaches, tutors, and curriculum writers with one or more years of experience by posting an informational recruitment flyer on a variety of social media interest groups and by directly messaging individuals who identified themselves as elementary math teachers. The flyer introduced the researcher, provided the purpose of the study, the expectations for the study, and invited them to participate. Weekly posts were made in Facebook and LinkedIn groups soliciting participants until a sample of 50 participants were recruited. Once potential participants were identified for the study, they were given a consent form to complete and return. After participants returned the consent form, they received access to the demographic questions, DCRPS and LTSJ-BS surveys via email for completion. Participants received one link containing demographics questions and both surveys to simplify the completion process.

The surveys took approximately 15 – 20 minutes to complete. Follow-up emails were sent 6, 9, and 10 days after the initial survey link was first sent requesting participants to complete the surveys. The surveys closed 14 days after the initial survey completion request was sent. The survey responses were housed on the survey development website, Google Forms. The DCRPS and LTSJ-BS surveys were also used as posttests. Upon completion of the professional development program, participants received access to the posttest surveys via email for completion. Upon completion of the surveys, participants received an email with a digital gift card from Amazon.

Qualitative Data Collection

Upon completion of the quantitative analysis, selected in-service K-5 mathematics teachers, coaches, and tutors were informed of their selection to participate in an interview. The researcher emailed a link to access an interview scheduling page on calendly.com, allowing them to schedule their preferred interview time. Interviews took approximately 45 minutes. The researcher sent a confirmation email to each participant, including the interview date, time, and the researcher's contact information. The researcher sent a reminder to the participants on the day before the scheduled interview containing the interview link. Interviews were conducted, recorded, and transcribed using the Zoom platform.

Quantitative Data Analysis

The researcher began data analysis by presenting a report of the number of participants that were provided the pretest surveys and the number of participants who completed all sessions of the professional development and completed the posttest surveys. Descriptive statistics of participants that completed the study followed. Research Question 1 was answered using descriptive statistics from data collected from the LTSJ-BS and DCRPS pretests. Descriptive statistics including mean, standard deviation, and effect-size were analyzed using the SPSS system.

To answer Research Question 2, data collected from the LTSJ-BS and DCRPS was analyzed using a paired samples *t*-test to determine if there was a statistically significant difference between the means from the participants' pre and posttest. Statistical significance was based on a .05 level of significance. The null hypothesis for

this test states that the average of the differences between pre and posttest equals 0.

Qualitative Data Analysis

To answer Research Questions 3 and 4, the researcher used inductive thematic analysis. As recommended by Creswell and Guetterman (2019), six steps in analyzing qualitative data were followed. The researcher started by retrieving the transcripts from the online semi-structured interviews. After reading the interview transcripts and reflecting on their meaning, the researcher noted overall thoughts emerging from the data. Next, the researcher used thematic analysis to identify patterns across the data and started identifying potential codes based on themes or topics. A set of initial codes was created by forming data categories and labeling each category with a phrase or a term (Creswell & Guetterman, 2019). Codes were then sorted and combined to form themes and sub-themes as applicable. The researcher then merged similar themes and discarded themes that were not supported with enough data. When fitting, the researcher included participants' quotes in the findings and discussed findings in the form of narratives.

Data Integration

Findings from both the quantitative and qualitative data analysis revealed the answers to the research questions. Research Questions 1 and 2 were answered using quantitative data, while Research Questions 3 and 4 were answered using qualitative data. In this mixed-methods study, the quantitative analysis was complemented by the qualitative data to provide a more comprehensive understanding of teachers' beliefs and practices about using culturally relevant and social justice contexts in mathematics instruction. In other words, the qualitative findings were used to provide a more in-depth understanding of teachers' beliefs and practices regarding social justice and culturally

relevant practices in mathematics. To answer Research Question 5, the data was merged for comparison. In this study, the quantitative data framed the analysis, and the qualitative data was used to elaborate and explain the quantitative findings (Moseholm & Fetters, 2017).

Chapter 4: Results

This chapter presents the findings of this sequential explanatory mixed methods study whose purpose was threefold: to (a) examine in-service teachers' preexisting beliefs about the relevance of social justice and culturally relevant teaching related to their mathematics instructional practices before receiving a synchronous online professional development program; (b) assess the impact of a synchronous online professional development program on teachers' beliefs and classroom practices related to social justice and culturally relevant teaching in mathematics; and (c) understand in-service elementary math teachers' perception of infusing culturally relevant contexts in mathematics on student engagement.

This chapter first presents the demographic descriptive statistics of the participants and is then further organized by the six research questions that guided this study: two quantitative (RQ 1 and 2), two qualitative (RQ 3 and 4), and one mixed-method question (RQ 5). The research questions were as follows:

1. What are in-service elementary math teachers' preexisting beliefs about the relevance of social justice and culturally relevant teaching related to their mathematics instructional practices before receiving synchronous online professional development?

2. How do in-service elementary math teachers' beliefs about the relevance of social justice and culturally relevant teaching related to their mathematics instructional practices change in response to the synchronous online professional development program?

3. What are in-service elementary math teachers' perceptions of infusing culturally relevant and social justice contexts in mathematical word problems on student

engagement?

4. What are in-service elementary math teachers' perceptions of how their beliefs changed as a result of the synchronous online professional development program?

5. How do in-service elementary teachers' perceptions of infusing culturally relevant and social justice contexts in mathematical word problems help explain any changes in teachers' beliefs about the relevance of social justice and culturally relevant teaching?

Quantitative Data Analysis

To address Research Question 1, quantitative data was gathered from the Dispositions for Culturally Responsive Pedagogy Scale (DCRPS) and the Learning to Teach for Social Justice-Beliefs Scale (LTSJ-BS). Participants completed these surveys before (pretest survey) and after (posttest survey) participating in the synchronous online professional development program. To address Research Question 2, data were analyzed utilizing a paired samples *t*-test to determine the overall impact the synchronous online professional development had on teachers' beliefs about culturally relevant and social justice contexts in mathematics. Utilizing a paired samples *t*-test allowed the comparison of the pretest and posttest scores of the same research participants.

Demographic Characteristics

The participants in this study were North American in-service mathematics teachers, tutors, and coaches in Grades 1 to 5 actively teaching or coaching mathematics. A total of 30 educators participated in this study. Of the 30 participants, 26 were female and four were male. Eight of the participants were ages 21-35, nine were ages 36-45, 10 participants were 46-60, and three individuals were 60 years of age or older. The majority

of the participants self-identified as White, followed by Black/African American, American Indian or Alaska Native, and Hispanic of any race. In reference to the number of years of teaching experience, nine participants indicated that they had 2 to 10 years of teaching experience 11 participants indicated that they had 11 to 20 years of teaching experience, nine participants revealed that they had 21 to 30 years, and one participant indicated 31 or more years of teaching experience. The demographic profile for all participants is shown in Table 2.

Table 2

Demographic Profile of Participants

Baseline Characteristics		Full Sample	%
Gender	Male	4	13.3%
	Female	26	86.7%
Age Range	21-35	8	26.7%
	36-45	9	30.0%
	46-60	10	33.3%
	60 or Older	3	10.0%
Ethnicity	Hispanic of any race	1	3.3%
	American Indian or Alaska Native	2	6.7%
	Asian	0	0.0%
	Black or African American	4	13.3%
	White	23	76.7%
Years of Teaching Experience	2-10	9	30.0%
	11-20	11	36.7%
	21-30	9	30.0%
	31 or more	1	3.3%

The majority of the participants indicated that they were currently teaching

mathematics, four participants indicated that they were math coaches, and two indicated that they were math tutors. Twenty-one participants indicated teaching one grade level between first to fifth grade while nine participants indicated teaching multiple grade levels in elementary school. Table 3 shows the professional profile for all participants.

Table 3

Professional Profile of Participants

Baseline Characteristics		n	%
Current Position	Teacher	24	80.00%
	Math Coach	4	13.30%
	Math Tutor	2	6.70%
Years at Current Position	1	5	16.70%
	2	5	16.70%
	3	2	6.70%
	4	1	3.30%
	5	5	16.70%
	6	2	6.70%
	7	1	3.30%
	8	2	6.70%
	9	1	3.30%
	10	1	3.30%
	11	1	3.30%
	12	1	3.30%
	14	1	3.30%
	19	1	3.30%
	20	1	3.30%
Grade Level Currently Teaching	First	2	6.70%
	Second	2	6.70%
	Third	6	20.00%
	Fourth	5	16.70%
	Fifth	6	20.00%
	Multiple Levels	9	30.00%

Regarding the size of their school district, 23 out of 30 participants indicated that their district contains 701 or more students. The majority of the participants (25) indicated that they teach at a public school. Of the 25 participants working at a public school, six participants indicated that the percentage of students on free and reduced lunch in their school fell in the range of 20% to 40%, six participants indicated that their school fell in the 41%-60%of students on free and reduced lunch, six participants indicated their school fell between the range of 61% to 80%, and eight participants indicated their school had 81% or more students on free and reduced lunch. The participants' district and school characteristics are shown in Table 4.

