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Understanding the Latinx Student Experience in a First-Year, Non-Remedial, Terminal College Math Course: A Convergent Mixed Methods Study

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Understanding the Latinx Student Experience in a First-Year, Non-Remedial,

Terminal College Math Course: A Convergent Mixed Methods Study

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Ross Morgan

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Title: Understanding the Latinx Student Experience in a First-Year, Non-Remedial, Terminal College Math Course: A Convergent Mixed Methods Study
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Abstract

Working with Latinx students, a semester long study was conducted in the Spring of 2021 to better understand student's perception of Culturally Responsive Teaching Practices (CRTP) at Mountain State University (MSU). The course sections selected are a part of a larger first year, non-remedial, terminal mathematics courses designed to provide students with smaller teacher to student ratios as well as opportunities to earn credit towards graduation. Instructors in two of the sections received special training around CRTP, while instructors in the other two sections did not receive this training. Findings demonstrate that simple adjustments to instructional practices had a statistically significant effect on student's perceptions of mathematics in two domains of CRTP. These adjustments include providing students an opportunity to apply the math they learn to their chosen pathways through article reviews and mathematical application to relevant problems. Additionally, sharing a diverse representation of current mathematicians in practice as well as sharing their trials and tribulations provides students a more realistic view of who can do mathematics.

There are also opportunities for larger, systemic changes. Most notably, this includes restructuring these specialized sections to focus on students' understanding and application of the content, versus a lecture style instructional approach currently utilized.

ii

To achieve this change, the university must focus on three changes: (a) build a pipeline between the undergraduate and graduate programs to train and hire more diverse mathematics instructors; (b) develop opportunities to train instructors in Culturally Responsive Teaching; and (c) enable greater autonomy for these four sections and the larger group of classes that share the same course title. While MSU has tentatively rolled out some opportunities to better support students, there continue to be opportunities to expand the utilization of CRTP within these terminal, non-remedial mathematics courses.

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Lastly, to the people in my life who have believed in me, even when I struggled to believe in myself: Tony Espinoza, Lee Kaplan, Gregg Osterhout, Jessica Mauracher, Brian Childress, Erin Anderson, and Lolita Tabron. Each of you touched me at a critical point in my life and encouraged me to keep going. Whenever I face challenges, I continue to reflect on our conversations and those conversations always help me move forward. Thank you.

Table of Contents

List of Figures

List of Tables

Chapter One: Introduction

Systemic inequities continue to permeate many aspects of American life, none more sinister than education (Bell, 1992). Despite an increasing awareness around the need to diversify practices, institutions of higher education continue to minimize the experience and knowledge of Black, Indigenous and People of Color (BIPOC) and prioritize Eurocentric practices that benefit White students (Ayala & Ramirez, 2019). Deculturalization—the practice of minimizing a student's culture—persists in instructional practices that continue to privilege White students, while marginalizing students of color (Ayala & Ramirez, 2019; Hammond, 2015). Some institutions have found success with implementation of diversity workshops (Bowman et al., 2016). However, diversity workshops are often viewed as a panacea to larger challenges of systemic racism and cultural acceptance; as a result, while institutions attempt to cultivate awareness of cultural diversity and its value in higher education, Latinx students continue to experience the cognitive dissonance that results from inadequate action from university faculty and staff to embed practices that recognize and value Latinx students' culture and diversity. In one respect, Latinx students receive messages that their presence and unique perspectives are critical in higher education; yet, without addressing the underlying conditions (e.g., lack of faculty racial diversity, racial/ethnic stereotyping in various

1

fields, and low-retention rates), it is no wonder that Latinx students feel unwelcome in higher education (McGee, 2016).

To address the opportunity gap in high schools, researchers have focused on a variety of different ways to support educators in adjusting their instructional practice to better support more diverse student populations, including Latinx students (Gay, 2018; Maltese et al., 2012; Pappamihiel & Moreno, 2011). Culturally responsive pedagogy has pushed educators to examine their teaching and consider why they chose those practices. Furthermore, introduction of equity-based math practices, culturally responsive teaching, early college programs, and first-generation programs are examples of responses to the opportunity gap (Aguirre et al., 2013; Edmunds et al., 2020; Gay, 2018; Huerta et al., 2013). As a result of this work, Latinx students' high school graduation rates have been steadily increasing (National Center for Education Statistics, 2020) due to intentional changes to education. Beginning with President Regan's *A Nation at Risk* through President Obama's Every Student Succeeds Act (ESSA), assuring student subgroups, like Latinx students, are graduating prepared for post-secondary opportunities has been a major driver of policy and research (Malin et al., 2017; National Center for Education Statistics, 2020).

High school graduation rates also suggest positive outcomes of this work. For example, between 1980 and 2018, high school graduation rates for Latinx students increased nearly 30% (National Center for Educational Statistics, 2019). However, during this same time, post-secondary degree attainment for Latinx students only increased 12%

(National Center for Educational Statistics, 2019). White students, on the other hand, increased high school graduation rates by 23% and 20% for post-secondary degree attainment (National Center for Educational Statistics, 2019). Put another way: while our focus on closing the opportunity gap for Latinx students yielded improvement as measured by high school graduation, efforts have not translated to post-secondary degree attainment. In fact, the opportunity gap has continued to grow.

Background

The Latinx community is the fastest growing demographic in the United States (Galdeano et al., 2012; National Center for Education Statistics, 2020). Latinx students and families bring a strong desire to learn and grow in educational spaces (Cruz et al., 2019). Despite this desire, Figure 1.1 (next page), disparities remain between Latinx and White students, but the opportunity gap, as measured by high school graduation rates, is closing. Latinx students have a strong desire to develop their academic knowledge, but why does degree attainment continue to lag behind their White peers? Several researchers argue that it might be because the way we teach content in PreK-12 continues to come from a euro-centric model, as opposed to adapting to the needs of our diversifying classroom populations (Gay, 2018; Ladson-Billings, 1995).

Figure 1.1 *High School Degree Attainment for Latinx and White Students*
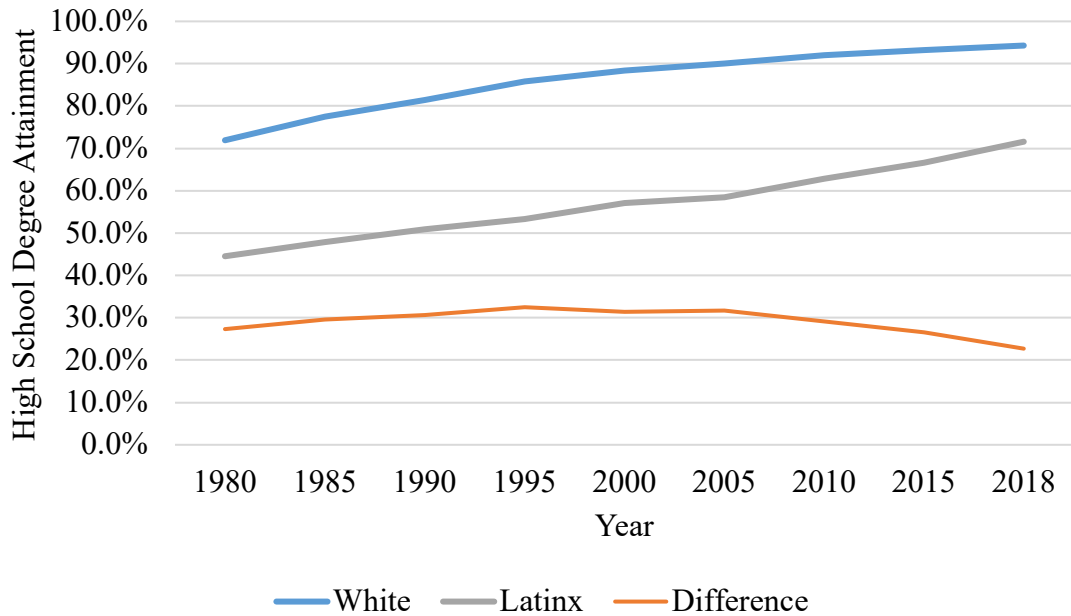
Source*: National Center for Education Statistics (NCES)*, *U.S.* Department of Education, 2019

From Figure 1.1, we can see that from the early 1980's through 1995 the gap between White students' high school degree attainment and Latinx degree attainment was growing. However, starting in 1995, this gap began to decrease, and we start to see that while the percentage of White students who earn a high school diploma are still increasing, Latinx students are also increasing; however, the rate of degree attainment has accelerated and the difference between degree attainment for these two groups is decreasing.

However, as is evidenced by Figure 1.2 later, there continues to be a persistence between Latinx degree attainment in post-secondary institutions and their White peers. While the focus on my study is around practices within post-secondary courses, there is

an opportunity to begin this work earlier in the PreK-12 setting and begin to rectify some of the systemic practices that continue to harm Latinx students, specifically around euro-centric modes of teaching (Gay, 2018; Ginsberg & Wlodkowski, 2009, p. 129). Teacher preparation programs can begin teaching equity-based practices centering the content around the students: bringing in their identities, working with students to craft authentic experiences where their passions drive the mathematical examples and instruction (Aguirre et. al, 2013; Ginsberg & Wlodkowski, 2009).

Why Has the Opportunity Gap begun to Close in Secondary Schools?

The question then arises: what occurred in public education prior to 1995, when educators began to explore how instructional practices were influencing the opportunity gap? What changes to instructional practices provided better instruction and resources to Latinx students? Prior to the 1980s, public sentiment largely reflected the idea that "schools don't make a difference" (Ravitch, 1990, p. 2). While it is impossible to tie one research strand or movement to national student outcomes, it is possible to locate ways cultural awareness increased desire to address institutional inequities at the PreK–12 level and thus contributed to improvement of Latinx graduation rates (Baumgartner et al., 2015; Gay, 2018).

An early and important moment highlighting the negative conditions facing Latinx public school students arose in southern California in 1968. During what came to be called the East Los Angeles walkouts, or Chicano "Blowouts," Mexican American students staged and organized a series of walkouts to protest the poor conditions at their

schools (Sahagun, 2018). While their actions were censored by media and their demands ignored by the L.A Board of Education, the walkouts led to a more unified voice and platform in the L.A. Chicano community with important national and political ramifications (Goodman et al., 2006).

In a shift from earlier decades, Gallup released survey results in 1982 indicating that the public now saw education as a critical piece of our country's continuing success (Gallup, 1982). While the demographic breakdown was limited to "White versus non-White," the survey revealed ways traditionally marginalized groups were advocating for educational rights. This non-white group is now referred to as Black, Indigenous, and People of Color (BIPOC), which is the term I will use. Black, Indigenous, and People of Color (BIPOC) families were evenly split on questions of whether to extend the school day or year, while only a third of White families thought more schooling was necessary (Gallop, 1982). Both BIPOC families and White families placed equal value in school's contribution to a student's future success, which point BIPOC communities' (including Latinx communities) continued valuation of public education and the underlying current toward educational reform in the 80s.

In 1990, Greenberg (1990) and others began exploring how educators could more authentically incorporate student's inherent gifts, knowledge, and experiences into the classroom experience—otherwise known as student "Funds of Knowledge" (Velez-Ibanez & Greenberg, 1992; Moll et al., 1992). For example, qualitative research was conducted with Latinx communities in the Tuscan, Arizona area to better integrate home

and classroom experiences (Velez-Ibanez & Greenberg, 1992). The goal was for teachers to leverage home life skills and traditions inside the classroom to create a more authentic learning environment for their Latinx students. While it is impossible to conclude that these specific actions led to reducing the opportunity gap for our Latinx students, the theme of embracing students cultures and including their cultures within the classroom emerges, as students, researchers, and educators at the PreK–12 levels begin to interrogate underlying assumptions and better incorporate culturally responsive teaching practices in public education.

Challenges at the Post-Secondary Level

Despite a growing awareness of the value of culture within the classroom, a growing disparity remains between Latinx students and White peers in post-secondary degree attainment, as shown in Figure 1.2 (Kiyama, 2010; National Center for Education Statistics, 2020). Higher education continues to lag in addressing underlying systems that perpetuate inequalities (Baldwin, 2015). While not overtly racist in their practices, institutions of higher learning have not meaningfully dealt with White privilege at the expense of other races and ethnicities. For example, culturally responsive pedagogies help instructors understand why and how White students are privileged. For example, Walkington et al. (2018) found that using second-person pronouns when decoding mathematical problems (e.g., first, *you* look at the numerator…) appears to benefit White students over Latinx students. While Walkington et al. was unclear as to why this situation may occur, they did hypothesize that it may have something to do with the

second person pronouns taking the students 'outside' of the mathematic scenario.

Additionally, while Latinx instructors tend to have a positive impact on Latinx students,

according to Alcantar and Hernandez (2020), college faculty demographics continue to

show that White faculty members hold 87% of all faculty positions and 90% of all tenure

track jobs (Flaherty, 2016). This lack of representation, coupled with implicit practices

that privilege White students, continues to harm Latinx students in very real ways.

Therefore, the growing disparity between White and Latinx students earning degrees is

not surprising.

As can be seen from Figure 1.2, the percentage of White and Latinx students

earning post-secondary degrees is increasing.

Figure 1.2 *Post-Secondary Degree Attainment for Latinx and White Students*
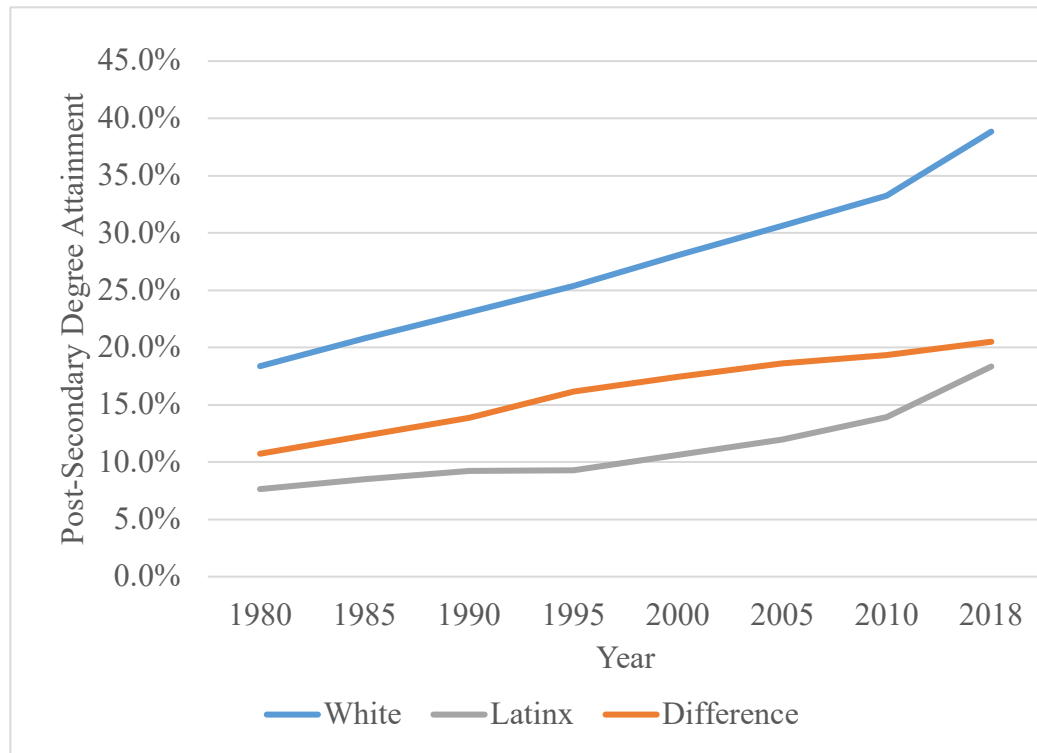
Source: National Center for Education Statistics (NCES), U.S. Department of Education, 2019

Regarding this data, there are some positives and negatives. Additionally, there is a clear acceleration of Latinx degree attainment in the past 10 years, as represented by the 'Difference' curve in Figure 1.2. As a result, the growth rate of the difference between Latinx and White student degree attainment is decreasing. Unfortunately, the greatest difference between Latinx high-school degree attainment and White high school degree attainment occurred in 1995. As of 2018, the peak difference has yet to occur for post-secondary degree attainment between Latinx and White students. Additionally, the current state of post-secondary degree attainment is worse than 1980 when the difference

9

between Latinx student's graduation and White student graduation was 10.7% (National Center for Educational Statistics, 2019).

To be clear, existing systems continue to perpetuate inequities in PreK–12 as evidenced by a continued difference between Latinx and White student degree attainment; however, research and practice has changed such that differences between graduation rates for Latinx and White students are decreasing (National Center for Education Statistics, 2020). There may be opportunities for educational instructional programs to integrate some of the findings within this paper into teacher preparation programs, to ensure we are providing PreK-12 students with more inclusive educational experiences. Meanwhile, while PreK–12 education has made important strides over the last 25 years, higher education has yet to make the same progress as public education. This is unacceptable.

Problem Statement

The workforce continues to push for higher levels of education, thus creating a need for nations to consider how they will compete in the world marketplace (Cantor et al., 2014). Yet, even as U.S. demographics show White individuals now represent less than 50% of the U.S. population (National Center for Education Statistics, 2020), diversity in colleges and universities have not kept up with these changes (National Science Foundation, 2017). Latinx students represent the fastest-growing group of students in the United States. Therefore, universities must examine how they are supporting Latinx student success. Unfortunately, despite the growing influence of Latinx

communities, their success in higher education continues to lag their White peers. As a result, the federal government has begun a concerted effort to better understand how institutions of higher learning can better meet the needs of Latinx students (National Science Foundation, 2017).

Due to systemic inequities, Latinx students often graduate high school with a lower level of mathematic completion than their White peers (Choi et al., 2017; Darolia et al., 2019; Joseph et al., 2017). Fortunately, research and pedagogical practices to address systemic inequities in PreK–12 education have begun to shift educator mindsets around how to better support a more diverse study body. For example, Olszewski-Kubilius and Thomson (2015) proposed a talent-development framework that educators can use to better support students. Much of this work has been informed by Gay (2018) and her focus on culturally responsive practices, and Ladson-Billings' (1995) culturally responsive pedagogy. Other researchers have identified specific strategies to leverage students' cultural and familial experiences to build a system that better honors Latinx student knowledge in PreK–12 and higher education (Kiyama, 2010; Rhodes, 2016).

In examining how to better prepare Latinx students for higher education, much work has focused on science, technology, engineering, and mathematics (STEM) pathways (Barber et al, 2020; Darolia et al., 2019; Joseph et al., 2017; Pashal & Taggart, 2019; Victorino et al., 2019). Although addressing challenges facing Latinx students in STEM pathways is important, colleges and universities provide a much broader set of

degrees beyond STEM. Yet, in non-STEM majors, where students must complete a collegiate-level mathematics course, research is scant (Baldwin, 2015).

Existing research has focused on non-academic strategies to address systemic inequities for Latinx students (Gavino, 2019; Pak, 2016; Pratt et al., 2019). These strategies are valuable and critical to improving Latinx student retention. For example, research found Latinx students perform better in classes, as measured by GPA, when their perception of campus climate is more positive (Victorino et al., 2019). Other researchers have found that a sense of family and community increased likelihood that Latinx students were able to navigate and complete a four-year program (Solis & Durán, 2020). Despite these findings, there is still a widening gap between Latinx students and White students, as shown in Figure 1.2. As of 2018, 20.5% fewer Latinx students graduate from post-secondary degree programs as compared to White students. Again, this is worse than 1980 when the difference between Latinx student's graduation and White student graduation was 10.7% (National Center for Educational Statistics, 2019). One solution to increasing Latinx student retention is through a closer examination of instructor classroom practice; however, there still is a large gap in research on how universities can better support Latinx students in the classroom context (Baldwin, 2015). To understand how to better support Latinx students in their first year, it is important to gain insights into practices that resonate best with the Latinx community. To be clear, this does not mean that this focus will necessarily resonate best with the students beyond the scope of this work; however, it does provide a starting point for a deeper conversation.

While GPA has historically been understood as strong predictor of student retention, further analysis revealed that GPA may be most important to White student retention (Boateng et al., 2016; Hafer et al., 2018; Iacobucci, 2008). Interestingly, though, GPA was not found to be the primary reason why Latinx students would stay with a specific program. Instead, Latinx students were more likely to stay engaged in a four-year collegiate program if they found success in English and mathematics (Barbera et al., 2017; Callahan & Belcheir, 2017). For this reason, the present research will explore practices within required mathematics courses designed for non-STEM majors.

Purpose Statement and Research Questions

The purpose of the present study is to understand the Latinx student experience in a 100-Level, terminal college math class. The selected math courses were credit bearing, counted towards a student's fulfilment mathematic requirements for graduation, and were non-calculus based. I used a convergent mixed-methods design to explore the frameworks of culturally responsive pedagogy (CRP) and culturally responsive teaching practices (CRTP) provide frameworks for the study (Gay, 2018; Ginsberg & Wlodkowski, 2009; Ladson-Billings, 1995). CRP incorporates a conception of self and others, social relations, and conception of knowledge to aid educators in their support of students. Within the CRTP framework, the instructor uses four domains to engage students: *establishing inclusion*, *developing attitude, enhancing meaning*, and *engendering competence*.

Prior to the start of the semester, graduate instructors of M117/118 (the "Treatment") received one hour of professional development about how to incorporate CRTP into lesson design. But, due to contract limitations, adjunct instructors of M101 (the "Control") did not receive the same training (J. Hagman & R. Morgan, personal communication, October 30, 2020). To address these differences in instructor training, I utilized Independent Samples t-test to ascertain whether there is a statistically significant difference in student perceptions of instructors' CRTP.

Students who registered for these sections were expected to attend the classes in person or watch remotely. This modification was a university decision made considering the COVID-19 pandemic that was impacting the United States at the time (J. Hagman & R. Morgan, personal communication, October 30, 2020). For most students within the M101 or M117/118 sections (not the sections represented within this study), classes were held asynchronously without dedicated faculty.

The study includes both quantitative and qualitative data gathered concurrently to match student data with voice and experience. Quantitative data explores how students perceive instructor engagement with CRTP at a four-year institution of higher education in a terminal, first year, non-remedial mathematics course. Qualitative data explores Latinx students' experiences in math and their ability to internalize content when CRTPs are utilized. I combined the qualitative and quantitative data to better understand the relationship between CRTP and Latinx student retention by addressing the following research questions:

1. How are student perceptions of mathematics affected when culturally responsive teaching practices are utilized in a first-year, non-remedial terminal mathematics course?

2. What are Latinx student perceptions of their instructor's use of culturally responsive teaching practices to establish inclusion, develop student attitude, enhance meaning, and engender competence in a first-year, non-remedial math class?

3. What do Latinx student perceptions of the four CRTP domains reveal about the relationship between these domains and student success in the class?

Research Methods

One issue facing current research around Latinx student success within the post-secondary field is the disconnect between quantitative data and the lived student experience. As a result, there is an opportunity to use a convergent mixed-method design to better understand the Latinx student experience and which classroom variables are most influential in supporting their success (Creswell & Plano Clark, 2018).

For Research Question 1 (RQ1), an Independent Samples t-test was utilized to determine if there was a statistically significant difference between student perceptions of instructors teaching practices who were received PD on CRTP and instructors who did not. Data was collected via student survey instruments (Fowler, 2014; Rhodes, 2016). To gather this quantifiable data, student survey instruments were administered in April, 2021 in four classes: two classes were identified as Control, where there has been no additional

15

training around CRTP, and two classes were identified as the Treatment, where instructors received professional development around culturally responsive teaching practices. The survey included both demographic data, as well as data around specific teaching practices. It can be found in Appendix C (Fowler, 2014; Ginsberg & Wlodkowski, 2009; Rhodes, 2016). An Independent Sample t-test was run on the student's overall perception of instructor utilization of CRTP, as well as student perception of instructor utilization of the four domains of CRTP: *establishing inclusion, developing attitude, enhancing meaning* and *engendering competence* (Ginsberg & Wlodkowski, 2009). Through Rhodes' (2016) *Culturally Responsive Teaching Survey*, Latinx students had the opportunity to reflect on which specific practices were deployed in their classes and which domains their teachers leveraged to support student success. Finally, to understand the impact of the CRT, descriptive analyses were conducted with both Control and Treatment groups. The t-test determined whether there was statistical significance among findings.

To answer Research Question 2 (RQ2), Latinx students from two classes were asked to participate in two interviews to understand their experience in their first-year math classes. The first interview was conducted as a panel interview, with students discussing their experience as a group early in the semester. The second round of interviews were conducted individually in April 2021. I coded interviews deductively in alignment with CRTP domains. Immediately following the initial deductive coding, I completed a second round of open coding looking for emergent themes. This provided an

opportunity to align the work to the CRPT framework and ensure that any emergent themes were not overlooked (Bradley et al., 2007).

To validate the conclusions of RQ2, three data verification tools were used: peer-debriefing, member-checking, and data-triangulation (Creswell & Poth, 2018). I also shared my initial conclusions with Dr. Anderson. Dr. Anderson who helped determine whether I was over/under critical of certain conclusions, lacking specificity around my conclusions, or misguided in my conclusions. Peer debriefing feedback from these sessions allowed me to refine conclusions within analysis section of the paper.

I used member checking within a month of each interview to ensure accuracy of participants responses and to determine whether my analysis was reflective of participant intent. Participants had an opportunity to refine or adjust any interpretations of our original conversation where I may misunderstand or misrepresented their sentiments. This was done by providing participants copies of the findings prior to publishing. Finally, I used data-triangulation to ensure participant responses were representative of trends and not my preconceptions. Triangulation was conducted via multiple interviews, comparisons with quantitative survey data, and a literature review.

Finally, for Research Question 3 (RQ3), the quantitative data and the qualitative were integrated to identify areas of convergence and divergence between the data sets (Creswell & Plano Clark, 2018). Since the estimated sample size is expected to be small, and since Latinx student perception of CRTP hasn't been well studied, the ability to parse the data into subgroups within the Latinx community was challenging. As a result,

17

quantitative data was examined through descriptive statistics and an Independent Samples t-test. Descriptive statistics were run on all student populations within the class. However, analytical statistics focused on full class Treatment versus Control to understand how CRTP may support student success in a first year, non-remedial terminal mathematics course due to small sample size. To gain a deeper understanding of student experience, the qualitative portion of this project examined impacts on specific groups of students, intentionally chosen based on gender, English language proficiency, extra-curricular engagement, and scholarships or grant awards. While selection criteria for the qualitative portion of the present research is discussed in Chapter 3, it is important to understand that a mixed-methods model allows for a deeper understanding of how CRTP influenced subgroups of Latinx students within a first year, non-remedial, terminal math course.

Theoretical Frameworks

In using a convergent mixed methods design to identify and advocate for increasing Latinx student success at the post-secondary level, two theoretical lenses will be applied. The first lens, Culturally Relevant Pedagogy (CRP), was selected to advocate for a change in the learning environment (Ladson-Billings, 1995).

To summarize the discussion above around the relationship between the CRP and CRTP frameworks, Figure 1.3 provides a visual for how Ginsberg and Wlodkowski's (2009) work integrates within Ladson-Billings (1995) seminal work. Figure 1.3 visualizes

the CRP pillars as the circular vertices of the triangle and the CRTP domains in the rectangles. The CRTP domains are informed by the CRP pillars.

Figure 1.3 *Integration of Culturally Relevant Pedagogy with Culturally Responsive Teaching in College*
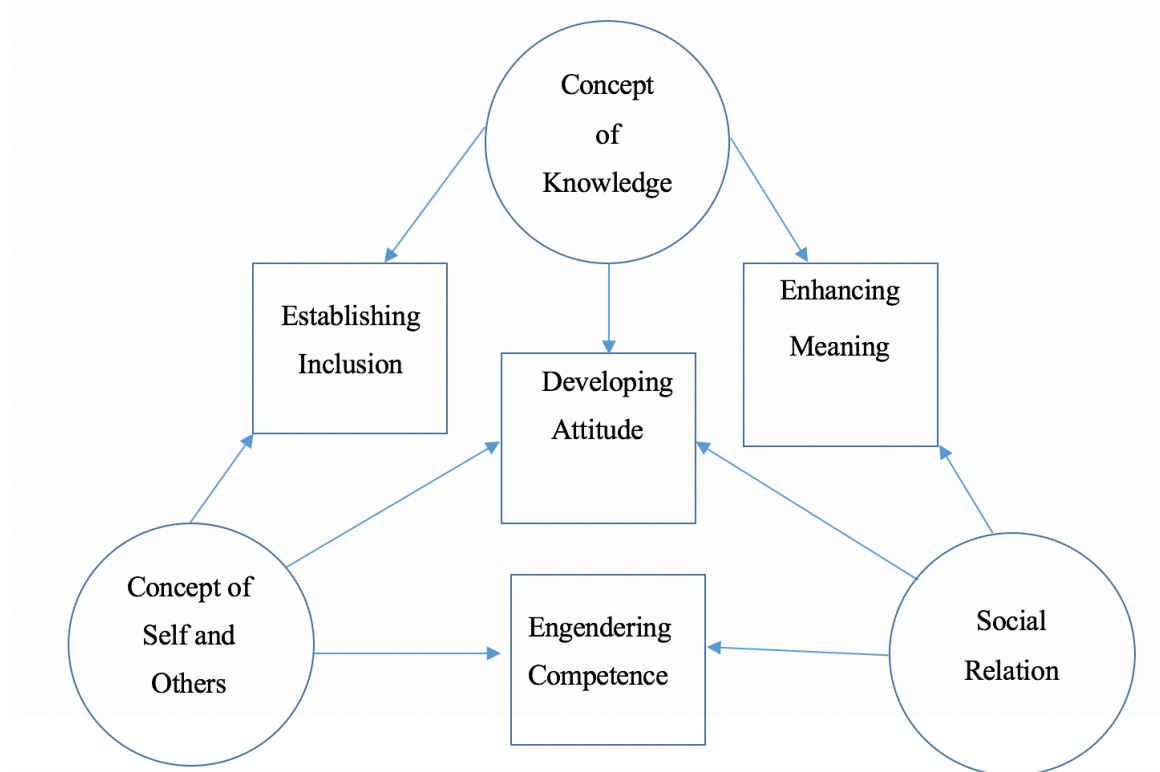
Ladson-Billings' (1995) work forms the three circles, the vertices of the diagram: concept of knowledge, concept of self and others, and social relations; while Ginsberg and Wlodkowski's framework (2009)—heavily influenced by Ladson-Billings work—are informed by the three vertices and are thus positioned in the squares in Figure 1.3: *establishing inclusion, enhancing meaning, engendering competence* and *developing attitude* (Ginsberg & Wlodkowski, 2009; Ladson-Billings, 1995).

19

Culturally Relevant Pedagogy

In 1995, Ladson-Billings identified a specific branch within Critical Race Theory, that she termed Culturally Relevant Pedagogy (CRP). In this theory, Ladson-Billings (1995) identifies three core values: conception of self and others, social relations, and conception of knowledge.