Table 4

Participants' District and School Characteristics

Baseline Characteristics	Range	n	%
District Size	100-300	3	10.0%
	301-500	1	3.3%
	501-700	1	3.3%
	701 or above	23	76.7%
	Not Applicable	2	6.7%
School Type	Public	25	83.3%
	Private	4	13.3%
	Other	1	3.3%
Percentage of Students on Free/Reduced Lunch	20-40	6	20.0%
	41-60	6	20.0%
	61-80	6	20.0%
	81 or above	8	26.7%
	Not Applicable	4	13.3%

Participants were representative of 15 states in the United States including

Alabama, Arizona, California, Connecticut, Georgia, Illinoi, Kentucky, Maryland, Massachusetts, North Carolina, New Jersey, New York, Pennsylvania, South Carolina, and Texas. The states in which participants are currently teaching are noted in Table 5.

Table 5

States Currently Teaching

Baseline Characteristics	State	n	%
State Currently Teaching	AL	2	6.7%
	AZ	1	3.3%
	CA	2	6.7%
	CT	1	3.3%
	GA	3	10.0%
	IL	1	3.3%
	KY	2	6.7%
	MD	1	3.3%
	MA	2	6.7%
	NC	6	20.0%
	NJ	2	6.7%
	NY	3	10.0%
	PA	2	6.7%
	SC	1	3.3%
	TX	1	3.3%

Additionally, seven participants had previously participated in professional development regarding the topics of culturally relevant teaching and social justice education, whereas 23 participants indicated they had not participated in any previous training related to culturally relevant teaching or social justice education.

Results for Research Question 1

Research Question 1 explored the preexisting beliefs about the relevance of social justice and culturally relevant teaching related to their mathematics instructional

practices, as measured by the DCRPS and the LTSJ-BS. The DCRPS is a self-reported survey that measures teachers' dispositions for culturally responsive practice. The questionnaire is comprised of 19 items intended to assess three domains of culturally relevant practices: praxis, community, social justice. The breakdown of items is as follows: six statements regarding praxis measure self-reflective teaching practices, nine statements on community assess participants' attitudes toward nurturing relationships within the classroom, and four items pertaining social justice assess how well teachers think about schools as systems that maintain educational inequities (Whitaker & Valtierra, 2018). Items are scored on a five-point Likert scale, 1 (*strongly disagree*), 2 (*disagree*), 3 (*neither agree or disagree*), 4 (*agree*), and 5 (*strongly agree*). The maximum score for each domain is as follows: 30 for praxis, 45 for community, and 20 for social justice, with a maximum total score of 95 (Whitaker & Valtierra, 2018).

The total mean for Likert-scale items on the DCRPS (n = 30) was M = 87.47, SD = 6.13. The mean quantities for each of the three domains in survey responses as established by Whitaker and Valtierra (2018) are as follows: (a) Praxis: M = 27.67, SD = 2.52; (b) Community: M = 42.50, SD = 2.30; and (c) Social Justice: M = 17.30, SD = 2.72. Mean, standard deviation, minimum, and maximum statistics for each domain are shown in Table 6.

Table 6

Descriptive Statistics

Domains	N	Mean	Std. Deviation	Minimum	Maximum
Praxis	30	27.67	2.52	20	30
Community	30	42.50	2.30	36	45
Social Justice	30	17.30	2.72	10	20
DCRPS Total	30	87.47	6.13	75	95

The preexisting beliefs about the relevance of social justice education in the mathematics classroom was measured by the LTSJ-BS survey. The LTSJ-BS is a self-reported questionnaire that measures teachers' beliefs and perspectives about teaching for social justice. The questionnaire is comprised of 12 social justice beliefs items. Items are scored on a five-point Likert scale, 1 (*strongly disagree*), 2 (*disagree*), 3 (*uncertain*), 4 (*agree*), and 5 (*strongly agree*). Some items are positively worded (1, 2, 4, 7, and 8) while others are negatively worded (3, 5, 6, 9, 10, 11, and 12). Negatively worded items were reverse scored so that higher total scores match stronger beliefs related to teaching for social justice (Ludlow et al., 2008). The maximum total score is 60 (Ludlow et al., 2008). The total mean for Likert-scale items on the LTSJ-BS (n = 30) was M = 47.20, SD = 6.74. Participants' pretest scores for the LTSJ-BS are displayed in Table 7.

Table 7

LTSJ-BS Pretest Total Score

Pretest Survey	N	Mean	Std. Deviation	Minimum	Maximum
Total LTSJ-BS Pretest Score	30	47.2	6.74	35	57

Research Question 2

Research Question 2 sought to determine the effect of the synchronous online professional development program on teachers' beliefs about the relevance of social justice and culturally relevant teaching related to their mathematics instructional practices, as measured by the DCRPS and the LTSJ-BS pretest and posttest scores. Participants completed these surveys before (pre-test survey) and after (post-test survey) participating in the synchronous online professional development program. To address

Research Question 2, data were analyzed utilizing a paired samples *t*-test to determine the overall impact the synchronous online professional development had on teachers' beliefs about culturally relevant and social justice contexts in mathematics. Utilizing a paired samples *t*-test test allowed the comparison of the pretest and posttest scores of the same research participants.

The following hypotheses were proposed for Research question 2:

H_0: There is no difference in participants' beliefs about the relevance of social justice and culturally relevant teaching related to their mathematical instructional practices between the DCRPS pretest and the posttest.

H_0: There is no difference in participants' beliefs about the relevance of social justice and culturally relevant teaching related to their mathematical instructional practices between the LTSJ-BS pretest and the posttest.

H_1: Participants' beliefs about the relevance of social justice and culturally relevant teaching related to their mathematics instructional practices will improve on the DCRPS posttest than on the pretest.

H_1: Participants' beliefs about the relevance of social justice and culturally relevant teaching related to their mathematics instructional practices will improve on the LTSJ-BS posttest than on the pretest

Paired samples *t*-tests were conducted to evaluate the effects of the synchronous online professional development program on the DCRPS scores for the three domains and total score and on the LTSJ-BS total score. Since we have a directional hypothesis, one-tailed tests were conducted. The null hypothesis stated that there is no change in teachers' beliefs between the pretest and the posttest. A paired samples *t*-test revealed

that teachers did not score significantly higher on the DCRPS posttest (M = 88.60, SD = 6.39) compared to the DCRPS pretest (M = 87.47, SD = 6.13, t (29) = - .91, p = .18). Additionally, paired samples t-test revealed that teachers did not score significantly higher on the LTSJ-BS posttest (M = 48.60, SD = 8.41) than they did on the LTSJ-BS pretest (M = 47.20, SD = 6.74, t (29) = -1.37, p = .09). Consequently, the researcher failed to reject the null hypothesis.

Furthermore, a paired samples t-test conducted to analyze the three domains on the DCRPS revealed no significant difference between pre and post-test. Teachers did not score significantly higher on the DCRPS posttest for the praxis domain (M = 28.2, SD = 2.12) compared to the pretest (M = 27.67, SD = 2.52, t (29) = -1.17, p = .13). Similarly, teachers' posttest scores for the community domain (M = 42.7, SD = 2.73) did not reveal a significant difference when compared to the pretest (M = 42.50, SD = 2.30, t (29) = -.42, p = .34). Finally, teachers did not score significantly higher on the DCRPS posttest for the social justice domain (M = 17.7, SD = 2.58) when compared to the pretest (M = 17.30, SD = 2.72, t (29) = -.70, p = .25). Results of the paired samples t-test are displayed in Table 8.

Table 8

Paired t-Test Results

Domains	N	Df	*t*	*p*	Mean	Std Dev	Cohen's *d*
Praxis	30	29	-1.17	.13	-.53	2.50	-.21
Community	30	29	-.42	.34	-.20	2.63	-.08
Social Justice	30	29	-.70	.20	-.40	3.14	-.13
Total DCRPS Score	30	29	-.91	2.63	-1.13	6.79	-.17
Total LTSJ-BS Score	30	29	-1.37	.08	-1.40	5.58	-.25

Qualitative Data Analysis

In response to Research Questions 3 and 4, 10 participants were interviewed upon completion of the synchronous online professional development program regarding their beliefs of infusing culturally relevant and social justice contexts in mathematical word problems on student engagement. The interview also assessed their perceptions of how their beliefs changed after the synchronous online professional development program. All 10 interviews were manually coded using inductive thematic analysis to discover themes in the data. Inductive analysis is a "process of coding the data without trying to fit it into a pre-existing coding frame" (Braun & Clarke, 2006, p.89). Creswell and Guetterman's (2019) six steps for thematic analysis were used to search for and name themes. These phases consisted of: (1) familiarizing oneself with the data, (2) generating codes, (3) constructing themes, (4) reviewing potential themes, (5) defining and naming themes, and (6) producing the report.

To begin this process, transcripts were retrieved from the online semi-structured interviews conducted via Zoom. Each interview transcript was read once by the researcher to familiarize herself with the data and reflect on their meaning. Then, overall thoughts emerging from each interview transcript were noted. Thematic analysis was used to identify patterns across the data and generate potential codes based on emerging themes. A set of initial codes was created by categorizing data. Each category was labeled with a phrase or term as fitting. Then, codes were sorted and grouped to form themes and subthemes as applicable. Similar themes were merged, and themes not supported with sufficient data were discarded.