Conception of Self and Others. Ladson-Billings (1995) argues the stance that to be culturally relevant, educators must remove deficit-based thinking from their practice. This means identifying student strengths and leveraging them to engage and support our students. This requires educators to be adaptive and responsive to student needs. Understanding and responding to student needs implies that educators have an awareness of privilege and socio-political consciousness to deeply understand and support Latinx student achievement in the classroom (Hammond, 2015).

Social Relations. The second pillar, social relations, is the educator's ability to form communities of learners. Social relations stipulates that the instructor "develops a community of learners' and demonstrates a 'connectedness with all students… where they are encouraged to learn collaboratively and be responsible for another" (Ladson-Billings, 1995, p. 481. Within this pillar, it is important for instructors to build authentic relationships with trust and respect (Gay, 2018). In practice, this looks like students actively collaborating and responsible for each other and for the direction of their learning (Ladson-Billings, 1995).

Conception of Knowledge. Both co-creation of knowledge and

demonstration of knowledge must be evaluated critically to understand who may benefit

from certain methods of demonstration. Demonstrations include common assessments

such as exams, presentations, and essays; however, in a culturally responsive classroom,

these demonstrations could extend to meet the student's strengths such as demonstrating

learnings through the creation of a song, painting, poem, etc. Further, helping students

learn how to challenge intellectual assumptions, such as the teacher holds all of the

knowledge, helps students shift the narrative from being the recipients of knowledge to

being the creators of knowledge (Ladson-Billings, 1995, p. 482)

Culturally Responsive Teaching Practices in College

Within the CRP framework, there are multiple frameworks with which to choose

from to better understand our student's experiences. One such framework focuses on the

instructor's ability to address student diversity and motivation through four classroom

pillars: *establishing inclusion, developing attitude, enhancing meaning and engendering*

competence (Ginsberg & Wlodkowski, 2009). By focusing on this framework, it is

possible to examine the effects of classroom practices where these pillars are present, and

their potential impact on Latinx student perception of success in a 100-level mathematics

course.

Establishing Inclusion. The first domain for establishing culturally

responsive teaching in college, as identified by Ginsberg and Wlodkowski, (2009) is to

ensure that students see the human aspect of what they are learning. This implies that

21

students are not simply receiving information, but—in a truly constructivists paradigm—students and instructors are co-creating knowledge, which addresses the concept of knowledge within CRP.

A second aspect to *establishing inclusion*, as identified by Ginsberg and Wlodkowski (2009) is the student's ability to see relevance to their work. This speaks to a humanist approach to teaching, wherein students "personal experiences and contemporary situations" are incorporated in the work (Ginsberg & Wlodkowski, 2009, p. 77). In short, inclusion is more than just what one student perceives the work to be; rather, the student begins to understand the concept of self in relation to others within the class, which harkens back to CRP.

Developing Attitude. The second domain within Ginsberg and Wlodkowski's (2009) framework, is "*developing attitude.*" From Ginsberg and Wlodkowski, *developing attitude* means that as instructors we create an environment where students voice is central to creating relevant material, and their own volition and intrinsic motivation begins to take over (2009, p. 130). The challenge higher education faces is that traditionally U.S. education has maintained a Eurocentric approach with regards to how content is taught (Gay, 2018; Ginsberg & Wlodkowski, 2009, p. 129). This leads to inequities in opportunities to engage with deeper learning through elementary and secondary educational experiences, and sets the stage for a negative college experience. For instructors to help students develop attitude toward the content, the instructor must begin to reconstruct what knowledge looks like with their students.

22

Instead, higher education continues to rely on Eurocentric frameworks in which knowledge and education are informed by the needs of nation-state at the expense of the individual culture and background (Baker, 2012). In other words, the Eurocentric model has framed what is and what is not important in the educational experience. In a more individual context, this plays out as the student conforming to the institution, rather than the institution adapting to student needs. To combat this approach, it is necessary to examine how instructors can support marginalized students by engaging in truly personalized learning experiences that value the student culture and heritage, thus addressing the social relations component of CRP (Gay, 2019; Ladson-Billings,1995). Instructors must cultivate an environment where student relevance, volition, and intrinsic motivation are central to their pedagogy (Ginsberg & Wlodkowski, 2009). As a composite of all three CRP pillars, when instructors intentionally develop student academic attitude by engaging in positive relationships with the student, challenging the concept of what constitutes knowledge, and celebrating the concept of self and others, a student's volition begins to drive their ability to construct mathematical relevancy within their lived-experience, which impacts student learning and mathematical experience (Ginsberg & Wlodkowski, 2009; Ladson-Billings, 1995; Shin & Lee, 2017). By contrast, many instructors cultivate an environment where the marginalized group's knowledge, values, and experiences are devalued by the belief that mathematics is agnostic to culture or perception, positioning it as universal truth. Ultimately, the ability to find relevance to the student's interests reflects the relationship the instructor builds with students.

23

Enhancing Meaning. To better engage, challenge and support students, instructors must be willing to examine how they are co-constructing the learning experience with students. By co-constructing knowledge, as opposed to utilizing traditional instructional strategies like lecturing, instructors are able to better support student "involvement, participation, engrossment, and transcendence, as in involvement in an experiment, participation in a project, captivation in acting out roles and transcendence of an ideological model" (Ginsberg & Wlodkowski, 2009, p. 192). Further examples include limiting algorithmic approaches to problem solving and incorporating decision-making process to help students identify their own paths through content and creating authentic research opportunities to better capitalize on student interests (Ginsberg & Wlodkowski, 2009, pp. 218–220). These more engaging approaches to learning ensure that students are not passive but are active and engaging in higher levels of thinking such as evaluating, critiquing, and creating, thus engaging their concept of knowledge to drive instruction. Through this deeper analysis of content, students can address systemic power struggles that have marginalized Latinx communities, understand themselves as active participants (Giroux & McLaren, 1986). These actions begin to impact their own intrinsic motivation, thus leading to a greater meaning and better retention.

Engendering Competence. Ginsberg and Wlodkowski (2009) argue that the best way to engender competence is through authentic, varied formative and summative assessments, if assessments are well-written and avoid stereotypes and algorithmic

24

approaches to problem solving (2009, pp. 272–277). However, for instructors to engender student competence, they must know them—engaging the social relations component of CRP. With these positive relationships, instructors can support students begin to adjust their concept of their selves by providing opportunities to successfully demonstrate their knowledge.

Bringing the Two Frameworks Together

In merging CRP, as represented by the circles, with CRT in college, as represented by the rectangles, we see how multiple pillars of CRP have informed the four domains in Figure 1.3 (Ladson-Billings, 1995; Gay, 2018; Ginsberg & Wlodkowski, 2009). To develop this relationship, questions from Rhodes' (2016) survey instrument were used to find commonalities between CRP and CRTP in college. For example, Rhodes' (2016) question number 16 states "My instructor encourages students to use cross-cultural comparisons when analyzing material" (p. 221). Students who respond in the affirmative, indicate their instructor is *enhancing meaning* by providing students an opportunity to enhance meaning to broaden their understanding of who contains the knowledge and what knowledge may be (Concept of Knowledge) through positive interactions between peers (Social Relations).

Significance of Study

Current research around Latinx students and their post-secondary pursuits has focused on various Latinx student memberships within the institution or quantifiable metrics to understand which variables (high school GPA, sex, age, socio-economic status,

etc.) predict Latinx student retention (Darolia et al., 2019; Paschal & Taggart, 2019; Rincón, 2018; Solis & Durán, 2020). To address these challenges, research has focused on what universities can do outside of classroom and in narrowly defined STEM pathways to create a more welcoming environment (Pak, 2018; Paschal & Taggart, 2019). However, little work has been done to examine practices within the classroom that support Latinx student retention in a first-year mathematics course (Baldwin, 2015).

Additionally, while studies have focused on Latinx student perceptions or variables affecting Latinx student success, I was unable to find studies that blended both qualitative and quantitative methodologies. As a result, there is an opportunity to develop a deeper understanding of Latinx student success in first year, non-remedial terminal mathematics courses by blending both methodologies to address our ultimate problem:

> How do we better support Latinx student success within a first-year, non-remedial terminal mathematics course and ultimately close the degree attainment gap between Latinx and White students?

In identifying what practices resonate with Latinx students, I can argue for a culturally responsive first-year, non-remedial, terminal mathematics courses that meet the needs of an increasingly diverse population. Since the Latinx community is currently the fastest growing community, CRTP represents a strategic approach to shifting the perception of who is and is not college material (Galdeano et al., 2012).

Delimitations

The focus of this study is to examine the current work at one university in a western state, focusing on multiple sections of two undergraduate, introductory math classes for non-STEM majors. Additionally, while the theoretical framework is based on practices designed to support Black students, Latinx students, and other marginalized groups, the focus of the present research is students who self-identify as Latinx. The study aims to ensure that, as the Latinx population continues to grow, our institutions of higher education adapt to better meet Latinx student needs.

Limitations

This study provides a snapshot in time, which may not be representative of larger, more comprehensive studies. It looks at non-remedial introductory level math courses at one higher education institution. This may impact which types of students are selected to participate, and as such, may not provide an adequate representation of Latinx-student experience at four-year institutions in general.

The study is engaging one challenge facing universities as they work to increase Latinx student retention. At the research site, 64% of Latinx students stay engaged with college work and earn a Bachelor's degree within six years (National Center for Educational Statistics, 2019). However, the broader picture indicates that only 18% of the Latinx community possessed a four-year degree in 2018 (National Center for Educational Statistics, 2019). Indeed, colleges and universities have a lot of work to do around how

they recruit Latinx students in the first place. While this is a critical conversation, it is beyond the scope of this research.

Another limitation is potential sample size. The study site, Mountain State University (MSU), is facing real challenges posed by COVID-19 (K. McLaughlin, personal communication, June 5, 2020). As such, while the math department has intentionally developed two sections of their mathematics for social sciences and two sections of College Algebra in Context— in-person courses, capped at 30 students—there are fewer students enrolled this year due to impacts of COVID-19. Class sizes range from twelve to twenty students, and students have the option to view classes online. The sample size for the quantitative portion of this study is a minimum of 25. Sample size will be discussed more in chapter three. Ideally, a larger sample would provide greater nuance with regards to subgroups within the Latinx student body and within the math for social science sections; however, COVID-19 restrictions prevented the larger sections from meeting in person, and as such, limited the study to two, grant-funded sections with the express intent of providing additional support to students who wish to receive it.

Finally, due to COVID-19, there is a possibility that students were more sensitive to institutional changes, which may affect the data. While it may provide a unique view of the 20–21 school year, it may not be representative of the Latinx community in a more traditional year. Additionally, as the pandemic continued to affect the learning environment, these sections of math for social science and College Algebra in Context transitioned to a remote learning model after April. During this time, students engaged

with instructors asynchronously via the internet and some sort of conferencing tool, such as Zoom, Google Meet or other tools. While this effected how instructors used CRTP, instructors were still able to develop lessons capitalizing on the four domains of CRTP.

Assumptions

The study site chosen is a good proxy for other sites. As a public institution, the institution regularly admits 78% of applicants, with 29% enrolling full time, as compared to 71% admitted and 33% full-time attendance nationally (National Center for Educational Statistics, 2019). Of the 78% of students admitted, 11% identify as Latinx (6% identify as Latinx nationwide). As a result, the opportunity to work with Latinx students within this institution represents an opportunity to learn about their experience within a 100-Level terminal math course targeted towards non-STEM majors.

Positionality

As a White, cis-gendered, heterosexual male educator in a PreK–12 system, I began this journey operating with the belief that because I cared for my students of color, I was not racist and thus my actions were not racist. However, it was my *inaction* that was racist. I subjected my students of color to a pedagogy that rewarded rote memorization and lecture, rather than engaging them in authentic, relevant practice. As Fleming noted, "racism is not in your heart, but rather is in your head" (2018, p. 15). I have grown up in a world where I have engaged in, supported, and benefited from racist systems that continue to perpetuate inequitable practices, to maintain the status quo for White men. My lack of awareness around these systems of injustice does not excuse my

past behavior; however, I do hope I can improve outcomes for future students with this work.

In my cohort at the University of Denver (DU), there has been a running joke that I am the "quant guy." I value numbers, statistics, and measures, which I long-believed captured enough of our students lived experiences to inform education decisions. To me, "data-based instructional practice" meant finding quantitative data and using it to drive instruction. Qualitative data, on the other hand, felt "scratchy," or out of my comfort (Browning, 2021). As such, I have leaned heavily on quantitative approaches to justify my professional decisions and actions.

However, as I have learned during my time at DU, there is a time and place for qualitative data, which can be used to frame students' lived reality, especially within communities that continue to be marginalized—such as the Latinx community. In these cases, quantitative data can mask currents of systemic racist practices continuing to hurt Latinx communities and benefit White communities. Even when researchers disaggregate data based on race/ethnicity, the best outcome is a broad picture of a particular group, which risks the illusion that the group is monolithic in beliefs and perceptions. It is only through individual Latinx student experiences that add that to the larger narrative of the Latinx community, that we can begin to elevate the Latinx communities and make meaningful changes within our educational systems. I continue to believe in the power of the quantitative data to frame larger trends; however, I have come to appreciate the importance of qualitative data in offering context for those trends. As such, my choice of

30

a Convergent Mixed-Methods design to understand the reality facing Latinx students in a first year, non-remedial, terminal mathematics course is critical to ensure that changes are made intentionally, and with a deep and broad understanding of what our Latinx students value and want.

Along those lines, I situate myself between a pragmatic and critical world view. Pragmatic, because when we look at the discrepancies between various groups of student's successes in high school and post-secondary as measured by degree attainment, it is hard to ignore that there is something going on that must be affecting student success since various groups are not graduating at similar rates. For me, critical theory provides the lens with which I can view these discrepancies and begin to make sense out of the systems that are perpetuating these inequities. Together, pragmatism and critical theory provide a comprehensive paradigm with which to view this work (Egbert & Sanden, 2014).

The present research is a first step towards addressing inequities I have benefited from at the expense of other marginalized groups. Working with instructors and departmental leadership, I am committed to identifying practices that marginalize Latinx students, and collaborating on meaningful solutions toward inclusion, attitude, meaning, and competence. To do so, I intend to work *with* Latinx students to learn about instructional practices that resonate with their values and experiences, to address the systemic inequities that persist in higher education. By shifting the narrative away from "agnostic math" to a math of culture and lived experience, I hope to deliver a more

31

equitable experience for Latinx students. In addition, my long-term hope is that this work

contributes to an environment where Latinx students start to see themselves more

frequently as students, faculty, and leaders within institutions of higher education.

Summary

While progress has been made in closing the opportunity gap for Latinx students

in high school, much work remains in the post-secondary environment which can serve as

a learning opportunity for education programs and collegiate math instructors. As such,

this dissertation consists of five chapters, devoted to better understanding why Latinx

students continue to be marginalized in the PreK-20 system and how of Culturally

Responsive Teaching may impact Latinx student perception of a first-year, non-remedial

math class. In Chapter 2, I provide a thorough review of recent literature relevant to

Latinx student achievement in post-secondary institutions and culturally responsive

pedagogy. Chapter three reviews methods for data collection and analysis for the

qualitative and quantitation strands within these convergent mixed-methods social-justice

design (Creswell & Plano Clark, 2018). The data is presented and analyzed in chapter

four, while chapter five offers summaries, limitations, and recommendations. Products

from this paper will include a short Executive Summary for Mountain State University,

with recommendations for professional development opportunities with their instructors;

actions the University can take to continue to support this work; and policy

recommendations for MSU. The dissertation concludes with a bibliography and

appendices with relevant survey instruments and raw data.