Research Question 3

Research Question 3 investigated in-service elementary math teachers' perceptions of infusing culturally relevant and social justice contexts in mathematical word problems on student engagement. A semi-structured interview was conducted to address this research question. The interview included specific questions regarding student engagement. Questions 1 to 4 of the interview protocol specifically addressed participants' beliefs on engagement (see Appendix C). One overarching theme and two sub-themes emerged from the data regarding teachers' perceptions of using culturally relevant and social justice contexts in mathematical word problems on student engagement. The overarching theme was *an increase in student engagement* with *relevancy* and *relatability* of word problems as sub-themes. Participants reported at length the importance of considering student interests when writing, reframing, or selecting word problems for their students. They also reported increasing student engagement by making word problems relatable, which encompasses the idea that they have to see themselves in the problems to keep students engaged.

Increase Student Engagement. The overarching theme that culturally relevant and social justice contexts would increase student engagement emerged during data analysis. All but one of the participants stated that they believed infusing culturally relevant and social justice contexts in mathematical word problems would be an effective way to increase student engagement for several reasons and in varying circumstances. The value of using these contexts was found to be enhanced by its relevancy or connection to the real world and relatability or its potential to provide mirrors through mathematical word problems.

Teachers believe that teaching mathematics using culturally relevant or social justice contexts is an effective pedagogical strategy to increase student engagement in the mathematics classroom. When asked, how does teaching about social justice or culturally relevant pedagogy relate to student engagement? Teachers explained that culturally relevant and social justice contexts make word problems more relatable and personally relevant to students, improving student engagement. They felt that it was essential to adopt a teaching approach that recognizes the culture of learners. For instance, Participant 9 stated, "if they are invested in the context, then they are motivated to solve the problem because they'll understand how it applies to them or seems important in their lives." The person also stated, "If they're not invested or the context is irrelevant to them, then they might be less motivated to solve the problem." The teachers felt that student interest is an essential factor in student engagement, thus making word problems that interest students would, in turn, increase their engagement. Participant 10 held this viewpoint, she stated, , "If the word problems are about things that they are interested in and that they can relate to them, they're automatically going to be more engaged." Likewise, Participant 8 shared, "Yes, [engagement will increase with culturally relevant and social justice contexts] I think because they'll be more interested in that."

Relevancy of Word Problems. A thorough analysis of the data revealed that the consensus was that using culturally relevant and social justice contexts would increase student engagement by making the contexts personally relevant to the students in the classroom. The subjects felt that providing an opportunity for students to describe personal experiences play a vital role in making learning more relevant. Some of them argued that culture improves learning and student engagement. They believed that culture

is an essential lens through which students conceptualize the course of instruction and the learning process. Participant 5 stated,

> Just making them culturally aware of what's around them, I think that they're very interested because they know their classmates [are from different cultures] …it helps them be more engaged because they're interested to hear more and see more and learn more.

A core view was the importance of ensuring that the learning experiences provided an opportunity that validates the student's culture to while promoting a valuable school experience. The educators affirmed students' cultural heritage and identity and ensured that their voice became a core curriculum constituent. They also emphasized the need to share multiple perspectives and considered it an important aspect of culturally relevant pedagogy.

The participants felt that using social justice and culturally relevant contexts in mathematics promoted student engagement. They felt that this teaching practice ensured that learners remained on-task, attentive, and engaged with the instruction. The respondents suggested that student engagement varied based on the context of the word problems. Participant 7 stated, “the context of our word problems also is very important because they immediately will go into daydreaming if you make it too fun, too interesting, or too playful. The same participant also emphasized,

> If it's too playful or if it's nonsensical, then I lose them but when you use situations that spark either their imagination or reminds them of what's going on in the world, in the school, or in their homes, then the kids are engaged just because of the content. Not without regard of what skill you're teaching, but they

> do perk up because you've mentioned something to them that they've heard their parents discuss or that they've experienced, so it's powerful.

Likewise, participants had comparable views of using social justice and culturally relevant contexts in mathematic word problems when needing to re-engage off-task students in the math lesson. For example, Participant 10 stated that when students are not engaged with the math, "that's when I would make it relevant to them, like okay let's think about it this way, you know, because then they're going to be engaged if it feels relevant."

One participant described how as a result of the online synchronous professional development program she engages differently with students and as a result has increased the relevancy of the word problems she uses with students. She stated,

> I think the biggest change that I've seen is just more my awareness of how I'm teaching and how I'm talking to my students and understanding that the way that I word things can come across and give them certain ideas about things about life.

The same participant added that as a result of this change, she has experienced changes in the learning of her students. She shared,

> I've noticed, as I've changed how I talk about things. It's getting them to offer more information. So, it's becoming more about them, as opposed to what I'm telling them and I'm having them give me examples, so it's about their lives as opposed to just a situation that I come up with or a situation that's in the book. So, if they're giving me examples, then it's real to them.

Overall, the participants had similar views of fostering student engagement through culturally relevant and social justice contexts in mathematics by making word problems

relevant to students' lives.

***Relatability of Word Problems*.** The research subjects felt that to increase student engagement, it is essential to adopt a teaching approach that recognizes the culture of learners and that provides students with an opportunity to relate to the contexts used in mathematical word problems. Most participants agreed that student engagement increases when they can see themselves in the curriculum. Participant 2 shared this viewpoint. She stated, "like with the online professional development sessions just them seeing themselves in it." The same participant added that "in first grade we don't do that many word problems…we do some word problems and just having those times where they can see, they can relate to it a little bit" is vital for student engagement and learning. Participant 1 also held this viewpoint, she stated,

> By making it culturally relevant and connecting it to their lives it's going to help. They're going to have those prior connections to make, to connect dot A to dot B, so it helps them with the learning, as well as the engagement.

Participant 4 reported,

> They [students] are definitely more excited if there's a word problem or if I have, if I have made the word problems, which I don't do often just because it makes my life easier, but if it's something I mean, if it's something that they've done before or they've heard of before, then they're definitely very excited.

Participant 6 stated, “I think it validates that it makes them feel like it's important because it's somebody they know, so if it's not their name it's someone they know at school, and it makes some care more to figure it out.” Overall, the participants had similar views of how making word problems relatable to students increases student engagement.

Research Question 4

Research Question 4 stated, what are in-service elementary math teachers' perceptions of how their beliefs changed as a result of the synchronous online professional development program? Two key themes emerged from this research question: *increase in awareness* and *increase in knowledge* to be able to reframe word problems.

Increase in Awareness. The participants reported that participating in the synchronous online professional development helped them develop a heightened understanding/awareness of the problematic contexts used in mathematical word problems and how some of the contexts could negatively affect students in mathematics and, consequently, life. Participant 2 stated,

> I've become more aware of the way that curriculum writes word problems, especially in first grade because they pick up on so many little things, they don't realize what they're picking up on… the way that things [word problems] are worded, the way names are being used, the content that's within it.

The same participant expanded by providing an example. She stated that

> After doing the four sessions I did notice, yep, there's a lot of sports involved and we talked about you know how many points each team got, which I never thought anything about sports could be a drawback, but a lot of times when kids are playing sports, they have advantages within their family lives and not all kids have that.

Likewise, Participant 5 maintained that the synchronous online professional development increased her awareness of the messages word problems send. She stated, "I'm more like

aware now of he/she word problems or of word problems that they may just not understand because they don't have that background." She also reported that the synchronous online professional development helped her

> Just be more aware of the word problems that I use, I think that was my biggest [change]. I didn't think about it [messages word problems send] until we did the word problems in the online professional development where I was like, oh yeah, I bet mine wouldn't have been able to think about that.

Most participants believed in the neutrality of math and never placed importance on the contexts of word problems. Participant 10 explained,

> I never thought about that word problems had like an underlying message that we're sending to children, I never thought about that, it was just a word problem. But now, you know after taking your class, I've been reading the word problems a lot more careful.

Participant 10 also reported her most significant change as increasing her awareness of the messages mathematics word problems send. She stated, "I think just being more aware of what I'm putting in front of my students, and thinking about what messages I'm sending, would be the biggest change." The belief that the way mathematical word problems are written preference some students instead of all students in the classroom was shared amongst participants. Participant 2 shared this viewpoint, she stated,

> I have seen more of how math and word problems are written into curriculum, definitely favors families that are at least middle class or higher, and how it could look to students who are not within those socio-economic classes, and not even, you know, what culture they're coming from but just you know where they live,

what's available to them.

Similarly, Participant 1 shared that her biggest change is being able to "really look at those word problems and not take them for granted." She reported that now she can look at word problems with a different lens. She stated, "looking at word problems and going, oh my god water skiing and what is that telling our students about how we spend our discretionary money?" Overall, participants developed a heightened awareness of the messages mathematical word problems could potentially send students. During the interviews, they recalled heteronormativity, consumerism, and classism in mathematics word problems. However, Participant 6 held a different view and stated, "I don't think it [the online professional development program] changed [the teacher's beliefs] very much."

Increase in Knowledge. The participants felt that participating in the synchronous online professional development contributed to an increase in their knowledge about the use of culturally relevant and social justice contexts in mathematics word problems and their ability to use these contexts to reframe word problems. Participant 1 stated,

> You really made me look at the word problems. I would say that in the past I probably would have just said, oh, let's just throw some of the students' names in there because they love it when their names show up in problems, and not really looked at anything else beyond that. But actually, I'm looking at, are they [word problems] representative of their lives and how can I make those word problems reflective of their lives. So that's the biggest change.