Definition of Terms

Culturally Responsive Pedagogy (as a theory): "Responsive teaching that unleashes the higher learning potentials of ethnically diverse students by simultaneously cultivating students' academic and psychosocial abilities" (Gay, 2018).

Motivational Framework for Culturally Responsive Teaching (as a practice): Four domain goals: *Establishing Inclusion, Developing Attitude, Enhancing Meaning* and *Engendering competence*, that "reciprocally interact with and are part of learning to influence motivation and learning at any given moment" (Ginsberg & Wlodkowski, 2009, p. 36).

Equity: Racial equity can be examined in several different ways. Broadly speaking, racial equity for Latinx students in higher education includes the supports and resources necessary to ensure classroom success, retention, institutional receptivity, and student excellence (Perna et al., 2010). Equity also examines who is learning what and how (Esmonde, 2009). Therefore, in the context of this paper, equity is examining the make-up of introductory level college math courses, and the strategies instructors use to support Latinx student success and retention after the first year.

First Year, Non-Remedial, Terminal Mathematics Course: Collegiate level-math is more specialized than PreK–12. No longer are students moved through the same pathways as they are in PreK–12. As a result, defining a non-remedial,

non-STEM pathway is a challenging proposition. At the research site, work was done in advance to identify a specific courses which met the above description. Since the intent of this study was to examine non-STEM pathways, a math for social sciences course was chosen. This course satisfies the university's expectations for graduation, but does not qualify students to take more advanced, math-based courses such as economics, physical sciences, or statistics. Additionally, a second course titled College Algebra in Context met the definition above, and for certain students, met the requirements to be a 100-level terminal math course. As such, the two sections of this course which met the requirements of this study were also included.

Opportunity gap: The instructional strategies that professors use which continue to benefit White students over Latinx students.

Chapter Two: Literature Review

Introduction

As a PreK–12 educator, the choice to study student success in higher education may seem a little odd. For me, this journey began in 2008, when I noticed a troubling trend among high school students who pursued college degrees: despite educators' best efforts, a large percentage of students failed to make it through college. Bowen et al.'s (2009) *Crossing the Finish Line: Completing College at America's Public Universities* addressed this topic and resonated strongly with me. Bowen et al. (2009) note the excessive debt and challenges faced by a large proportion of students who start, but do not complete college. For me, this represented a call to examine what public schools could do to improve collegiate outcomes for our students; however, as was explained in Chapter 1, public schools are starting to make moves in the right direction, as measured by high school degree attainment for Latinx students (National Center for Educational Statistics, 2019). The lack of research around how to support Latinx students *within* the classrooms in universities and colleges presents a much greater opportunity to examine current practices and provide strategies to address strategies to better support incoming students. Additionally, my hope is that some of these findings can also translate back to the PreK-12 setting, especially in mathematics, where there continue to be opportunities

35

for educational faculty within universities to infuse educational theory classes with work around the importance of student identity within mathematics (Aguirre et. al, 2013)

In developing a study centered on Latinx students, and their experiences in a first year, non-remedial, terminal mathematics course, it is critical to begin with the term describing the population of study: *Latinx*. Latinx typically refers to individuals with ancestry in Central Latin America and the Caribbean. This includes countries such as Cuba, Dominican Republic, Mexico, Columbia, Guatemala, and others. Additionally, it may include European descendants as well as Indigenous and Afro-Latinx groups (Cuellar, 2018). Like other ethnic groups, gender, socio-economic status, native language all have large impacts around how students experience college; however, as mentioned in chapter one and further explored in chapter three, Latinx communities are broadly diverse and multi-faceted. However, in quantitative portion of the present research, Latinx student were necessarily positioned as a unified group, diminishing some of that rich diversity. By contrast, the qualitative portion of the paper provided an opportunity to explore these nuances by focusing on experiences as they related to student gender identity, English Language Proficiency, engagement in extra-curricular activities, and scholarships and grant awards. The integration that is paramount in mixed methods research models offered the opportunity to delve into the nuances of CRTP and begin a discussion around how different students experienced first-year math (Creswell & Plano Clark, 2018).

Further, the Latinx term is a new term, that has not been embraced by all members of the Latinx community (Brammer, 2016). For many younger Latinx individuals, the term Latinx represents a gender-neutral method of describing a large population of Latin American descent. Others within the Latinx community, see this as just another form of imperialization, taking over Latin culture by way of forcing changes in areas that older generations have not sought (Brammer, 2016).

While Latinx is often used as a blanket term, there are cultural differences between the various groups and differences in academic achievement. There are large discrepancies in college-degree attainment between subpopulations in the Latinx designation. For example, 14% of individuals who identify as Latinx hold a college degree; only 8% of Mexican Americans hold these degrees, as compared to 18% of Dominican-American individuals (Cuellar, 2018). Thus, a Latinx identity alone does not provide clarity around the student experience. To craft a more comprehensive and detailed picture of our Latinx community, we must develop a clearer understanding of ourselves and those with whom we work, by incorporating student gender identity, race, class, and country of citizenship in the research process (Alvarado et al., 2012).

For the qualitative portions of the study, I look at the relationship between four variables and the Latinx experience: gender identity or expression, English Language Learners, extra-curricular engagement, scholarships and grant awards (Baldwin, 2015; Ginsberg & Wlodkowski, 2009; Pak, 2018; Saenz & Ponjuan, 2008; Xu & Webber, 2016).

Finally, students accepted into post-secondary institutions can be labeled as either "college-eligible" or "college-ready" (Conley, 2005). While students in both groups have the met the pre-requisites for college admission, students in the college-eligible group may be challenged by the rigors and content of college courses. This is especially true in mathematics courses, which are often seen as "gateway" courses which, when failed, can eliminate otherwise capable individuals from successful college completion (Barbera et al., 2017; Callahan & Belcheir, 2017). This drives two questions that frame the present review of the literature. First, how are college eligible Latinx students prepared for college mathematics? And second, how are universities supporting Latinx students when they arrive on campus?

Literature Review Selection Criteria

To prepare for this dissertation, I conducted a comprehensive review of the literature. It contains two major themes: Latinx preparation for collegiate mathematics and post-secondary supports for Latinx students in higher education.

Inclusion, Exclusion, and Bounding Criteria

To better understand the existing theories around how to best support Latinx students in first-year college math, the following criteria were utilized to identify relevant literature for this dissertation.

Inclusion Criteria

1. Articles, books, and sources written in English

2. Sources no more than 15 years old, and preferably no more than 5 years old

    a. Seminal articles may be older

3. Articles published in peer-reviewed, academic journals

4. Sage Journals and ERIC (ProQuest) database searches, based on the following

    search parameters:

    a. Equity and mathematics, 2015–2020

    b. Opportunity gap in mathematics, 2015–2020

    c. Leading indicators for post-secondary success in mathematics, 2015–2020

    d. Underrepresented minorities and mathematics, 2015–2020

    e. Remediation in mathematics, 2010–2020

        i. Remediation in college mathematics

    f. First-year student retention 2015–2020

        i. First-year college retention rates and mathematics

        ii. GPA and student retention

    g. Latinx students and undergraduate mathematics, 2015–2020

    h. Case study and Latinx student retention, 2015–2020

    i. Culturally responsive teaching and post-secondary success, 2015–2020

    j. Equity in mathematics, 2015–2020

k.   Culturally responsive pedagogy in post-secondary mathematics, 2015–2020

l.   Adult learning theory, 2015–2020

m.   Leading for equity in mathematics and supervision, 2015–2020

Exclusion Criteria

These criteria limited the scope of research for this dissertation by excluding:

1. Research published before 2006, unless the piece was identified as seminal.

2. Non-refereed or peer-reviewed research

Bounding Criteria

The questions framing this study revolve around how colleges support traditionally marginalized students during their first year of university study. Specifically, how were students were supported both in and outside the classroom, through a variety of tools such as culturally responsive pedagogy, support groups of similar backgrounds and experiences, and community service opportunities. Thus, the following sections clarify critical terms, such as "college-eligible," "college-ready," and "post-secondary supports."

College-Eligible versus College-Ready. To examine how students prepare for their first-year, non-remedial mathematics course, there are a couple of pathways to consider. The first pathway is student exposure to highly rigorous content in high school. Programs such as honors, Advanced Placement, and International Baccalaureate represent an opportunity to prepare for a first-year, non-remedial mathematics course. In this literature review, an examination of college-eligible versus college-ready is

examined in relationship to first-year undergraduate level GPA to better understand the challenges faced by students who are college-eligible, but perhaps not college-ready. As will be discussed later, college-eligible refers to students who are ready for college as measured by the requirements to be accepted to college, versus college-ready which presumes a high school course load where students participated in highly rigorous courses, such as Honors, AP, or IB (Zelkowski, 2011).

Post-Secondary Supports. I then examined supports that are present for incoming freshmen to a four-year, college setting. Much of the research in this area focuses on the extra-curricular aspects of higher education, such as clubs and peer-mentoring programs. Research is limited is around post-secondary supports for Latinx students within the classroom, such as pedagogical practices shown to better support marginalized groups in general, as well as Latinx students (Baldwin, 2015). While limited, some work frames what culturally responsive education may look like in a collegiate setting. Seminal work from Gay (2018), Ladson-Billings (1995), and Ginsberg and Wlodkowski (2009) provides a theoretical framework through which to understand how to support Latinx students in a first-year collegiate math class.

Within the literature review, I will then delve into the question: How does an instructor's use of culturally relevant teaching in a university setting mitigate mathematical experience for a Latinx student who is college-eligible but not college-ready, and ensure that the student has a successful first experience with their mathematics course (Ginsberg & Wlodkowski, 2009; Zelkowski, 2011)?

Challenges Faced by Incoming Latinx Students

Public education systems should not simply prepare students to get into college; students should be prepared to succeed and complete degrees. There is a subtlety, however, that has caused me to narrow my focus from all students to the Latinx community. While the gap in graduation rates between Latinx and White students is decreasing at the high-school level, graduation rates between Latinx and White students in post-secondary institutions continues to grow (National Center for Educational Statistics, 2019). Therefore, my interest shifted to how we can better support our Latinx communities in higher education. Despite this focus on how higher education can better support Latinx students in the classroom, I provide a summary of the research around Latinx supports in PreK–12 in upcoming sections to show how they prepare Latinx students for college mathematics.

While finding strategies to better prepare Latinx students in secondary education for post-secondary readiness was initially my goal, I began to question my focus on public-schools. I began to wonder why PreK–12 educators are seeing increased graduation rates for our Latinx students at a time when federal and state oversight has also increased; yet, institutions of higher education were not witnessing as dramatic of a change degree attainment for their Latinx students.

Numerous studies have examined the transition between high school and college, identifying the first year of college as a challenging time for students with greater attrition than any other point in college (Cruz et al., 2019; Er, 2018; Pratt et al., 2017).

42

As a result, I looked more closely at why first-year undergraduate Latinx students may leave. Were there instructional practices that could be utilized to better support our Latinx communities, as they shift into higher education to better leverage their strengths to ensure their success in post-secondary institutions? This questioning led to an examination of a variety of themes in the present research.

As well, there are additional mediating variables that universities should consider when supporting Latinx students' transition to post-secondary institutions. For example, there continues to be a financial burden associated with taking remedial courses that do not count towards degree attainment (Pratt et al., 2017; Whalen et al., 2010). Even when courses do count towards graduation, the costs of attending college have increased so dramatically that attending college has become a luxury, causing undue stress on Latinx students before they have even applied (Martinez et al., 2020). This effect can even have negative impacts on student success in PreK–12. While it is beyond the scope of this dissertation, it remains an issue to consider when examining experiences among Latinx students.

Research Theme 1: Latinx Student Preparation for College Mathematics

Since 1995, the gap between the number of Latinx students earning high-school degrees as compared to the number of White students earning high-school degrees has been decreasing, with a little more than 71% of Latinx students earning high school diplomas in 2018 (National Center for Educational Statistics, 2019). While White students are still outpacing their Latinx peers in terms of degree attainment, with 92%

earning high school degrees, the disparity between Latinx success and White success is especially pronounced in terms of undergraduate degree attainment.

Latinx students are driven to pursue college degrees. In recent years, universities have witnessed a dramatic increase in Latinx students, in some cases growing from 13% to 22% in just nine years (Cantú, 2019). Yet, despite these dramatic increases, degree attainment has remained persistently low, with only 32% of admitted Latinx students earning a degree within four years, and 54% earning a degree within six years (National Center for Educational Statistics, 2019). The question becomes, if Latinx students are college-eligible, why are retention rates so low?

Zelkowski (2011) argued that not all college-eligible students are college-ready (2011). Importantly, Zelkowski (2011) did not disaggregate his results to examine particular effects on Latinx students. However, through his examination of the opportunity gap, we see how university instructors' roles and practices might better support Latinx student retention and recruit more Latinx students. Given the increasing percentage of Latinx students pursuing college degrees combined with persistently lower rates of degree attainment, it is critical that colleges try to support both college-eligible and college-ready students (Integrated Postsecondary Education Data System, 2020; National Center for Educational Statistics, 2019). Methods such as remediation or English as a second language courses meant to better prepare Latinx students for collegiate success show little evidence of providing them the tools and structures necessary to be successful (Boatman & Long, 2017; Hodara, 2015). Rather, it is the

relationship between the instructor and the student which can help support Latinx students as they transition from high school to their first year of college (Ginsberg & Wlodkowski, 2009; Zelkowski, 2011). Ensuring that instructors build positive, nurturing relationships that support student efficacy, in conjunction with access to relevant and rigorous material through CRTP is indicative of success for Latinx students (Ginsberg & Wlodkowski, 2009; Zelkowski, 2011).

In examining the opportunity to incorporate CRTP in a first year, non-remedial, terminal college math course, it is necessary to look at two categories of students: college-eligible and college-ready. Zelkowski, uses Conley's definition as follows:

College-eligible refers to meeting a state's minimum high school graduation requirements *and* public college admissions requirements. *College-ready*, on the other hand, refers to meeting a state's highly recommended course-taking suggestions to improve college-readiness, competing rigorous advanced core subject courses during the senior year of high school, and meeting the minimum college entrance test scores predicting successful completion of entry-level college core courses (Conley, 2005, p. 9).

The challenge for colleges, and instructors, becomes: how do we ensure that "college-eligible" Latinx students receive the support they need to successfully manage the transition between high school and college? To support Latinx students in their pursuit of postsecondary success, research breaks into two major themes. The first theme is focused on preparation during high school and can take many forms. Advanced Placement/International Baccalaureate programs, early-college programs, dual/concurrent

enrollment program, and the Advancement Via Individual Determination (AVID) program, among others, prepare students for the rigor of college (Darolia et al., 2019; Edmunds et al., 2020; Huerta et al., 2013). Within these high school programs, lies the promise to prepare students for the rigors associated with college, making them "college-ready."

Further complicating the picture for Latinx students is the intersection of Latinx identity and first-generation student status. Seventy-one percent of first-generation students are likely to leave after their first year due to low GPA. Latinx students are frequently first-generation students (DeAngelo & Franke, 2016; Pratt et al., 2017). Pratt et al. (2017) define first-generation students as "those whose parents did not obtain a 4-year college degree" (p. 106). Therefore, when identifying systemic supports that best address Latinx student efficacy, there is a critical need to ensure that college-eligible Latinx students are successful in gateway courses, such as mathematics. Coupled with the critical importance of success in first-year mathematics, it becomes clear that if students are college-eligible, universities must target those classes which are most likely influence Latinx students' retention for additional support (Barbera et al., 2017; Callahan & Belcheir, 2017; Musoba & Krichevskiy, 2014).

However, conventional wisdom presumes that remedial courses like remedial mathematics, English as a Second Language, etc., best meet Latinx student needs. These practices reinforce a narrative that Latinx students must conform. Research reveals that mathematics remediation is largely ineffective, with 75.4% of students not meeting

expectations within remediation, and 81.5% of those students never attaining a degree (Bahr, 2008).

Since many Latinx students are first-generation students, and since universities continue to struggle to retain many first-year students, we must examine and change existing structures to capitalize on inherent strengths within the Latinx community in their pursuit of higher education (Fernandez et al., 2019; Kiyama, 2010; Pratt et al., 2017). Supporting knowledge acquisition by leveraging Latinx student lived experiences through CRTP will help students find success their first year. By considering these practices, it is possible to explore how collegiate instructors can better engage diverse students and ensure they persist and succeed (Ginsberg & Wlodkowski, 2009).

Finally, when first-year Latinx students succeed in their first year, their likelihood of graduation is much higher (Paschal & Taggert, 2019). The challenge becomes how might college math instructors bridge high school and college to ensure college-eligible Latinx students persist beyond the first year. To address this challenge, we must first ask: How are college-eligible, but not college-ready, Latinx students prepared for collegiate mathematics?

Research Subtheme 1.1: High School Preparation for Collegiate Mathematics

High school mathematics continues to be highly predictive of student success in post-secondary institutions (Zelkowski, 2011; Sanchez et al., 2015). However, the phrase "success" has different meanings for different organizations. Success for secondary schools, as defined by the U.S. Department of Education means passing state-level

assessments aligned to current standards (U.S. Department of Education, 2017). Despite common standards and similar assessments, there is a wide discrepancy of what college and career readiness means at the state level, with little commonality across states (Woods, 2017).

From Zelkowski's (2011) quantitative study, based on the National Educational Longitudinal Study (NELS:88) data set, he identified two major predictors of college-readiness: 1) continuous enrollment in 9–12 mathematics and 2) time spent on mathematics homework in grade twelve. Zelkowski (2011) further asserts that homework completed in school is less predictive of college-readiness than homework completed outside of school.

Upon first examination, Zelkowski's (2011) assertion that homework improves college-readiness seems valuable. However, the data is not clear as to how much time students spent to earn better grades; thus, it is difficult to determine the direct effect of homework on college readiness (Maltese et al., 2012). Further, Maltese et al. (2012) argued that homework reveals no significant improvement on student math grades in math because high school grades are often based on performance and effort, as opposed to comprehension. Maltese et al. (2012) did find a stronger correlation with homework and performance on standardized assessments, which is useful in determining college-eligibility, but not necessarily college-readiness. Despite this, many states are beginning to back away from standardized tests as a measure of college-eligibility toward a more

wholistic review of student work (Woods et al., 2018). This move should better inform students of their college readiness and may mitigate student attrition.

The second finding of Zelkowski's (2011) study positively correlated to college-readiness was continuous enrollment in 9–12 high-school mathematics. Yet, state requirements for high school graduation do not necessarily align with variables that strongly correlate to collegiate success. In Colorado, for example, students are only required to pass three years of mathematics and show proficiency on one of several assessments such as ACT, Accuplacer, ASVAB, SAT, or district supported portfolio of work to graduate from high school (CDE, 2020). While this may provide greater access to high school degrees, Stohs and Schutte (2019) showed that graduation rates alone are not a quality indicator of collegiate eligibility. Instead, Stohs and Schutte (2019) recommend aligning high school success criteria to first-year collegiate success for first generation and underrepresented students to better address opportunity gaps. In this way, states like Colorado have three groups of students interested in post-secondary education: college-ready, college-eligible, and college-ineligible. College-ineligible students have the required courses to graduate from high school but lack the necessary course-work for admission to a four-year institution.

While homework and continuous enrollment have some validity in addressing college-eligibility, there are many other factors that play into a student's ability to succeed in college. One strand of research breaks down college-readiness into three competencies: cognitive, noncognitive, and college knowledge (Conley, 2003; Duncheon,

2018). Continuous enrollment in mathematics would qualify as a cognitive competency, whereas established homework routines would qualify as behaviors or noncognitive competencies. More broadly, cognitive competency refers to the entirety of courses such as English, math, science, and second languages that students take to lay the foundation for success in their first year of college (Duncheon, 2018). Noncognitive competencies are the soft-skills, such as perseverance and positive mindsets necessary to carry students through challenging college classes and experiences. The third competency—college knowledge—is a metric that high schools can use to ensure students are able to access college. For example, schoolwide campaigns around college application processes, application due dates, and other foundational knowledge students require to even be accepted to college are forms of college knowledge. These competencies provided the basis to what Conley (2003) refers to as "college readiness." For a truly comprehensive picture of college readiness, these three domains, cognitive, noncognitive, and college knowledge, provide a holistic picture of how high schools can further examine how they are preparing students for college.

With this knowledge, universities can start their work looking at how collegiate professors can support their students around the college readiness measures, specifically around cognitive and noncognitive competencies. Through foundational concepts and relevance, instructors can impact a student's college readiness, even after the student has arrived on campus. The exciting aspect of this, is that when examined through the lens of CRTP, instructors can build noncognitive skills by engaging in practices which develop

student attitude, the second domain of Ginsberg & Wlodkowski's (2009) CRT in college framework. For example, instructors could use differentiated instruction to support students' unique strengths in attaining college level content, followed by working with students to design activities to further their understanding. This provides multiple entry points and creates a positive experience towards a given topic (Aguirre et al., 2013; Ginsberg & Wlodkowski, 2009).

Research Subtheme 1.2: Undergraduate Remediation in Preparation of Collegiate Level Mathematics

Ideally, every first-year college student would be ready for college level mathematics. However, given the decentralized nature of PreK–12 education in the United States, students arrive on campus with a wide range of math skills (U.S. Department of Education, National Center for Education Statistics, 2011; Bahr, 2010; Ran & Lin, 2019). One strategy to address this range of skills is to provide students access to remedial mathematics courses. A traditional approach to remedial math education rests on the assumption that students only need access to the underlying content for future success in mathematics. The challenge with this assumption is that it continues to ignore mediating variables such as financial costs associated with paying for credits that do not count towards graduation (Pratt et al., 2017; Whalen et al., 2010).

Currently, Latinx students are heavily represented in college-level remedial math. (Crisp et al., 2017). Yet, remedial math course have mixed results when examined through the lenses of degree attainment persistence into year two (Bahr, 2008; Crisp &

Delgado, 2013; Fong et al., 2015; Ngo & Melguizo, 2016). Students who participate in remedial mathematics courses are less likely persist through their second year of course work. Furthermore, students who participate in remedial coursework fall 11.5 credits behind their peers by the end of their third year (Boatman & Long, 2017). The costs and burden of traditional remediation add additional barriers (e.g., time, money) to a group largely comprised of first-generation and often under-resourced students. Even if these courses were free, the time students spend in these course delays required coursework, further extends the tuition burden, and delays graduation and ability to earn a salary, thus perpetuating inequities.

In Crisp et al.'s 2017 study, the team analyzed a national sample of 640 Latinx students aged 17 to 23 who were enrolled in a developmental math courses at 290 institutions. Using a hierarchical generalized linear model, the team found that 61% of students successfully completed the math program and only 46% earned college-level math credit within 6 academic years. Further, Crisp and colleagues found that Latinx student's chances of taking a college-level math course was negatively associated with the quantity of developmental math courses; or, the more remediation a student requires, the more likely they would not attaint college-level math.

Therefore, while the intent of remediation is to prepare students for college-level mathematics, there is little support students are benefitting from this approach. In cases where author's claim that remediation works, it is important to understand what the author means by "remediation works." Bahr (2008) asserts that for students who

52

remediate successfully, their outcomes are like students who do not need remediation in their first year. Bahr (2008) capitalizes on the idea that "when remediation works, it works extremely well." However, Bahr's (2008) study does not differentiate the students who need remediation. In his paper, students are organized in 5 groups, college math, intermediate algebra/geometry, beginning algebra, pre-algebra, and basic arithmetic. Given that different majors require different mathematics courses, simply grouping students based on their placement doesn't account for the skill variance within that placement. For example, a student classified as "beginning algebra" may have just missed the cutoff point for a first-year non-remedial math course, a concern raised by Goudas and Boylan (2012). Goudas and Boylan (2012) found that students near the cutoff points for classes, just under or just over, have similar outcomes regardless of remediation; thus, the effectiveness of remediation is conflated for those populations. It is highly likely that Bahr's (2008) work inadvertently identifies students near the cut off as examples of remediation success. This is dangerous in light of a preponderance of data that does not support remediation (Boatman & Long, 2017; Crisp & Delgado, 2013; Crisp et al., 2017; Fong et al., 2015; Goudas & Boylan, 2012; Ngo & Melguizo, 2016).

Ironically, Bahr's (2008) own paper noted that most students requiring math remediation do not fare well, with 75.4% of math students not remediating successfully and 81.5% of those students never completing a credential. Between these statistics, and Goudas and Boylan's (2012) observations about students near cutoff points, it is hard to find support for remediation.

Alternative Mathematic Course Pathways. Some institutions are working to design pathways that avoid placing students in remedial mathematics by identifying alternative pathways to meet student needs. Logue et al. (2017) found that institutions that encourage students to enroll directly in college statistics to earn their math credits, are more likely to graduate. Providing an alternative pathway for students to attain degrees allows colleges to leverage student interests and personal goals by matching them with classes that develop the critical thinking necessary to be successful after college. Ginsberg and Wlodkowski (2009) found that aligning math courses with students needs provides student relevancy by engaging the *enhancing meaning* domain. In this way, students attend college for longer, identify what their specific pathway may be, and take the appropriate mathematics course towards the end of their program.

Research Subtheme 1.3: How Culturally Responsive Pedagogy Explains Poor Outcomes from Remediation

Given the lack of research-based evidence to support remediation, it is interesting to look at the intersection of post-secondary remediation and CRT (Ladson-Billings, 1995). Concepts like remediation make assumptions about student's capabilities regarding grade-level course work and are often rooted in a belief that students lack the ability, desire, or initiative to tackle grade-level content. This "deficit mindset" affects an instructor's practice, by influencing how and what the instructor teaches (Landsmen & Lewis, 2011, p. 61; Thomas-Brown et al., 2020). Instructors and institutions who adopt a deficit-mindset continue to underserve Latinx students and do not prepare them for the

54

rigors of higher education. To combat these deficit views, instructors and mathematics departments must examine the intent of each math course and identify potential alternatives to support a more diverse body of students by nurturing more contextually relevant content for traditionally marginalized students. This shift from deficit thinking to asset-based thinking, capitalizes on the conception of knowledge pillar within the CRP framework (Ladson-Billings, 1995).

Since CRP has traditionally been used in PreK–12 educational settings, research is limited around CRP in higher education, and even more scant in relation to remedial college math courses (Baldwin, 2015). As a result, there is an opportunity to explore how leveraging the framework of CRP in a collegiate setting might allow a deeper examination of how to best support first-year math students. As a result, we may discover ways to ensure Latinx student success in critical gatekeeping classes like mathematics.

Research Subtheme 1.4: Intersection of Gender and Post-Secondary Success

Evaluating the impact of gender on the success of students has played a role in educational research for some time now. When exploring the intersection of gender and Latinx identity, it becomes apparent that Latinx students who identify as male are facing unique challenges, as compared to other gender identities. In 2008, Saenz and Ponjùan noticed a disturbing trend: despite Latinx students representing one of the most rapidly growing demographics in the United States, Latinx males were "vanishing" from secondary and post-secondary institutions. A complex mixture of issues including lower grades in critical classes like mathematics and English, and perceptions that they may not

55

be cut out for higher education explained the disappearance (Mosoba & Krichevskiy, 2013). In addition, qualitative studies found that Latinx students who identify as male are consciously attending universities in close proximities to their homes, to continue supporting their families, even while attending college (Ponjùan & Hernandez, 2020). In these later cases, Latinx males often leave to support families if the need arises.

Despite these challenges, Ponjùan and Hernandez (2020) posit potential assets of Latinx male students that universities could leverage by exploring how to reframe these challenges as the very supports that will ensure Latinx males feel welcomed and supported. Throughout their study, Ponjùan and Hernandez (2020) discussed various types of student capital/assets that should be leveraged, using Yosso's (2005) concept of community wealth which include social, familial, cultural, aspirational, resistant, navigational, and linguistic strengths. To Ponjùan and Hernandez (2020), these various types of capital represent the strengths that individuals bring to college. The question is which sources of capital are universities going to leverage to support their students? The researchers found that institutions who leveraged familial and cultural capital components of their student's identities were ultimately more successful in retaining their Latinx male students (Ponjùan and Hernandez, 2020). Importantly, they identified familial capital as "the community of peers, staff, and faculty that nurtures their culture and becomes their family while in college" (Ponjùan and Hernandez, 2020, p. 4). Other capital, such as cultural capital, allowed students to flex their influence by affecting institutional "policies, programs and practices to be more student centered and culturally sensitive"

(Ponjuan & Hernandez, 2020, p. 2). This is especially true for students attending Hispanic Serving Institutions.

This finding aligns well with Ladson-Billings (1995) work in CRP. Ladson-Billings (1995) explained, "[e]ducational practices must match with the children's culture in ways which ensure the generation of academically important behaviors" (p. 497). If we are to nurture our students' strengths, it cannot be by forcing them into a box; rather, we must leverage their strengths into our educational practice. Ensuring our institutions are exploring methods to elevate student cultural and familial capital will be critical, if we are to improve retention for our Latinx students.

Although much of the research around supporting Latinx students in the college environment is centered on extra-curricular opportunities, there is an opportunity to explore Ponjùan and Hernandez's (2020) work in the context of a non-remedial, first year mathematics. In Ginsberg & Wlodkowski's (2009) work, all four of their CRT in college domains are activated through familial and cultural capital. For example, in the *establish inclusion* domain, the intent is to develop an environment where students and instructors are connected to, and respect, one another (Ginsberg & Wlodkowski, p. 73). If instructors create this environment in the classroom, they leverage the familial capital component critical to Latinx male student success and retention.

Research Subtheme 1.5: English Language Learners and Collegiate Success

Surprisingly, there is limited research around English Language Learners and their experience in the post-secondary environment (Ouellette-Schramm, 2018). This is

due in part, to where historic research has focused: how to support Latinx students outside of the classroom (Baldwin, 2015). External to collegiate classes within the United States, much research has focused on Latinx community groups, where Latinx students are the majority demographic, thus accounting for Spanish language supports is less a consideration. However, research around how instructors can adapt their practice to support the needs of English Language Learners is exceptionally limited (Baldwin, 2015). Despite this limited knowledge base, when considering Latinx students, it is important to explore how and when English Language Learners are supported as they develop the academic language to be successful at the university (Hodora, 2015).

Hodora (2015) finds that many universities instituting English as a Second Language courses to support students are in fact having a negative effect on student retention (2015). As discussed in Research Subtheme 1.2, these remedial approaches do not retain students. Some theories as to why these remediation techniques may be failing are similar, regardless of whether the focus is on mathematics or language remediation: the cost and time associated with these courses, which ultimately do not lead to degrees, injures motivation among Latinx students (Hodora, 2015; Pratt et al., 2017; Whalen et al., 2010). Hodora (2015) goes further to distill English Language Learners into three groups. Group one consists of first-generation language learners who finished high school, or its equivalent, in a country whose primary language was not English. Group two consists of generation 1.5, or those who attended high school in the United States, but immigrated to the United States and spoke a language other than English at home.