Having a similar experience, Participant 3 stated, "my most [biggest change] that I can

use most directly within my classroom is reframing the skills and the concepts into something that's more attainable for them with their 10- and 11-year-old lenses that they're looking through things." The same participant shared,

> I think one of the biggest changes that I had is that just relying on your textbooks isn't going to be good enough, that we always we rely on this wonderful curriculum we're given, and you believe that if you just do what you have there, you've met the needs [of the students] and I don't think now that all the materials we've been given would pass the litmus test of whether or not they're acceptable. So, I think that one of my biggest takeaways is no matter what I'm using to look at it from a different lens, even if it is something the district is handed to me and said, oh, this is great!

Like Participant 3, Participant 4 shared how her practice has changed after participating in the synchronous online professional development. She stated, "When I am copying and pasting those word problems, I'm changing them more often than I would have. I would have just copied and pasted it on and been done with it." As a result of the professional development program, most participants extended their knowledge of using culturally relevant contexts rather than just using students' names in their word problems. Participant 4 stated,

> I think more of the situations than just changing the names in the word problems and that even some of the kids that aren't multi-racial or have a different race even those kids will struggle with just the way they word those math questions and problems on state tests and then in the textbooks.

Overall, the interviewees' change in instructional practices was evident when describing

how they considered and prepared mathematics word problems for a lesson.

Mixed Methods Data Analysis

In this mixed-methods study, to provide a more comprehensive understanding of teachers' beliefs about using culturally relevant and social justice contexts in mathematics instruction, the quantitative data from phase one of the study was integrated with the qualitative data from phase two of the study using a joint display. A joint display is a visual way of bringing the quantitative and qualitative data together to understand participants' perspectives beyond the information gained separately from the quantitative and qualitative results (Guetterman et al., 2015). In this study, the quantitative data will frame the analysis, and the qualitative data will be used to elaborate and explain the quantitative findings (Moseholm & Fetters, 2017).

Research Question 5

Research Question 5 stated, how do in-service elementary teachers' perceptions of infusing culturally relevant and social justice contexts in mathematical word problems help explain any changes in teachers' beliefs about the relevance of social justice and culturally relevant teaching? To answer Research Question 5, 10 participants were interviewed, and data was merged for comparison using a joint display as shown in Table 9. After the quantitative data was analyzed, four participants who showed a negative change in beliefs from pretest to posttest results according to the DCRPS and LTSJ-BS scores were selected. A negative change means the participant’s raw score decreased from pretest to posttest on either or both scales. Conversely, four participants who showed a positive change in beliefs from pretest to posttest results as measured by the DCRPS and LTSJ-BS were selected. A positive change means the participant scored

higher on the posttest than on the pretest of both scales, therefore showing growth. Finally, two participants whose scores did not change from pretest to posttest results according to the DCRPS and LTSJ-BS scores were selected. These participants scored the same on the pretest and posttest. Tables 9 and 10 show that regardless of the participant's pretest and posttest scores, participants experienced a positive change in beliefs when interviewed.

Table 9

Negative, Neutral, and Positive Changes Between Pretest and Posttest Related to Increase in Awareness

Increase in awareness Interviewees developed an awareness of the messages mathematical word problems could potentially send students.	
Negative Change	"So just being aware because with the state testing, we don't know what they're the questions are going to be like and what background. So, to me, I learned I need to one have more different types of problems to have them aware of okay this is just extra information that's really not going to change the problem, or this May, you know, make you need to think in a different way or just, I don't know." "I think it brought it to my attention, like it's not something I ever thought about. So, I think it's something that, um, I will use. I really like the idea of the mirrors in math and having children being able to see themselves in the problem or having context where they can help others in the problems." "I have seen problems about boys and girls now a little bit more cognizant of paying attention to that. So, I think I'm going to make a big change, and talk to the kids about the problems when we get to one that doesn't really make sense or bringing a why would somebody be collecting that food, you know, could they use it to give to the shelter? I think it's important"
No Change	"The biggest change that I've seen is I don't just look at our [math word] problems anymore and just use them, because that's what's in the textbook."
Positive Change	"Changing names, making sure that what's in them makes sense. That it would be appropriate for fourth graders, you know, no matter what their ethnicity is because some of them are even ridiculous. Trying to make them a little bit more real world. The PD made me think it's important that they see that there's other people that their friends aren't all white."

Table 10

Negative, Neutral, and Positive Changes Between Pretest and Posttest Related to Increase in Knowledge

Increase in knowledge Interviewees knowledge about the use of culturally relevant and social justice contexts in mathematics word problems and their ability to use these contexts to reframe word problems increased.	
Negative Change	"I feel like I can make the kind of impact I need to make without disturbing what the children are supposed to be learning. I feel like I'm able to expand their learning and not just deal with the numbers, but also impact how they think about the world, how they think about themselves. That can happen in math, and I think it's really going to be a way of not creating people who are not math people that they actually see how math is used in the real world. because we're going to be presenting to them real world situations. We call any word problem right now a real-world math problem, but it's not real for the world of the kids that I'm teaching. So, I now I feel like empowered to make that change."
No Change	"I feel like I came into it with a pretty decent mindset already, so I wasn't starting from square one. I was really inspired by the idea of having this database of things that I could just pull out of and knowing that these things were going to resonate with my kids, because these are the hobbies, these are the names, these are the holidays, these are the foods, this is what's going on. So I already have this vehicle for it, but the change that I want to make and how I want to use it, and delving into that database, I think is really what's going to be the big change for me."
Positive Change	"Just going in and reworking the problem, so that it's not gender stereotyping. I find that a lot of them are about running and like, cross country to me is just a very affluent sport, you know. I just feel like a cross country team is just not anything that my kids in school have any idea about. And so just changing the whole premise of the problem but leaving the numbers, so that the math itself is the same, but situated better. And, since there's only one or two on the worksheet, it's been kind of easy to change those two problems."

All participants expressed an increase in awareness and an increase in knowledge to reframe word problems when interviewed. The discrepancy between quantitative and qualitative results could be due to the DCRPS and the LTSJ-BS not directly aligning with the objectives of the online professional development program. Additionally, a significant difference did not exist between the pretest and posttest of the DCRPS or the LTSJ-BS because the surveys did not accurately evaluate the change in beliefs expected from the synchronous online professional development program.

Some interviewees showed a negative change in beliefs from pretest to posttest about infusing culturally relevant and social justice contexts in mathematics as measured

by the DCRPS and LTSJ-BS, but showed positive beliefs during the one-on-one semi-structured interview. For instance, Participant 8 scored 80 points on the DCRPS pretest and 68 on the posttest. When interviewed, this Participant shared that because of the synchronous online professional development program, "I'm more like aware of the he-she word problems and of word problems that they [students] may just not understand because they do not have that background." This increase in awareness was also shared by Participant 6, whose raw score on the DCRPS pretest was 91 and posttest was 89.

Although these participants experienced increased awareness and positive beliefs about infusing culturally relevant contexts in mathematics word problems after participating in the synchronous online professional development program, both participants revealed not feeling comfortable infusing social justice contexts in mathematics for varied reasons. Some of the reasons included student maturity, parental conflicts, and standardized assessments. Participant 5 felt that social justice contexts were inappropriate for her student population. She stated, "This is a Bible-ry area, so I'm just very careful of how I go about certain things. I wish I did more. I mean, it can definitely be added in more." This same Participant shared that her group of third graders are too young and less mature and would not be able to engage in social justice topics. Similarly, Participant 6 explained that her decision not to implement social justice contexts in mathematics results from the conflict in her state about critical race theory. She also shared,

> I honestly think it would make the majority of my students very uncomfortable and up in arms, and it actually could lead to some problems with the parents. And so part of it is a safety net for myself. Social justice topics would, I think, end up

being a distraction and an argument with my students.

These sentiments validate the negative change in scores from pretest to posttest on the LTSJ-BS for both participants. Participant 5 had a net change in score of -1 whereas Participant 6 had a net change in score of -14.

Several participants demonstrated a positive change in their beliefs about culturally relevant and social justice pedagogies as measured by the DCRPS and LTSJ-BS. Some of these participants showed a more significant change from pretest to posttest than others. For example, Participant 2 showed the most significant positive change as measured by the DCRPS. This Participant had a net change in score of +19. When interviewed, Participant 2 shared that as a result of the synchronous online professional development program

> I've become more aware of the way that curriculum writers write word problems…I have seen more of how word problems in the curriculum definitely favors families that are at least middle class or higher, and how it could look to students who are not within those socio-economic classes.

Participant 3 also demonstrated a positive change in beliefs as measured by the DCRPS scores, but the difference between pretest and posttest scores was more negligible. This Participant had a net change in score of +8. Even though the DCRPS shows a minor change in beliefs, when interviewed, this Participant reported that as a result of the synchronous online professional development

> One of the biggest changes that I have, is that just relying on your textbooks isn't going to be good enough…but even the biggest change that I can use most directly within my classroom is reframing the skills and the concepts into

something that's more attainable for them…

Lastly, Participants 9 and 10 did not demonstrate any significant change in beliefs from pretest to posttest as measured by the DCRPS and LTSJ-BS. When asked about any changes in beliefs resulting from the synchronous online professional development program, Participant 9 expressed, "I feel like I came into it with a pretty decent mindset already, so I wasn't starting from square one." The Participant justified that the professional development did not alter her beliefs. Conversely, Participant 10 stated, "The biggest change that I've seen is, I don't just look at our problems anymore and just use them, because that's what's in the textbook." About her beliefs, the same Participant said, "what it [synchronous online professional development program] changed in my beliefs, I would say, I never thought that word problems had underlying messages that we're sending to children, always thought that it's just a word problem." Although the quantitative data failed to reach significance, the qualitative data helps explain the quantitative results.

Summary

This chapter provided the demographic descriptive statistics of the 30 elementary mathematics educators who completed the DCRPS and LTSJ-BS pretest and posttest surveys. It also presented a descriptive profile of the 10 teachers who completed the pretest and posttest surveys and participated in a one-on-one interview after partaking in four synchronous online professional development sessions. Additionally, a description of the statistical analysis and thematic analysis and the findings of the quantitative, qualitative, and mixed methods analyses are presented.

Statistical results indicated that teachers did not score significantly higher on the DCRPS, or LTSJ-BS posttest compared to the pretest. This chapter also offered the thoughts and perceptions of 10 elementary mathematics teachers regarding their beliefs on infusing culturally relevant and social justice contexts in mathematical word problems on student engagement and their perceptions of how their beliefs changed due to the synchronous online professional development program. Several participants felt that reframing word problems using culturally relevant and social justice topics would increase student engagement in the mathematics classroom. They expressed that utilizing these contexts would create word problems that are more relevant and relatable to students. A consensus amongst participants was that the synchronous online professional development program increased their awareness of the messages word problems could potentially send to students. They reported that the synchronous online professional development was instrumental in their understanding and ability to reframe mathematical word problems in the future.

The following chapter will discuss the findings of this study and the themes, as well as how the literature supports them. Moreover, Chapter 5 will discuss the interpretations of the study and context findings, implications of the findings, the study's limitations, and recommendations for future research.

Chapter 5: Discussion

This sequential explanatory mixed methods study was conducted to examine in-service elementary mathematics teachers, coaches, and tutors' beliefs about the relevance of social justice and culturally relevant teaching related to their mathematics instructional practices and how those beliefs were affected through online synchronous professional development program. This study was grounded in critical theory and critical race theory and sought to: (a) examine in-service teachers' preexisting beliefs about the relevance of social justice and culturally relevant teaching related to their mathematics instructional practices before receiving a synchronous online professional development program; (b) assess the impact of synchronous online professional development program on teachers' beliefs and classroom practices related to social justice and culturally relevant teaching in mathematics; and (c) understand in-service elementary math teachers' perception of infusing culturally relevant contexts in mathematics on student engagement.

The previous chapter presented the results of the quantitative, qualitative, and mixed-methods analyses utilizing pre and post-test data gathered from the DCRPS and LTSJ-BS surveys and one-on-one interviews. This chapter will provide a summary and interpretation of the findings and connections between the current study and existing literature. Also, implications of the results are suggested, and limitations of the study are addressed. Finally, recommendations for future research on the topic are suggested.

Interpretation of the Study and Context Findings

The following sections will offer an interpretation of the findings gathered through quantitative, qualitative, and mixed methods analyses of data collected via the Dispositions of Culturally Relevant Pedagogy Scale (DCRPS) and the Learning to Teach

for Social Justice Beliefs Scale (LTJ-BS), both before and after participation on a synchronous online professional development program and one-on-one interviews of 10 participants after participating on the synchronous online professional development. Each of the five research questions will be discussed within the context of the current literature on culturally relevant pedagogy and teaching mathematics for social justice.

Research Question 1

Research Question 1 investigated, What are in-service elementary math teachers' preexisting beliefs about the relevance of social justice and culturally relevant teaching related to their mathematics instructional practices before receiving synchronous online professional development? Data analysis from the DCRPS as completed by elementary mathematics teachers, coaches, and tutors from 15 states in (the United States revealed overall positive attitudes toward culturally responsive pedagogy, as discerned by a Likert scale, with items ranging from 1 (*strongly disagree*) to 5 (*strongly agree*), with a maximum total score of 95 (M = 87.47, SD = 6.13). Across survey responses for the three domains in the DCRPS (praxis, community, and social justice), there was no significant variability amongst level of agreement with items for Praxis with a maximum score of 30, (M = 27.67, SD = 2.52), Community with a maximum score of 45, (M = 42.50, SD = 2.30), and Social Justice with a maximum score of 20 (M = 17.30, SD = 2.72). Results from the praxis domain reveal that teachers understand how their identity and the identity of the students affect their teaching practice and are willing to assess their teaching practices and transform them to benefit diverse students in the classroom (Whitaker & Valtierra, 2018). Culturally responsive teachers have a strong understanding of self-identity (Cavendish et al., 2021). As revealed in the DCRPS, the teachers in this study

demonstrated a positive disposition to be vulnerable, examine their own identities, and take advantage of professional development opportunities focused on issues of diversity (Whitaker & Valtierra, 2018).

Results from the dispositions for community domain revealed that teachers are willing to work in a collaborative environment to nurture positive relationships within the community. These teachers are open to learning about their students' cultures and will integrate these experiences in their teaching to connect to students' realities and increase engagement. To be an effective educator, teachers must know their students' cultures and use this knowledge to inform practice (Ladson-Billings, 1995). Finally, the disposition for social justice domain revealed that teachers have a positive attitude towards using real-life contexts in the curriculum. They understand the necessity of including topics of race, gender, and sexuality when necessary.

Furthermore, they value equity over equality because they believe school plays a part in disrupting or maintaining social inequities. These findings parallel a study conducted by Simic-Muller et al. (2015), where the researchers discovered that teachers genuinely value the use of real-world contexts. However, their understanding of real-world contexts is limited to trivial daily life situations because they are not comfortable discussing controversial issues. Nonetheless, understanding the importance of integrating culturally relevant pedagogy or social justice principles is an essential step in transforming beliefs and practices.

Data analysis from the Learning to Teach for Social Justice Belief Scale (LTSJ-BS) scale as completed by elementary mathematics teachers, coaches, and tutors in the United States revealed slightly positive beliefs about the relevance of social justice

education in the mathematics classroom. From the participants' responses, it is evident that a concern for social justice guides the goals of mathematics educators involved in this study. Similarly, Subasi Singh and Akar (2021) sought to understand teachers' beliefs about their needs, strengths, and enthusiasm in teaching students in culturally diverse learning environments. The participants included educators teaching in Vienna. The researchers found that the teachers had positive views and diverse abilities suitable for teaching in culturally diverse classrooms. The increasing racial and ethnic diversity in the United States has significant implications on the demographics of school communities, mainly based on the potential to contribute to culturally diverse learning environments.

For this reason, teachers find cultural diversity in their classrooms to be a rather difficult phenomenon, mainly when these teachers have not participated in professional development programs focusing on culturally relevant pedagogies or teaching for social justice. It is worth noting that a change in the racial profile of the learning environment does not constitute a problem per se; the issue lies in how teachers address (or do not) the change. This challenge increases when there is a mismatch between the teachers' backgrounds and the students (Bennett et al., 2018; Freidus, 2020; Hyland, 2009; Maddamsetti, 2020). Educators are the enactors of the curriculum. Accordingly, scholars emphasize that culturally sensitive professionals should consider the needs of a culturally diverse learning environment (Civitillo et al., 2018). Previous studies demonstrate the positive implications of adopting culturally relevant and social justice teaching practices in the classroom.

Research Question 2

Research Question 2 sought to determine, How do in-service elementary math

teachers' beliefs about the relevance of social justice and culturally relevant teaching related to their mathematics instructional practices change in response to the synchronous online professional development program? The null hypothesis for this research question was that there would be no difference in participants' beliefs about the relevance of social justice and culturally relevant teaching related to their mathematical instructional practices between the dispositions for culturally responsive pedagogy scale pretest and posttest. This study was also guided by the hypothesis that there would be no difference in participants' beliefs about the relevance of social justice and culturally relevant teaching related to their mathematic instructional practices between the LTSJ-BS pretest and posttest. A paired samples *t*-test showed that teaching professionals did not score significantly higher on the DCRPS posttest (M = 88.60, SD = 6.39) compared to the DCRPS pretest (M = 87.47, SD = 6.13, t (29) = - .91, p = .18). Furthermore, the paired samples t-test revealed that teachers did not score significantly higher on the LTSJ-BS posttest (M = 48.60, SD = 8.41) than they did on the LTSJ-BS pretest (M = 47.20, SD = 6.74, t (29) = -1.37, p = .09). Consequently, the researcher failed to reject the null hypothesis.