Finally, group 3 reflects second generation students who were born in the United States, but whose families spoke a language other than English at home (Hodora, 2015).

When examining the three groups, it is possible to begin to explore not only how language acquisition is affecting student retention, but how a student's cultural origins in conjunction with language acquisition influence development (Cummins, 2000). In other words, the language development and cultural identity of students influences their perception of educational practices in the classroom.

While remedial course work in English language acquisition (ELA) or mathematics has been shown to be ineffective for Latinx success and retention, it is interesting to explore how a student's cultural and linguistic identities may be leveraged by instructors within culturally responsive classrooms. Ginsberg & Wlodkowski (2009) explore this idea in their domain, *Developing Attitude* (2009, p. 137). Rather than locate ELA in a separate class, Ginsberg & Wlodkowski (2009) discuss the power behind instructor's implementation of "linguistic and contextual support" to their lessons, to better support English language learners (ELL). For this reason, exploring how instructors are embedding linguistic supports within their lessons and student perceptions of those impacts, this dissertation has incorporated an English language proficiency metric in the survey to better understand impacts of various instructional strategies on ELL who are also of Latinx descent.

Research Theme 2: Latinx Supports in Post-Secondary Institutions

Within the second research theme, there is substantial research around how to better support Latinx students during their first year of college. In my review of the literature, I explored two pathways for post-secondary support: extra-curricular supports and in-class supports. With regards to extra-curricular supports, research has found very promising practices in helping establish communities for Latinx students (Cruz et al., 2019; Pax, 2018; Rincón, 2018).

The second area of research concerns supporting Latinx students in the classroom. Surprisingly, it is limited (Baldwin, 2015). Despite the lack of research around instructional practices within the classroom, there are opportunities to explore existing frameworks, as proposed by Ginsberg and Wlodkowski (2009), to understand how to better support Latinx students in their first year of college.

Research Subtheme 2.1: Extra-Curricular Latinx Communities

Several studies have been conducted around Latinx students and the importance of sustaining a community on campus. One aspect of community is centered on helping Latinx students build strong connections through service learning (Pak, 2018). It makes sense that in pursuit of understanding how to better support our Latinx students in higher educational systems, examining social impacts outside of class provides a critical lever to support their Latinx students. With Pak's (2018) focus on service-learning, she attempts to understand how engaging the social component of *establishing inclusion* within the university environment, impacts Latinx student achievement.

In Pak's (2018) study, she focused on a new course for heritage or native Spanish speakers. The students in her study grew up speaking Spanish at home and most of their parents had some college experience or a bachelor's degree. In a course targeted at third-year students, Pak (2018) worked with 16 Latinx students, aged 18 to 22, to understand how they were impacted by the service-learning experience and how that experience affects the likelihood of retention. Data was gathered through the use of five bi-weekly reflections and a final essay in Spanish.

Student responses to the class and service-learning were positive and reinforced social integration as a positive aspect of the experience. The challenge, however, was that twelve of the sixteen student participants were juniors or seniors, while only four were first- or second-year students. Studies have shown that students are most likely to leave during their first year, so these findings do not directly address the issue at hand (Herzog, 2005; Kamer & Ishitani, 2019; Ishitani, 2016).

For example, in Ishitani's 2016 study of 7,571 students, 11% dropped out their first year and 15% dropped out during the second year. An even broader examination of first-year retention rates published by the National Center for Education Statistics (2019), showed that 24.5% of first-time first year (FTFY) students at 5,135 institutions did not return for a second year. While these studies represent broad cross sections, and do not focus on Latinx students, studies have shown that that historically underrepresented populations are more likely to be represented in the college-eligible group, and thus are under-prepared for the rigors of college. Thus, they are more likely to leave as compared

61

to their classmates who arrive on campus college-ready (Adelman, 2006; DeAngelo & Franke, 2016). In another study from NCES 2017 data, 64.8% of White students obtained a Bachelor's degree within 6 years of starting their studies, while only 50.5% of Latinx students obtain a Bachelor's degree (Chen et al., 2019).

Therefore, while Pak's (2018) study does provide a good argument for incorporating service-learning to establish inclusion within the community, there is a question with regards to the likelihood that junior and senior Latinx students already have the social networks and skills required to be successful in a four-year university. Specifically, are Latinx students who have matriculated to their third and fourth years truly representative of all students who began collegiate programs? Or, have junior and senior Latinx students already found successful strategies to navigate higher education? Or, did they arrive with the prerequisite skills already in place?

A value to Pak's (2018) study, as viewed through CRTP, is around the engagement of the *establishing inclusion* domain or building a sense of community within our Latinx students. With Latinx students engaging in service-learning programs within their communities, Pak (2018) aligns with Ginsberg and Wlodkowski's (2009) *establishing inclus*ion domain ensuring that 'collaboration and cooperation are expected' by university faculty. Therefore, rather than waiting for students to develop a community on their own, university faculty are actively supporting students in creating support systems to nurture Latinx student community.

While Pak's (2018) study primarily focused on junior and senior students, the opportunity to examine how inclusion is established is beneficial. Recent studies continue to examine the value of providing Latinx students with community access points to leverage the power of inclusivity towards addressing stereotype threat and imposter syndrome (Baldwin, 2015; Cruz et al., 2019; Rincón, 2018).

External classroom supports are critical to ensuring historically underrepresented communities thrive in an environment that continues to be monopolized by White students (Pak, 2018). Latinx students must have a strong sense of community for success, but how are institutions ensuring that we are adjusting in-class practice to foster a sense of cultural awareness and responsiveness towards our communities who have, to date, continued to be underrepresented?

Research Subtheme 2.2: In-Class Latinx Communities

Mathematics continues to be a gateway course in higher education (Callahan & Belcheir, 2017; Whalen et al., 2010). Unfortunately, mathematics also is a barrier for many students (Bahr, 2008; Ran &Lin, 2019). For Black or Latinx students, successful completion of a first-year math class has been found to be especially critical to student retention, even more than overall GPA. This has been shown to be true for Latinx students (Musoba & Krichevskiy, 2013). To better situate this study around Latinx student experience in first year college mathematics, there are two themes of research we must consider. The first theme is success in a first-year, non-remedial college math class.

A second subtheme with Latinx communities on college campus is the importance of using culturally relevant practices within instruction (Gay, 2018; Ladson-Billings, 1995). Culturally relevant practices incorporate aspects such as helping students see themselves in the work, as well as building strong, authentic relationships between the teacher and student. Finally ensuring that knowledge is not just created by the instructor; rather, knowledge is co-created with students (Ladson-Billings, 1995).

In Cruz et al.'s (2019) study, the team examined the value of developing a peer support program. Similar to Pak's (2018) focus on addressing the inclusion component of CRTP, Cruz et al. (2019) were studying the impact of how improving social connections for Latinx students may improve retention through a peer coaching mechanism. While not specifically about instructor practice within the classroom, providing peer coaching does begin to address some of the more academic components of college, and begins to really focus on how to better support college-eligible students.

In Cruz et al.'s (2019) study, it is possible to see how they are leveraging the *engendering competence* domain of Ginsberg and Wlodkowski's framework. While Ginsberg and Wlodkowski (2009) look at *engendering competence* through a lens of how assessments can engender competence, an argument can be made that peer tutoring is providing similar support. Ginsberg and Wlodkowski (2009) "propose that the essential purpose of assessment is to *Engender Competence*. Assessment provides evidence of learning and proficiency" (p. 263). Ginsberg and Wlodkowski (2009) argue for a narrow view of *engendering competence* and argue that traditional Eurocentric forms of

64

assessment are prone to implicit bias. As a result, the ability to sustain relationships

between the instructor and student become incompatible, as the instructor is not reflecting

on how to best support the student in measuring their knowledge, but how successfully

the student can demonstrate their knowledge on an artificial assessment. In Cruz et al.'s

(2019) study, the tutor takes on the role of the "instructor" by providing one-on-one

services for the student, building the relationship, assessing their knowledge, and

adapting their practice to meet the student's needs. The original frame for Ginsberg and

Wlodkowski's (2009) methodology was around an instructor-student relationship;

therefore, this frame provides a suitable fit to examine Cruz et al.'s (2019) study. There is

an opportunity to expand upon this frame when we examine other methods to *engender*

competence. For example, in Rhodes' (2016) construction of a culturally responsive

teaching survey, Rhodes' (2016) identifies the opportunity of peer tutors as a method to

engender competence. Again, this is a fair expansion of *engendering competence*,

because other researchers have found evidence of the power of peer tutoring at improving

a student's outcomes (Cruz et al., 2019; Kim, 2015).

In their study, Cruz et al. (2019) examined the effects of a peer-mentor program at

a historically Spanish institute in south Texas. This four-year, master's degree granting

institution generally has a demographic of 70% Latinx students. Additionally, their study

focused primarily on the impact of peer-to-peer coaching in STEM majors, through a

qualitative study. In Cruz et al.'s (2019) study, upperclassmen applied and were selected

to work with their freshman and sophomore partners around practical components of

navigating the college experience: goal setting, note taking, studying for exams and other soft skills required for success. In this study, the authors used a quasi-experimental study with 45 control students (non-mentees) and 45 test subjects (mentees). With these groups, the authors conducted semi-structured interviews and used triangulation to evaluate the qualitative data. Additional demographic data was collected, such as Pell-Grant recipients, gender and first-generation status. Cruz et al. (2019) found that four themes arose from their interviews. Through triangulation, the author's labeled student responses by these four themes: sense of belonging, social support system, academic support system, and helpful Llesson topics.

Cruz et al. (2019) first identified the themes of sense of belonging and social support system, accounted for 52% of student responses. Responses within these two themes centered on the value of having ally's and friends in such a new and intimidating environment. Examined through the lens of CRT, the importance of addressing the social components of inclusion became a clear strategy for encouraging Latinx student retention; however, the other three domains in CRT (*developing attitude, enhancing meaning* and *engendering competence*) were also engaged (Ginsberg & Wlodkowski, 2009; Rhodes, 2016). In Cruz et al.'s (2019) study, Latinx students were quoted identifying the peer coaches as critical in helping the mentees reach their full potentials.

This study also elevates the need to engage Latinx students in academics, as the other two emergent themes from Cruz's study are academic support and helpful lesson topics. The academic support system theme represents the strategies that students can use

66

to improve performance in classroom, through the use of engaging with their instructors, and study tips. The academic support system theme, which represents an additional 36% of student comments, was commented on more frequently than either sense of belonging or social support system, which represented 18% and 34% of student responses, respectively. This appears to imply that while Latinx students appreciate the social components, there is also a critical need for Academic support. Helpful lesson topics covered additional strategies like study skills and time-management, which represented the final 12% of student responses.

It is the presence of academic support system and helpful lesson topics that begins to provide an opportunity to explore the impact of instructional practices of the instructors. While Cruz et al. (2019) elevates the importance of the providing Latinx students with the soft skills associated with success (time management, accessing instructors, study skills, etc.), it does not explore the instructor's ability to support student success, which was beyond the scope of the paper. However, similar studies focused on improving first-year Latinx student retention have found that instructors are interested in learning how they can better support Latinx students (Baldwin, 2015). Additionally, when examining the emerging theme frequencies, while social support systems was 34% of responses, academic support was slightly higher at 36%. As a result, while Cruz et al.'s (2019) paper does not extend their findings beyond the peer-to-peer mentoring program, there is an opportunity to extrapolate the results around academic support system and helpful lesson topics. I propose that while Latinx students in this study

appreciated the social aspects of the social support system and sense of belonging, there is a nearly equal percentage of responses seeking support in the areas of academic supports and helpful lesson topics, which focused on soft skills. This may begin to contribute to increased student-retention rates for Latinx students (Ginsberg & Wlodkowski, 2009; Ladson-Billings, 1995).

Cruz et al.'s (2019) intent was not to incorporate the critical social relationship that forms between the instructor and the student. Despite this, there were two additional limitations present. First, Cruz et al.'s (2019) priority was focused on Hispanic Serving Institutions (HSI). While HSI's may have a greater percentage of Hispanic and Latinx students, there is some question as to the viability of a program like the one presented here, working in institutions where Latinx student populations are much smaller. This reinforces the critical importance of ensuring that instructors at all institutions, HSI or otherwise, have the pedagogical skills necessary to build relationships with Latinx students in each course. While many institutions may be interested in developing programs such as this one, as of 2019, only 48 universities in the United States were designated as HSI's, allowing them access to additional funding through Title V funding (U.S. Department of Education, 2020). Again, while 52% of students in Cruz et al.'s (2019) study identified the peer-to-peer relationships as important for their success, these same students also referenced 48% of their success being derived from strictly academic components, such as academic support systems and helpful lesson topics around soft skills. Therefore, while studies around first-year retention of Latinx students often

examine the value of addressing strictly social components, such as in Pax's 2018 study, we have here an example where students identified the academic supports as nearly as important as the social supports. This supports further research into how instructors can utilize the four domains of CRT to aid in Latinx student retention and success (Ginsberg & Wlodkowski, 2009).

The second limitation is the focus on STEM majors. Mathematics serves as a gateway course to many programs, beyond only STEM pathways, for many first-year Latinx students, and as shown earlier, supporting all Latinx students in their first year of mathematics is critical to their success. First-year math success is a strong predictor of eventual graduation for students, regardless of major, so providing mentoring support for all Latinx students, would be appropriate in meeting more student's needs (Callahan & Belcheir, 2017).

Research Theme Conclusions

To understand how to better design systems which better support Latinx students, and thereby increase retention, current research trends identify many supports outside the classroom that aide Latinx students in higher education. Research around building a sense of community and shifting assumptions around what qualifies as pre-requisite knowledge to pursue college addresses challenges our students face such as imposter syndrome (Kiyama, 2010; Pak, 2018; Victorino et al., 2019). This research affirms the need for colleges to ensure Latinx students see themselves as members of the campus community.

Additionally, Latinx students have expressed an appreciation for these social supports, but in nearly equal numbers, have also expressed a desire for more academic supports (Cruz et al., 2019). Therefore, there is a need to better understand how instructors within 100-Level mathematics classes are working to support their college-eligible Latinx students' success and retention.

Research Methods

In researching existing literature around Latinx student experiences within first-year college mathematics courses, qualitative and quantitative research methodologies have helped tell the story of Latinx students and provide the statistical analysis to aid in developing significant solutions (Kiyama, 2010; Lane et al., 2020; Malin et al., 2017; Morningstar et al., 2018; Tichavakunda & Galan, 2020).

However, the exploration to explore the Latinx student experience in 100-Level terminal mathematics class through a mixed methods methodology is missing. The value of utilizing a mixed-methods model to study the Latinx student experience within a first-year collegiate mathematics course provides a unique opportunity to integrate the qualitative and quantitative data (Creswell & Plano Clark, 2018). Integration for a convergent, mixed-methods study, as defined by Creswell and Plano Clark (2018), provides the opportunity to compare quantitative data with qualitative themes derived from student voice and provides an opportunity to better understand nuances within quantitative data, that would otherwise not be discovered.