Furthermore, a paired samples *t*-test focusing on the three domains of the DCRPS, praxis, community, and social justice did not show a significant difference between pre and posttest. The mathematics educators did not score significantly higher on the DCRPS posttest for the praxis domain (M = 28.2, SD = 2.12) compared to the pretest (M = 27.67, SD = 2.52, t (29) = -1.17, p = .13). Similarly, teachers' posttest scores for the community domain (M = 42.7, SD = 2.73) did not reveal a significant difference when compared to the pretest (M = 42.50, SD = 2.30, t (29) = -.42, p = .34). Finally, teachers did not score

significantly higher on the DCRPS posttest for the social justice domain (M = 17.7, SD = 2.58) when compared to the pretest (M = 17.30, SD = 2.72, t (29) = -.70, p = .25), community, and social justice domain than the pretest. Overall, participants scored slightly higher on the DCRPS and the LTSJB posttest than the pretest; however, the results failed to reach significance. Participants who volunteered to participate in the synchronous professional development program had favorable views about culturally relevant pedagogy and teaching math for social justice, thus their pre-survey scores were high causing a ceiling effect. A ceiling effect happens when the value of one variable is already high for all or most participants (Schoonenboom & Burke-Johnson, 2021). In the present study, a ceiling effect may have caused an inaccurate measure of the mean scores between pretests and posttest of the DCRPS and LTSJ-B surveys. Additionally, a ceiling effect may have minimized the true effects of the synchronous online professional development.

These results build on existing evidence of the value of professional development in fostering culturally relevant practices. For instance, Mette et al. (2016) conducted research to comprehend the implications of the teacher-based professional development program in promoting culturally sensitive pedagogy in midwestern United States. School administrators and teachers were involved in professional development programs to improve teachers' teaching practices through better cultural competence. They found that professional development helped shape their beliefs. The researchers reported that professional development helped teachers recognize the students' cultural differences they taught (Mette et al., 2016). As the diversity of our nation increases, teachers are faced with educating a diverse student population, thus the importance of professional

development that will help them implement culturally relevant practices (Mette et al., 2016).

Findings in the present study are also consistent with the findings of Ciampa and Reisboard (2019). Ciampa and Reisboard (2019) examined the impact of a professional development initiative that helped elementary teachers implement culturally relevant strategies in their classrooms. The researchers found that professional development increased awareness of the implicit and explicit bias in the school curriculum. Additionally, Ciampa and Reisboard (2019) stated that professional development significantly impacted developing students' and teachers' racial and cultural identities, which helped implement culturally relevant practices in the classroom. These findings suggest that professional development can potentially change teachers' beliefs, impacting teachers' instructional practices.

In line with this study, Brown et al. (2019) examined teachers' knowledge of cultural relevancy and the teaching practices implemented after professional development on culturally relevant education. They found that teachers understood the theory of culturally relevant pedagogy before participating in professional development, but their practice did not align with the theory. After training, Brown et al. (2019) reported that the divide between theory and application was resolved. The findings of this study show the value of professional development in fostering culturally relevant practices.

Research Question 3

Research Question 3 explored, What are in-service elementary math teachers' perceptions of infusing culturally relevant and social justice contexts in mathematical word problems on student engagement? The overarching theme obtained from a

qualitative analysis of the data obtained from the participants was an increase in student engagement with relevancy and relatability of word problems being sub-themes. Participants provided comprehensive information about the value of considering student interests when writing, reframing, or selecting word problems for their students. Additionally, the interviewees associated an improved increase in student engagement with making word problems relatable, which encompasses the idea that to keep students engaged, they must see themselves in the problems. Scholars who have conducted similar research maintain that teachers felt that culturally relevant teaching practices helped increase student engagement by enhancing classroom instruction (Bradshaw et al., 2018; Samuels et al., 2017). Teachers who are responsive feel responsible for students' success and strive to better engage them. Culturally responsive teachers prioritize learners' needs, interests, and concerns; promote student engagement; and eliminate factors that negatively impact student achievement (Ragoonaden & Mueller, 2017). Professional development addressing teaching for social justice and culturally relevant teaching practices play a vital role in enhancing student engagement in the classroom through providing students culturally relevant contexts they can relate to (Bradshaw et al., 2018; Samuels et al., 2017).

In the current study, it was evident that all except one of the interviewees stated that infusing culturally relevant and social justice contexts in mathematical word problems played a critical role in enhancing student engagement. The value of using these contexts was improved based on its relevancy or connection to the real world and relatability or its potential to provide mirrors through mathematical word problems. An important finding was that culture was an important lens through which students can

conceptualize mathematical concepts, similar to the findings in the extant literature.

Research Question 4

Research Question 4 investigated, What are in-service elementary math teachers' perceptions of how their beliefs changed as a result of the synchronous online professional development program? Two major themes emerged from this research question: increase in awareness of problematic contexts presented in word problems and increase in knowledge to reframe mathematical word problems. The interviewees stated that the professional development program proved to help enhance comprehension and awareness of the problematic contexts used in mathematical word problems and how some of the contexts could negatively impact students in mathematics and, consequently, in life. These results build on existing evidence of teachers recognizing word problems as hegemonic features of the mathematics curriculum (Bright, 2016a; Yeh & Otis, 2019).

Moreover, in the present study, after participating in the synchronous online professional development, teachers were able to conceptualize how the contexts used in word problems hinder the success of culturally diverse students in mathematics, limiting their effective participation and leading to poor performance. Similar research reveals that professional development programs influence teachers' beliefs by shaping their skills and knowledge (Vangrieken et al., 2017; Warren, 2018). For instance, these programs play a critical role in contributing to a positive change in their views and perspectives concerning diversity. Teachers begin to recognize the cultural differences in the learning environment. The professional development program helped educators reflect on their biases and the process of teaching in a culturally diverse classroom. Additionally, it makes them change their beliefs and attitudes, as affirmed by participants.

According to Egert et al. (2018), professional development programs change teachers' beliefs and views concerning learning and help them to gain a comprehensive insight into who their students are. It is particularly essential to develop a heightened awareness and comprehension of culturally relevant teaching practices and social justice education to create curricular resources relevant and relatable to students in the classroom. Similarly, interviewees in the present study felt that participating in the professional development program was critical to enhancing the educator's knowledge about the use of culturally relevant and social justice contexts in mathematics word problems and their aspirations to use these contexts to reframe word problems. Throughout the synchronous online professional development, participants learned strategies to reframe problematic contexts and transformed them using culturally relevant and social justice contexts.

Research Question 5

Research Question 5 sought to explain, How do in-service elementary teachers' perceptions of infusing culturally relevant and social justice contexts in mathematical word problems help explain any changes in teachers' beliefs about the relevance of social justice and culturally relevant teaching?

The qualitative analysis helped understand the quantitative results of this study. Although quantitative results showed no significant difference between pretest and posttest, one-on-one interviews comprehensively explained how teachers' beliefs changed after participating in the synchronous online professional development. Interviewees felt that the synchronous online professional development program increased their awareness of the messages word problems could potentially send to

students. They also reported that the synchronous online professional development was instrumental in their understanding and ability to reframe word problems using culturally relevant and social justice contexts. While previous research has shown that teachers can change their beliefs after participating in professional development (Polly et al., 2017; Reagan et al., 2016; Teng, 2016; Thurman & Barzel, 2020), there is not a clear relationship between beliefs, professional development, and practices (Santos & Miguel, 2019). The current study provides new insight into the relationship between teachers' beliefs, professional development, and practice. After participating in the synchronous online professional development, interviewees were able to identify problematic word problems and reported reframing their contexts using culturally relevant and social justice contexts before using the problems with their students in their mathematics lessons. This result builds on existing evidence of the importance of providing teachers professional development of practical application in the classroom (Gay, 2018). The synchronous online professional development program contained not only theoretical modules but also had practical strategies and exercises that teachers could immediately implement into their practice.

A key finding of the study is that teachers feel more comfortable using culturally relevant contexts than social justice contexts in mathematics. Teachers revealed not feeling comfortable infusing social justice contexts in mathematics for various reasons. Some of the reasons provided were lack of student maturity, parental conflicts, and state laws banning controversial topics. These results build on existing evidence that while teachers agree to use real-world contexts to teach mathematics and recognize the importance of providing contexts in which students can relate, they are not comfortable

using controversial issues (Simic-Muller et al., 2015).

Implications of Findings

Findings associated with this mixed method study have important implications for practice. Specifically, it is essential that school leaders and administrators assess teacher knowledge of culturally relevant pedagogy and teaching math for social justice to develop a plan for professional development implementation. Mathematic teachers can benefit from opportunities to gain comprehensive insight into the value of leveraging culturally relevant and social justice contexts in mathematical word problems and benefit from guidance on implementation. Based on the data obtained from participants in this study, it is evident that school and district level leaders ought to establish professional development programs on culturally relevant teaching practices and teaching math for social justice at the elementary level. Developing an initiative to help teachers understand the tenets of culturally relevant pedagogy and teaching math for social justice, and supporting teachers in the process would empower them, and consequently, their students. Research studies have confirmed that school leaders can positively influence teachers' capacity to implement newly acquired knowledge from professional development (Goldsmith et al., 2014; Hilton et al., 2015; Kennedy, 2016).

Teachers might have the motivation and zeal to use a practice if district and school leaders support them (Hilton et al., 2015). In a study, Hilton et al. (2015) explored whether the engagement of school principals as active co-participants in teacher professional development could positively influence teachers. The study found that principals who engage in professional development alongside their building teachers better understand the support they need to provide teachers to sustain change. Moreover,

they discovered their role as facilitators of change for teachers. For example, Hilton et al. (2015) described how principals allowed teachers to implement different approaches in their classroom by being more flexible with the curriculum, which encouraged teachers to change their practice. On the contrary, without the support and involvement of school or district leadership, teachers can be left on their own to implement and sustain any changes in their teaching practices (Whitworth & Chiu, 2015). Research studies suggest that leaders are the missing element in creating impactful professional development for teachers (Whitworth & Chiu, 2015).

Additionally, findings associated with this mixed-method study have important theoretical implications. The current study used Critical Theory (CT) and Critical Race Theory (CRT) as frameworks for uncovering and understanding word problems as hegemonic features of the mathematics curriculum and changing them to achieve the goal of social justice.

Critical Theory "assumes it necessary to expose and overcome unjust social hierarchies derived from socioeconomic class, race, gender, sexuality… and other hegemonic factors in society and school" (Schubert, 2008, p. 404). In the present study, utilizing the lens of critical theory, mathematics educators examined and discovered the problematic contexts used in word problems. Teachers expressed their awareness of how certain perspectives, such as White, male, heterosexual, middle or upper class, and English-speaking, dominate the word problems in the textbooks and other curricular materials they currently use. These results support existing evidence of teachers utilizing a critical theory lens to examine the curriculum after receiving professional development (Bright, 2016a; Yeh & Otis, 2019). In their studies, Bright (2016a) and Yeh and Otis

(2019) discovered that teachers can identify word problems endorsing sexism, racism, linguicism, White privilege, consumerism, and Western-faith normativity.

Critical Race Theory is used to understand education inequities (Ladson-Billings & Tate, 1995). Ladson-Billings (1998) states that CRT "sees the official school curriculum as a culturally specific artifact designed to maintain a White supremacist master script" (p.18). The results of the present study fit with the theory that CRT provided teachers with a method to expose racism in mathematics word problems and a method to understand how they can disrupt subtle but racially unjust contexts found in mathematical word problems through culturally relevant and social justice contexts. This study revealed that teachers could look at curriculum through the lenses of CT and CRT and can learn to identify problematic word problems and transform them using culturally relevant and social justice contexts. Consistent with the findings of this study, Coles-Ritchie and Smith (2017) conducted a study using CRT as the theoretical framework because it allowed them to examine racist policies and assumptions that exist in school structures. Coles-Ritchie and Smith (2017) found that examining racist policies provided teachers with opportunities to expose racist practices present in schools. The researchers found that professional development encouraged conversations about race creating a starting point for race talks as a transformative process for educators. Teachers can benefit from professional development that uses both CT and CRT to uncover and understand word problems as hegemonic features of the mathematics curriculum and transform them to achieve the goal of social justice in mathematics education.

Limitations of the Study

Threats to both the internal validity and external validity of the study could have

potentially affected the study's findings. Internal validity is the extent to which the researcher is confident that other factors did not influence the cause-and-effect relationship being tested (Edmonds & Kennedy, 2017). A major threat to the internal validity of this study was attrition, or subjects dropping out and not finishing the professional development sessions (Edmonds & Kennedy, 2017). The researcher recruited more participants than the minimum required sample size needed to achieve statistical power to mitigate this threat. Having extra participants compensated for unexpected participants withdrawing from the study. This threat was also mitigated by giving participants a gift card as a reward upon completing the professional development sessions and posttests.

Another threat to the internal validity of this study was potential researcher bias or the experimenter effect. Whether consciously or unconsciously, the researcher's beliefs and behaviors can bias the study results in many ways (Edmonds & Kennedy, 2017). For example, the researcher can influence the study's findings by communicating the desired outcome (Edmonds & Kennedy, 2017). Additionally, the researcher can unintentionally give participants subtle cues (i.e., facial expressions, gestures) that may threaten the study's validity. The researcher established and followed interview protocols to help minimize differences in researcher-participant interactions to mitigate this threat.

Another threat to internal validity this study was susceptible to is history. According to Creswell and Guetterman (2019), this threat occurs when an event happens simultaneously as the treatment and can potentially change participants' behavior. Furthermore, the event rather than the treatment becomes a possible explanation for the changes in participants' behaviors. Current attacks on Critical Race Theory (CRT) and

new guides by state school boards in Iowa, Georgia, Utah, and Florida forbidding critical race theory discussions in classrooms (Calvan, 2021) was a major threat to the current study. Forbidding the use of critical theory in classrooms also means that elementary math teachers were not going to be able to infuse culturally relevant or social justice contexts in mathematics. Hence, making it hard to evaluate the in-service elementary math teachers' perceptions of infusing culturally relevant contexts in mathematics on student engagement.

The last type of threat to the internal validity of this study was self-selection bias. Creswell and Guetterman (2019) stated that self-selection bias occurs when participants choose to participate in the study. These participants may be more motivated to learn and improve their practice than participants who do not choose to participate in the training. In this study, teachers who currently have a diverse student population in their classrooms might feel compelled to participate in the study. To mitigate this threat, the researcher recruited participants from various school districts in different states of the United States. Additionally, because of this type of bias, self-selection bias, there was likely a ceiling effect in place. A ceiling effect occurs when the value of one variable is already high for all or most participants thus the researcher cannot ascertain that one variable affected the other (Schoonenboom & Burke-Johnson, 2021). In this study, most of the mathematics teachers who volunteered to participate had favorable views about culturally relevant pedagogy and teaching math for social justice thus their survey scores were high causing a ceiling effect. Someone with a low score would likely not have volunteered to participate in this study. A ceiling effect may have caused an inaccurate measure of the mean scores between pretests and posttest of the DCRPS and LTSJ-B surveys.

Additionally, a ceiling effect may have minimized the true impacts of the synchronous online professional development program.

Self-selection bias was also a threat to the external validity of the study. Threats to external validity must be considered in this study. Creswell and Guetterman (2019) stated that threats to external validity impact the generalizability of the results. The results of a study are generalizable when they can be applied to a larger population. It is unclear whether the researcher can generalize the results of this study beyond teachers that have similar characteristics to those in this study.

Another threat to the external validity in this study was the Hawthorne effect. The Hawthorne effect occurs when participants change or improve their behavior simply because they know they are being studied. In this study, participants may have influenced the data collected during the interviews by changing their behavior. These changes in behavior are usually in line with the expectations of the study. To mitigate this threat, the researcher took extreme precautions to maintain objectivity during the interviews.

Lastly, survey scope error was a threat to the reliability of the data and its findings in this study. Survey scope error happens when a survey or scale fails to include all the necessary items to fully answer the study's research questions or explain the topic's essential parts (Davies, 2020). In this study, the scales the researcher used to measure teachers' beliefs did not directly align with the objectives of the synchronous online professional development program. The main goals were to help teachers recognize problematic messages word problems can send to students and provide teachers with tools to reframe them using culturally relevant and social justice contexts. However, culturally relevant, and social justice topics were also covered. The DCRPS was

developed to measure "teacher's beliefs and attitudes underlying culturally responsive teaching practices" (Whitaker & Valtierra, 2018, p. 1) and the LTSJ-BS, measured teacher's beliefs regarding teaching for social justice and socially just practices in their classroom (Ludlow et al., 2008). In future research, ways to mitigate this threat include conducting a qualitative study with one-on-one interviews before and after the treatment. Additionally, future research could involve the development of a survey tool that measures changes in beliefs about using culturally relevant and social justice contexts in mathematics.

Recommendations for Future Research

This sequential explanatory mixed-method study examined in-service elementary mathematics teachers, tutors, and coaches' beliefs of infusing culturally relevant and social justice contexts in mathematic word problems after participating in a synchronous online professional development program developed by the researcher. The findings from this study suggest that, in the context of an online synchronous professional development program, in-service teachers' beliefs about culturally relevant teaching and teaching for social justice in mathematics have the potential to change positively. Given these findings and understanding that learning to teach for social justice is an ongoing process, a longitudinal mixed method study is suggested to provide a better understanding of changes in teacher' beliefs over time.

This study examined teachers' perceptions by collecting data through surveys and interviews. Creswell and Guetterman (2019) recommend utilizing multiple sources of data collection to enhance the validity of the study through triangulation. While the researcher in this study collected qualitative data in the form of one-on-one teacher

interviews, additional qualitative data from other sources, (lesson plans, assessments, reframed word problems) would be ideal. Therefore, it is recommended that this study be replicated with the inclusion of teacher artifacts as a data source to analyze changes in teaching practices. Furthermore, the inclusion of classroom observations would not only provide data on the impact on teacher's actual practice but also provide valuable data on the impact of using culturally relevant and social justice contexts in mathematics word problems on student engagement and motivation. These changes would help gain a better understanding on the direct effects of synchronous online professional development program on teachers' beliefs, knowledge, and teaching practices as well as on student motivation and engagement.

Another suggestion for further research is replicating this study with mathematics elementary teachers from the same school district. Teachers within the same district or school would have greater opportunities to work as a professional learning community (PLC) to transform existing word problems found in their shared curriculum. Professional learning communities grant teachers with opportunities to directly impact teaching practices and student learning (Owen, 2015). Additionally, as stated by Cochran-Smith (2004), teaching for social justice is a continuous process that involves facing problems and through inquiry finding solutions to these problems. Therefore, a professional learning community would be beneficial for teachers to continue to support each other and expand their knowledge about culturally relevant, social justice, and mathematics education.