Potential Predictor Variables

As this literature review draws to a close, it is important to articulate the variables that have been addressed, and how those will frame the rest of this paper. I do not believe that any one individual can be framed by a study based only on their ethnicity; nor do I believe that simply instituting CRTP will suddenly do away with centuries of systemic Euro-centric practices that have disproportionately benefited White students. The four predictor variables that follow represent a small entry into individualizing the study within the Latinx community and better understanding their individual experiences in college math. I will note in chapter three, however, a lack of prior research, coupled with time and sample sizes prevent a more robust study to examine how CRTP impact more targeted Latinx populations in a quantitative method. Therefore, qualitative methods are used to enhance the quantitative approaches by adding critically important contextual data to the study.

Gender and College Success

Research has discovered differences in gender and student retention. This is especially true in traditionally gendered majors, such as STEM fields which have historically graduated a higher percentage of males than females; or nursing, which historically graduated a higher percentage of females than males. In both pathways, research has shown that the underrepresented gender has a greater likelihood of not completing a degree (Barbera et al., 2017; Saenz & Ponjuan, 2008). As a result, in a class such as a first-year, non-remedial terminal mathematics course, identifying practices that

resonate with specific genders may provide an opportunity to explore specific

instructional practices that better support specific genders, in an attempt better serve

students. This focus on gender is especially critical for Latinx students, as a wide

disparity between male and female students has arisen, sometimes lending to the term the

"vanishing Latino male in higher Education" (Saenz & Ponjuan, 2008, p. 54).

English Language Learners and Collegiate Success

A student's ability to comprehend material is a result of their ability to decode

academic language, especially in higher education. In fact, ELL represent one of the

fastest growing groups in the United States (Perry & Hart, 2012). In addition, research

has found that ELL students need two years to gain the skills to be able to interact in

social conditions comfortably, and five to seven years to engage in cognitively complex

situations, such as engaging in discussions or reading and comprehending advanced texts

(Ginsberg & Wlodkowski, 2009). Rather than focus on categorical classifications of

English Language Proficiency, utilizing a continuous measure of a student's perceived

language ability will help distill information regarding CRTP in college and their impacts

on students with varying degrees of ELA.

Extra-Curricular Engagement and College Success

One common research theme that begins to emerge is the critical importance of

community for all students, particularly Latinx students (Pax, 2018; Ponjuán &

Hernandez, 2020). For students who are members of traditionally marginalized groups,

access to community outside the classroom can represent a firm foundation on which to

build the supports necessary for long term-success and graduate (Adelman, 2006; DeAngelo & Franke, 2016). As a result, it can be critical to find supports for Latinx students outside of class. While a bit tangential to this study, extra-curricular supports can be considered an additional method to help students *establish inclusion*, one of the four domains identified by Ginsberg & Wlodkowski (2009), for Culturally Responsive Teaching Practices in College (2009). Therefore, instructors who learn about their students and advocate for supports on their behalf their needs is critical for student success.

Receipt of Scholarships/Grants and Collegiate Success

One of the greatest challenges facing students who are pursuing a degree in higher education is the costs of earning a degree. As discussed, cost is compounded when students are forced to take costly remedial courses that do not yield credits towards a degree (Bahr, 2008; Hodora, 2015; Pratt et al., 2019; Whalen et al., 2010). The financial burden of college can be especially pronounced for Latinx students, who are frequently first-generation students (Pratt et al., 2019). Research has found that while many variables affect a student's retention in college, the financial burden is one of the greatest determinants of retention (Saenz & Ponjuán, 2009; Xu & Webber, 2018).

Other Variables and Collegiate Success

While other variables may affect student's success, the preceding four were chosen as a focus based on the literature review and findings. While it would be interesting to examine student country of origin, sexuality, and other variables, these

variables are beyond the scope of this research due to time and participant constraints. While certainly a limitation for this study, a larger, more comprehensive study should look at these variables.

Objectives of the Literature Review

In conducting the literature review for this dissertation, the focus was to better understand how education, PreK–16, works to help or hinder Latinx students through their transition from high school to college. The review highlighted the realities facing college-eligible as compared to college-ready students (Conley, 2005; Zelkowski, 2011). To better understand what "college-ready" looks like, I included a discussion around mitigating variables and their influence on GPA (Boateng et al., 2016; Hafer et al., 2018; Iacobucci, 2008). Existing research has identified Latinx-student success in college mathematics and English courses, as having a better predictive quality for student retention than other course grades or GPA (Callahan & Belcheir, 2017).

Next, looking for ways universities are working with math instructors to better meet the needs of Latinx students, a lack of literature became apparent. The second theme explored in this literature review examined the supports that Latinx students receive in and out of the classroom. While there has been substantial research on how to better support Latinx students outside of the classroom, research around what is happening in the classroom is limited (Baldwin, 2015; Cruz et al., 2019; Pax, 2018; Rincón, 2018). While there is awareness of the critical importance of GPA on student retention, as well as the relationship of success in mathematics to student retention, there is still limited

research about how to better support first-year Latinx math students in non-remedial mathematics courses. The present research seeks to address this gap.

Methodologically, to better understand the structures and experiences of Latinx students in a 100-level terminal mathematics course, Ginsberg & Wlodkowski's (2009) four domains of CRT in college were found to provide a coherent understanding of how Latinx students perceive their instructors attempts to support them and provide more clarity around which domains Latinx students found to be more supportive of their needs.

Given the lack of existing research, the present study explores the impact on Latinx student retention instructional practices when instructors deploy practices from Ginsberg and Wlodkowski's (2009) framework. Additionally, the opportunity to capture student voice in this research will illuminate nuances around why specific practices may resonate better with specific students, and how those practices can potentially be shared with other instructors. As a result, rather than a strictly qualitative or quantitative approach, a mixed-methods study provides the necessary breadth to determine statistically significant approaches to supporting Latinx students, and to better understand why those practices are working. Finally, while a mixed-methods approach provides a bridge between the two traditional research approaches, it also adds to existing research which is heavily dominated by distinct qualitative research and quantitative studies but lacks mixed-methods methodologies.

Chapter Three: Methods

In chapters one and two, I established the rationale for this study. The Latinx community continues to be the fastest growing demographic in the United States (Galdeano et al., 2012). Despite this rapid increase, post-secondary degree attainment for Latinx students continues to lag their White peers, as measured by (National Center for Educational Statistics, 2019). Much work has been completed around how to support Latinx students in STEM pathways. While this research represents a good start, STEM pathways represent a narrow focus (Baldwin, 2015). For all other Latinx students, mathematics continues to serve as a barrier to success; yet, while much research has been conducted around building communities of support for Latinx students in STEM pathways, much less work has been focused on building similar communities within non-STEM pathways, specifically pathways that include Latinx students (Baldwin, 2015; Ran & Lin, 2019).

Therefore, there was a need to examine both how well non-STEM mathematics courses support Latinx students as measured by their performance in the class, and their perception of their class experience. To better understand the disparities and why they continued to occur, a convergent mixed-method design was utilized to better understand the Latinx student experience both quantitatively and qualitatively (Creswell & Plano Clark, 2018).

Treating Groups as Monolithic Representations of Larger Systems

      To achieve a sufficient sample size for quantitative data analysis, the community in Math 101 (Control) and Math 117/118 (Treatment) was not disaggregated by race. While the approach offers the opportunity to achieve greater power in quantitative analysis, it dilutes the voice of the Latinx students within these courses. As numerous studies have noted, including Lui et al. (2018), Latinx students' culture, heritage, and lived experience inform their learning styles far more than an over-arching racial identification. As discussed in my statement of researcher positionality, I identify as a cis-gendered White male with privileged experience. As a result, I was careful to attend to the diversity within the Latinx community. Even with my best efforts, this presented a limitation to the research.

      Learning styles are informed by student culture, experiences as native language speakers or non-native language speakers, gender identity, and so on. When I looked at Latinx students as a singular group, as opposed to a diverse body made up of many cultures, traditions, and experiences, I neglected the nuance of experience that can truly revolutionize the learning experience for our Latinx students. While CRTP and CRP aim to address this issue through relationship building with students, an unknowing or unscrupulous researcher might use quantitative data to assert broad claims about Latinx students and particular strategies that have a statistically significant impact on one subset of a much larger group.

To combat such false narratives, I anchored the statistical analysis with exemplar stories from students within this study, as part of a mixed methods approach. Participant stories and experiences provide context for student experiences and provide deeper understanding of how one instructional strategy, CRTP, supported a small sub-population within the much larger, more diverse, Latinx community.

Research Questions

The purpose of this study is to understand the student experience in a first-year collegiate non-remedial math class. A convergent mixed-methods design will be used where Culturally Responsive Pedagogy (CRP) and Culturally Responsive Teaching Practices (CRTP) in college provide frameworks for the study (Ginsberg & Wlodkowski, 2009; Ladson-Billings, 1995). CRP incorporates a conception of self and others, social relations and conception of knowledge to aid educators in their support of students. Built from CRP, CRTP includes four domains through which the instructor can engage students*: establishing inclusion, developing attitude, enhancing meaning* and *engendering competence*. The study included both quantitative and qualitative data gathered concurrently because of the need to match student data with their voice and experience. Quantitative data contributed to understanding how CRPT influences student perceptions of success in a 100-Level terminal mathematics course. Qualitative data explored student experiences in math class and their ability to internalize content, when CRTP practices are utilized. The two forms of data were combined to better understand the impacts of CRTP on student retention by addressing the following research questions:

78

1. How are student perceptions of mathematics affected when Culturally Responsive Teaching Practices are utilized in a first-year, non-remedial terminal mathematics course?

2. What are Latinx student perceptions of their instructor's use of culturally responsive teaching practices to establish inclusion, develop student attitude, enhance meaning, and engender competence in a first-year, non-remedial terminal math class?

3. What do Latinx student perceptions of the four CRTP domains reveal about the relationship between these domains and student success in the class?

Research Method

Research method decisions are generally driven by specific research questions. In this case, the research questions incorporated multiple research practices: research question one represented a quantitative research approach; research question two represented a qualitative research question; and research question three explored how the two data sets informed each other. As a result, a convergent mixed-methods research model blends both quantitative and qualitative research practices to provide the best framework to answer these three questions.

Mixed Methods Research Designs

In choosing a mixed methods approach, I leveraged the strengths of qualitative research where the focus is on understanding how individuals and smaller communities perceive their experience; whereas quantitative research takes a view of a small sample to

better understand trends across a population (Merriam & Tisdell, 2016, p. 6; Spatz, 2016, p. 7). However, a mixed-methods approach is more than simply running simultaneous qualitative and quantitative experiments. In a true mixed-methods approach, Creswell and Plano Clarke (2018) identify four critical pieces that were incorporated into the research design, prior to running a convergent mixed-method experiment (Creswell & Creswell, 2018, p. 215; Creswell & Plano Clark, 2018, p. 5). These four criteria are listed in the following sections.

Collection and Analysis of Qualitative and Quantitative data. The important thing to remember with mixed methods research is that it is not an attempt to dilute the rigor of either strand of traditional research (Creswell & Plano Clark, 2018). Rather, mixed methods require the researcher to adhere to all data collection and analysis procedures to maintain the rigorous standards of both strands. As a result, research may address commonly acknowledged weaknesses of both quantitative and qualitative research methods. For example, quantitative research methods have strength in analyzing large data sets to understand how specific variables affect outcomes in larger data sets; yet quantitative research practices do not explain why these variables are influencing the outcomes. Qualitative research has its strength in understanding why specific results occur, without the ability to generalize to large groups or populations (Creswell & Plano Clark, 2018). Nevertheless, qualitative research may be transferable to future studies. As a result, mixed-methods research provides a natural ability to look at large scale data and infuse it with a deeper understanding of why outcomes occurred.

Integration of both qualitative and quantitative data. Collecting

qualitative and quantitative data independently does not yield a mixed-methods study;

rather, it is the intentionality associated with blending the data that characterizes a mixed-

method (Creswell & Plano Clark, 2018). Through blending the data, nuances overlooked

in either quantitative or qualitative approaches can be illuminated for a more robust

understanding of the research questions. To truly integrate qualitative and quantitative

data, the researcher must address the following: intent of the integration, the integration

data analysis procedures, representation of integration results, and interpretation of the

integration results (Creswell & Plano Clarke, 2018). For purposes of this project, the

section on Research Question 3 delves more deeply into the integration process.

Procedural Organization that Provides a Clear Logic for Utilizing

a Mixed-Methods Approach. The next step in establishing mixed methods as the

research choice is ensuring there is a clear logic as to why the researcher choose mixed

methods rather than a qualitative or a quantitative approach (Creswell & Poth, 2018).

This may stem from the fact that the existing literature base currently has largely created

two independent research tracks based either on qualitative or quantitative research

methods. Additionally, if there is a need to determine more "complete and corroborated

results," then a mixed methods approach may be best (Creswell & Plano Clark, 2018, p.

8). It is for these reasons that I chose a mixed-methods approach. First, literature

currently exists that looks at qualitative questions surrounding how four-year institutions

support Latinx students in mathematics. Second, there is a substantial body of

quantitative research which argues for strategies that are seen as successful for Latinx students. However, scant research blends the two research pathways (Baldwin, 2015). In addition, the ability to both hear individual voices and extrapolate them to larger, systemic improvements through quantitative data analysis, yields powerful justification for a convergent mixed methods design for this project.

Procedures Framed within a Theory and Philosophy. For a convergent mixed-methods study, as with any other research approach, the theoretical framework needs to be articulated (Creswell & Plano Clark, 2018; Egbert & Sanden, 2014). For purposes of this research, Ginsberg and Wlodkowski's (2009) CRTP in college frames the dissertation (2009). Within the limited body of research around pedagogical practices in use in higher education, which are intentionally chosen to support traditionally marginalized groups, Ginsberg and Wlodkowski's (2009) work has been cited several times (Rhodes, 2018). Additionally, existing literature helps frame qualitative approaches to gather insights around Ginsberg and Wlodkwoski's (2009) four domains (Rhodes, 2016). Finally, I appreciate the bridge from the PreK–12 work of Ladson-Billings (1995) to post-secondary Culturally Responsive Teaching Practices that Ginsberg and Wlodkowski's (2009) work provides (Figure 1.3). However, while a theoretical framework provides the outline of paper, it does not necessarily provide the lens, or paradigm/philosophy through which the researcher views the problem. According to Egbert and Sanden (2014), a paradigm is "a researcher's specific stance on how knowledge (as defined by that same researcher's epistemological perspective about the

82

nature of knowledge) can be revealed" (p. 32). One of the more common paradigms within mixed-methods research in general, and convergent mixed methods specifically, is a pragmatic paradigm (Creswell & Plano Clark, 2018; Denscombe, 2008).

A pragmatic paradigm looks for real world solutions and utilizes multiple approaches to better understand complex problems (Creswell & Plano Clark, 2018). Pragmatism does not exclude either qualitative research, like a more positivist world view would, nor does it exclude quantitative research like more constructivist worldviews might. Pragmatism blends the best parts of both qualitative and quantitative research. In summary, Tashakkori and Teddlie (2010) have shown that pragmatic paradigms are a natural lens to view mixed-methods problems because both pragmatism and mixed methods benefit from the following assumptions:

1. Quantitative and qualitative research methods can exist in one study.
2. The question, not the methodology, should be what drives the approach to how a solution is found.
3. The belief that one research methodology is better than another is a false dichotomy as both qualitative and quantitively research methodologies have their own strengths and weaknesses.
4. The assumption that there is one truth or reality should be abandoned.
5. The underlying philosophy should drive the research approach, not the other way around.