Finally, another suggestion for further research would be replicating this study with mathematics teachers whose views do not necessarily align with the goals of

culturally relevant contexts and teaching for social justice in mathematics education. Participants with the traditional belief that mathematics education is neutral would provide valuable insight on the effectiveness of synchronous online professional development on infusing culturally relevant and social justice contexts in mathematics. It would be interesting to see if participants beliefs and instructional practices change as a result of the professional development program.

Conclusion

As currently developed and written, mathematical word problems lack cultural relevance for an increasingly culturally diverse population in elementary schools in the United States. The design and context of mathematical word problems promote the norms, values, and beliefs of the dominant culture while potentially negatively influencing students from non-dominant culture engagement and achievement in mathematics. This explanatory sequential mixed methods study investigated in-service teacher's beliefs before and after participating in a synchronous online professional development program focused on transforming mathematical word problems to reflect culturally relevant and social justice contexts.

Analysis revealed that although teachers did not score significantly higher on the DCRPS, or LTSJ-BS posttest compared to the pretest, they felt that reframing word problems using culturally relevant and social justice topics would increase student engagement in the mathematics classroom. They expressed that utilizing these contexts would create word problems that are more relevant and relatable to students. Moreover, the synchronous online professional development program increased participants' awareness of the messages word problems could potentially send to students. They also

reported that the synchronous online professional development was instrumental in their understanding and ability to reframe mathematical word problems in the future.

One of the study's key findings is that teachers feel more comfortable using culturally relevant contexts than social justice contexts in mathematics. Teachers pointed at the lack of student maturity, parental conflicts, and state laws banning controversial topics as some of the reasons for not feeling comfortable using social justice contexts in their classroom. This study provides insight into how synchronous online professional development programs of practical application can influence teachers' beliefs about recognizing math word problem's hidden messages that perpetuate the status quo. It can also provide insight into how teachers can change the narrative by reframing them using culturally relevant and social justice contexts. The findings may inform future professional development programs in mathematics education to teach mathematics for social justice.

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Appendix A

Dispositions for Culturally Responsive Pedagogy Scale

Appendix A: Dispositions for Culturally Responsive Pedagogy Scale

The Dispositions for Culturally Responsive Pedagogy Scale

Respond to the following statements regarding your beliefs about culturally responsive pedagogy. Response categories: Strongly Disagree=1, Disagree=2, Uncertain=3, Agree=4, Strongly Agree=5

	Scale				
	1	2	3	4	5
F1. Praxis					
1. I value assessing my own teaching practices.					
2. I am aware of my cultural background.					
3. I am willing to take advantage of professional development opportunities focused on issues of diversity.					
4. I am open to feedback about my teaching practices.					
5. I am willing to examine my own identities.					
6. I am willing to be vulnerable.					
F2. Community					
1. I value developing personal relationships with students.					
2. I value collaborating with families.					
3. I value collaborating with colleagues.					
4. I value collaborative learning.					
5. I value student input into classroom rules.					
6. I value dialog as a way to learn about students' out of school lives.					
7. I value student differences.					
8. I view myself as a member of the learning community along with students.					
9. I am comfortable with conflict as an inevitable part of the teaching and learning processes.					
F3. Social Justice					
1. I believe it is important to acknowledge how issues of power are enacted through schools.					
2. I believe that schools can reproduce social inequities.					
3. I believe that hot topic conversations (e.g., race, gender, sexuality, religion, etc.) should be had in class when necessary and/or relevant.					
4. I value equity (giving each student what they individually need) over equality (giving each student the same thing).					

Appendix B

Learning to Teach for Social Justice - Beliefs Scale

Appendix B: Learning to Teach for Social Justice – Beliefs Scale

Learning to Teach for Social Justice – Beliefs Scale	
Respond to the following statements regarding your beliefs about social justice. [ab]	
1	An important part of being a teacher is examining my attitudes and beliefs about race, class, gender, disabilities, and sexual orientation.
2	Issues related to racism and inequities are openly discussed in my classroom.
3R	For the most part, covering multicultural topics is not relevant to the subjects I teach.
4	Good teaching incorporates diverse cultures and experiences into classroom lessons and discussions.
5R	The most important goal in working with immigrant children and English language learners is that they assimilate into American society.
6R	It's reasonable for teachers to have lower classroom expectations for students who don't speak English as their first language.
7	Part of the responsibilities of the teacher is to challenge school arrangements that maintain societal inequities.
8	Teachers should teach students to think critically about government positions and actions.
9R	Economically disadvantages students have more to gain in schools because they bring less into the classroom.
10R	Although teachers have to appreciate diversity, it's NOT their job to change society. 11R Whether students succeed in school depends primarily on how hard they work. 12R Realistically, the job of a teacher to prepare students for the lives they are likely to lead.

[a] Likert response categories: Strongly Disagree=1, Disagree=2, Uncertain=3, Agree=4, Strongly Agree=5

[b] R: denotes the items that were reverse scored.

Appendix C

Interview Questions

Appendix C: Interview Questions

Demographic / Background and Context

1. How many years have you been teaching?

2. Tell me how you became a teacher?
    a. Alternative Certification vs. Traditional Way
    b. What subject areas/grade levels are your certified to teach?
    c. What is your highest level of education?

3. What state do you teach in?

4. What grade level are you currently teaching?

5. What content area do you teach?

6. Please describe and explain the school in which you currently teach.
    a. Is your school located in an urban, suburban, or rural area?
    b. Is your school a public or private school?

7. How many students are in your classroom?

8. Describe the population of your school/classroom
    a. What do you know about the SES/Title 1/Free Reduced Lunch/ELL or ESOL population in your school?
    b. How many ethnic/cultural minority students do you have in your classroom?

What are in-service elementary math teachers' perceptions of infusing culturally relevant and social justice contexts in mathematical word problems on student engagement?

1. How do you define student engagement in the mathematics classroom?
    a. Please give an example from your practice.

2. What are some strategies you utilize in your mathematics classroom to engage students?
    a. How did teaching about social justice or culturally relevant pedagogies relate to student engagement?

3. How do your choices of instructional strategies impact student engagement level?
    a. Who or what is responsible for keeping students engaged in mathematics?
    b. When a student is off task, how do you address the students' behavior? How do you address your instructional planning?

4. In what ways, if any, do you see using social justice or culturally relevant contexts in mathematics as a way to improve student engagement?

What are in-service elementary math teachers' perceptions of how their beliefs changed as a result of the synchronous online professional development program?

13. As a result of the synchronous online professional development program and subsequent experiences, what is the greatest change you have seen in your beliefs about using culturally relevant and social justice contexts in mathematics? Please explain.
    a. What are the major factors that influenced the change?

*Skip to Question 17 if participant indicates no change in beliefs.

5. In what ways, if any have you used social justice or culturally relevant practices in your math lessons/instruction?
    a. Describe and explain any significant artifact(s) you chose to share with me.

6. What motivated you to implement social justice or culturally relevant practices in your math lessons/instruction?
    a. How did you introduce social justice or culturally relevant contexts at the beginning of implementation?
    b. From your experience, what are the advantages of using social justice or culturally relevant practices in the math classroom?
    c. From your experience, what are the disadvantages of using social justice or culturally relevant practices in the math classroom?

7. In what ways do you feel using social justice or culturally relevant contexts in mathematics add or detract from your instructional time?

8. In what ways, if any, do you see using social justice or culturally relevant contexts in mathematics as a way to improve student achievement?

9. Tell me about, if any, obstacles or limitations that you might face when using social justice or culturally relevant contexts in mathematics.

10. In what ways is mathematics education a gatekeeper of future opportunities?

11. As a mathematics teacher, what are ways in which you can help change society?
    a. What is your role in helping change society?

12. As a result of the synchronous online professional development program and subsequent experiences, what is the greatest change you have seen in your teaching? Please explain.
    a. What are the major factors that influenced the change?

13. What is the greatest change you have seen in the learning of students?

a. What are the major factors that influenced the change?

14. What social justice or cultural relevant topics, if any, do you avoid (stayed away from) using in mathematics contexts? Why?

15. What other experiences (professionally or personally) helped you addressed issues related to social justice pedagogy or culturally relevant pedagogy in teaching mathematics?

16. What if anything would you like to add about your experiences utilizing social justice or culturally relevant contexts in mathematics?

Continue with these questions if participant reports no change in beliefs:

17. In what ways is mathematics education a gatekeeper of future opportunities?

18. As a mathematics teacher, what are ways in which you can help change society?
    a. What is your role in helping change society?

19. What motivated you to implement (or not implement) social justice or culturally relevant practices in your math lessons/instruction?
    a. From your experience, what are the advantages of using social justice or culturally relevant practices in the math classroom?
    b. From your experience, what are the disadvantages of using social justice or culturally relevant practices in the math classroom?

20. In what ways do you feel using social justice or culturally relevant contexts in mathematics add or detract from your instructional time?

21. In what ways, if any, do you see using social justice or culturally relevant contexts in mathematics as a way to improve student achievement?

22. Tell me about, if any, obstacles or limitations that you might face when using social justice or culturally relevant contexts in mathematics.

23. As a result of the synchronous online professional development program and subsequent experiences, what is the greatest change you have seen in your teaching? Please explain.
    a. What are the major factors that influenced the change?

24. What social justice or cultural relevant topics, if any, do you avoid (stayed away from) using in mathematics contexts? Why?

25. What if anything would you like to add about your experiences utilizing social justice or culturally relevant contexts in mathematics?