Convergent Mixed Methods Design

Within mixed-methods research practices, there are multiple mixed-methods research models that can be utilized to study a phenomenon. The choice of which approach to choose was dependent upon how data was to be collected and analyzed. For me, the choice of a convergent mixed-methods design stemmed from the need to collect both qualitative and quantitative data, simultaneously. This allowed me to better understand how specific CRTP influence Latinx student retention, through studying the impact on a broad sample of students, conversations with a sub-sample of the larger group, and the integration both data sets to understand what is happening and why (Creswell & Plano Clark, 2018, p. 68).

Research Model

To better highlight the flow of data, Figure 3.1 articulates the data collection, data analysis, and data integration critical for this convergent, mixed-methods design.

Figure 3.1 *Procedural Diagram for Understanding the Latinx Student Experience in a First Year Collegiate Math Class*

Procedure	Product	Phase	Phase	Procedure	Product
• Student surveys (n≥46) • Qualtrics	• Numeric Data	QUAN Data Collection	qual Data Collection	•Group Interview. •1:1 student Interviews (n≤ 10)	•Interview transcripts •Portfolio of CRT tools and practices used in classes. •Survey short answer responses.
• Ind. Samples t-test	• Descriptive Statistical Analysis of various groups. • Comparison of means of groups perception of CRTP and their impact on classroom experience.	QUAN Data Analysis	qual Data Analysis	•Coding (CRE & CRT) •Comparison of individual and group codes/themes. •Member checking.	•Codes/Themes •Themed matrix
		QUAN + qual→ Merged Results		•Identify common concepts •Compare QUAN and Qual results by concept	•Joint Display
		QUAN + qual→ Interpretation		•Interpret/resolve similarities and differences.	•Discussion •Implications for present and future research.

To explain the methods design, the following discussion begins with the broadest aspects of this research design and narrows to the most specific aspects. Since quantitative data processes rely on larger population sets, the methodology to answer Research Question 1will be discussed first, followed by a discussion around Research Question 2, and concluding with Research Question 3.

Research Design

To conduct this research project, I explored universities in the Mountain West region. To select the site, several criteria were considered. First, the site had to be an accessible four-year university. To determine accessibility, the focus was on universities with higher rates of admission. Additionally, the site required a large enough sample size to conduct a statistically significant quantitative study.

Six universities were contacted to assess their interest. Two universities expressed potential interest; of those, one maintained a large-enough sample size in two non-remedial mathematics courses to provide the power and statistical significance necessary for the present study.

Mountain State University

I selected a public university in the mountain west region. For purposes of this paper, this university will be identified as Mountain State University (MSU). MSU has both undergraduate programs and graduate programs. However, only undergraduate students in two specific math courses were invited to participate. MSU has nearly 26,000 undergraduate students, with 89% of undergraduates aged 24 years or younger. Finally,

71% of the students identified as in-state students (National Center for Educational Statistics, 2019).

NCES utilizes 150% of normal time to capture students' matriculation through college. In this case, for a traditional four-year program, students who graduate within six years are counted in this 150% metric. At MSU 15% of undergraduate students identify as Hispanic/Latinx. Of these Latinx students, 64% will graduate within 150% of normal time (National Center for Educational Statistics, 2019). By comparison, White students graduate at a rate of 71% within the 150% metric. It may be easy to conclude that MSU is doing a great job supporting Latinx students, given the relatively small 7% gap between Latinx and White students. However, MSU is like national statistics that indicate only 18% of Latinx students have enrolled in the institution (National Center for Educational Statistics, 2019). MSU continues to look at recruitment strategies and methods to better attract Latinx students; however, recruitment is beyond the scope of this paper (J. Hagman & R. Morgan, personal communication, October 30, 2020). So, while 64% of Latinx students earn a degree in 6 years, the Latinx population is small to start (only 18% of the overall Latinx population)—thus perpetuating the opportunity gap between Latinx and White students. Therefore, MSU represents a good location to examine why Latinx students persist and how they might grow the Latinx-student body.

Universities can explore CRTP systemically and within individual classes. For example, Gay (2018) notes that aligning coursework with student interests is critical in establishing a culturally responsive practice (2018). At MSU, they provide students the

flexibility to choose which courses meet the All-University Core Curriculum (AUCC). As a result of this approach, students have multiple pathways through which to demonstrate proficiency in core subjects, including mathematics. For MSU, the AUCC stipulates students need at least three credits of quantitative reasoning to meet graduation requirements. To demonstrate that reasoning component, MSU provides students with 18 different college-level, credit bearing courses that fulfill the quantitative reasoning component of the AUCC. Some of these courses are terminal and some are prerequisites for other mathematics courses.

In exploring universities and courses that would address the needs of this study, I begin by identifying universities where systems were in place to support traditionally marginalized students. Originally, I worked with two universities. The challenge with one university was that much of their work focused on underrepresented students in STEM fields (Orm, 2020). This eliminated one of two possible sites from consideration. Therefore, as much of this research was looking at pathways which serve students in non-STEM fields, as this group continues to receive limited research and support in mathematics (Baldwin, 2015). The rationale with negating the STEM pathway courses, is due to the existing body of literature which is already working to establish better practices for instructors in STEM pathways to support traditionally marginalized groups (Crabtree et al., 2019; Darolia et al., 2019; Paschal & Taggart, 2019).

By no means has the field of STEM education addressed all inequities and ensured access for traditional marginalized groups; however, extant research has well

explored ways to support Latinx students in STEM pathways. Together with the Dean of the Mathematics Department at MSU, I explored which courses were designed to support Latinx students outside of STEM fields. The MSU math department offers two such courses: M101 and M117/118. In M117/118 (the Treatment), instructors receive PD around CRTP, while M101 (the Control) instructors did not receive any PD on CRTP.

While the M101 and M117/118 courses were traditionally asynchronous classes where students watched videos and took tests on content every one to two weeks, there were four sections selected for this study, designed to provide small groups with individual instructors. Students in these sections traditionally attend class in person; however, given the pandemic in the spring of 2021, MSU had instituted a few protocols to keep students safe. For these four sections, students attended the first two weeks virtually. In other words, students logged in at a specific time through zoom, and engaged directly with their instructors. After the first two weeks, students had the choice to attend class in person or continue logging in through zoom. Finally, after a mid-April spring break, all students returned to logging in through zoom to attend class.

The students who opted into these sections had to do so by working with their advisors. These sections were not publicized and were intended to provide a different experience, than the M101 or M117/118 courses generally have. This was by providing students a dedicated instructor who taught an actual class two to three times a week. The intent was to support BIPOC students or first-generation students; however, when talking

with instructors it appeared that the classes were predominately occupied by White students.

The instructors for these programs were graduate student TAs, working on their master's degrees. Two women taught the two treatment groups, while two men taught the control groups. Within the treatment groups, there were also undergraduate TAs, who were math students, who were there to provide additional support to students in the class.

Differentiating between STEM and Non-Stem

Figure 3.2 Fields Arranged by Purity, Randall Munroe, XKCD

FIELDS ARRANGED BY PURITY

MORE PURE →

SOCIOLOGY IS JUST APPLIED PSYCHOLOGY

PSYCHOLOGY IS JUST APPLIED BIOLOGY.

BIOLOGY IS JUST APPLIED CHEMISTRY

WHICH IS JUST APPLIED PHYSICS. IT'S NICE TO BE ON TOP.

OH, HEY, I DIDN'T SEE YOU GUYS ALL THE WAY OVER THERE.

SOCIOLOGISTS   PSYCHOLOGISTS   BIOLOGISTS   CHEMISTS   PHYSICISTS   MATHEMATICIANS
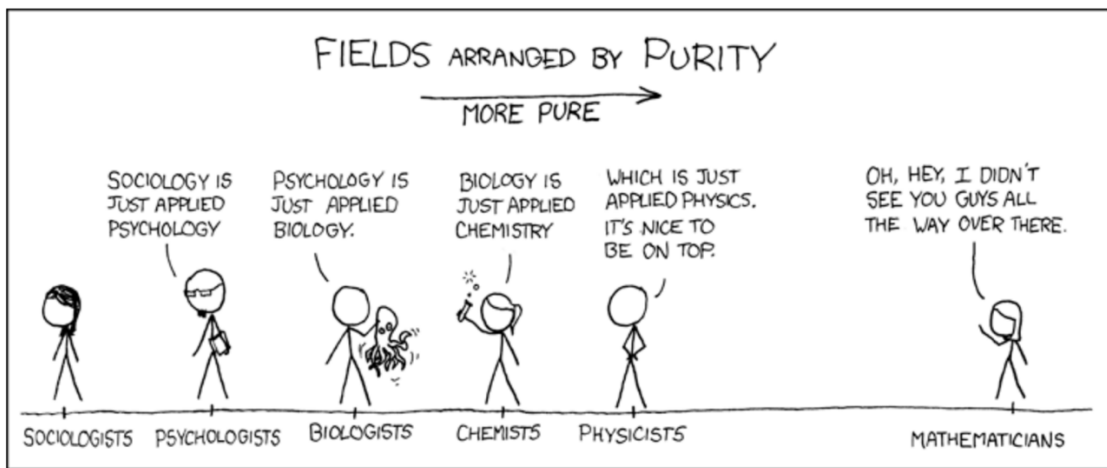
The comic above highlights some of the misconceptions about math. Many in the math field continue to see math as this agnostic field, where an individual's lived experience is irrelevant to the study of the content. In other words, math is a 'pure' field of study. However, holding a hierarchical view of content such as sociology, biology, applied physics or mathematics negates the reality that our lived experience informs our career choices and pathways, even in mathematics. Additionally, it serves to provide

90

artificial barriers between all fields of study. Unfortunately, this means that there is no clear delineation between what a terminal and non-terminal mathematics course. Does Abstract Algebra represent a terminal mathematics course, or is College Algebra? The answer, of course, depends on your field of study and what you need. Therefore, I needed to clarify what mathematics I wanted to focus on to ensure that the groups I was comparing were in truly terminal mathematics courses, that were sufficient for their majors.

Determining the difference between STEM and non-STEM courses can be somewhat arbitrary. As such, I worked with university leadership to discern specific university requirements for STEM students (J. Hagman & R. Morgan, personal communication, October 30, 2020; K. McLaughlin, personal communication, June 5, 2020). The inclusion criteria for study participants required students to be enrolled in a terminal math class that was non-calculus based. Again, many of the STEM based math courses, which traditionally include calculus-based courses, have received a fair amount of study from various researchers (Crabtree et al., 2019; Darolia et al., 2019; Paschal & Taggart, 2019). Non-calculus class are frequently overlooked by math departments and are often provided minimal support. M117/118 represents a great example of this in MSU case. The course has not dramatically changed since 2005, using the same videos and resources created 2005, despite serving over 4000 undergraduate students each year (S. Golden & R. Morgan, personal communication, February, 2021). Even when instructors

have made efforts to update videos from 2005, the department has not spent resources or energy to change the underlying structure of the course.

In the context of the present research, a terminal math class is identified as one that satisfies graduation requirements for MSU AUCC. For students at MSU, students have two sets of requirements to meet for graduation: their specific departments requirements, as well as the AUCC requirements. Two MSU courses met this distinction: Math 101: Math in the Social Sciences; and Math 117/118: College Algebra in Context. College Algebra in Context is analogous to Pre-Calculus courses in traditional high schools, covering topics such as graphing all equation families like linear, quadratic, cubic, trigonometric, exponential. Additionally, College Algebra covers topics such as trigonometric identities, properties of conics and other topics beyond basic algebra concepts taught in high school.

All Math 101 sections are terminal, the course counts for graduation credit, and it does not cover any topics in a traditional calculus course. As such, Math 101 met the requirements for this study.

By contrast, Math 117/118 represents a much larger program, comprised of students pursuing multiple pathways—including STEM. M117/118 serves approximately 2000–3000 students each semester. However, most sections of M117/118 are not instructor led. Instead, students work independently to complete College Algebra level modules on their own (S. Golden & R. Morgan, personal communication, February, 2021). Included in M117/118 are students planning to study chemistry, physics,

engineering, mathematics, biology, psychology, and other science majors. For students planning to major in chemistry, physics, engineering or mathematics, this course is not a terminal mathematics course. Additionally, while it does technically count as credit towards graduation, students in these majors traditionally earn more than enough math credits to cover AUCC graduation requirements, and this class could be considered remedial for STEM pathway students. This leads to STEM students starting in this course perceiving themselves to be behind their peers (J. Hagman & R. Morgan, personal communication, October 30, 2020). As such, this course does not align with the underlying assumptions of this paper for chemistry, physics, engineering, or mathematics students. Therefore, students who participated in the initial survey who identified as chemistry, physics, engineering, or mathematics majors were not included in the final tabulations for the data analysis of this study, nor were they invited to be part of the qualitative interviews. However, for biology and psychology students, Math117/118 is a terminal course that does not incorporate any traditional calculus concepts. Thus, these students were eligible for study participation.

Math 101 and Math 117/118 had two different formats in which the class was taught. For both classes, most students took a self-paced, asynchronous course, using an online platform to watch videos, complete assignments, and demonstrate mastery of concepts. Math 101 and Math 117/118 had two sections dedicated to serving traditionally marginalized groups such as Latinx students, first-generation students, or students from under-resourced families (J. Hagman & R. Morgan, personal

93

communication, October 30, 2020; K. McLaughlin, personal communication, June 5, 2020). Math 101 had two sections, which had a maximum enrollment of 30 students. Due to COVID-19, students enrolled in the semester of study had the choice to attend class in person or watch asynchronously, per university policy.

Math 117/118 had a much more formalized program, known as Paced Algebra to Calculus electronically (PACe). These instructor-led sections focus on traditionally marginalized communities but still utilize the online system for a majority of students (J. Hagman & R. Morgan, personal communication, October 30, 2020). Most students who enrolled in Math 117/118 complete the course independently and asynchronously and were deemed proficient once they complete five individual modules: algebra, geometry, college algebra, trigonometry, and statistics. Only students in sections that work directly with an instructor were included in this study.

Further Differences between Math 101 and Math 117/118

While the content for Math 101 and Math 117/118 are different, the intent of aligning to students' individual pathways aligns with Ginsberg and Wlodkowski's (2009) *enhancing meaning* domain (2009). These different pathways ensure that students enroll in mathematics courses most clearly aligned to their degree pathway, which represents more of the structural elements of CRTP and CRP. As discussed earlier, STEM pathways have received more focus and support in working with traditionally marginalized groups, including Latinx students. However, MSU supports Latinx math students outside of STEM fields. For example, the department intentionally hires more diverse instructors to

teach students in the PACe program and Math 117/118 instructors receive professional

development around culturally responsive practices (J. Hagman & R. Morgan, personal

communication, October 30, 2020). Therefore, since some students in the Math 117/118

PACE program were not themselves in STEM fields, they benefited from being

proximately located to traditional STEM students.

Math 101, on the other hand, received no additional professional development

around CRTP, and instructors are not intentionally hired for the program, based on

anything more than qualification to teach collegiate mathematics (J. Hagman & R.

Morgan, personal communication, October 30, 2020). Additionally, no students in this

pathway are pursuing majors in chemistry, physics, mathematics, and engineering. As

such, the Math 101 sections, which are traditionally viewed as non-mathematics

pathways, have received much less emphasis around how to better support their students.

In other words, unlike their peers in Math 117/118, they are not presently benefiting from

a proximal relationship to students in STEM pathways and nor an intentional focus on

CRTP.

Research Question 1

This study begins by asking: How are student perceptions of mathematics affected

when Culturally Responsive Teaching Practices are utilized in a first-year, non-remedial

mathematics course? This first question was designed to utilize Independent Samples t-

test between the two classes to better understand if there is an impact on student

experience within a first year, non-remedial terminal mathematics course based on instructors' receipt of CRTP training.

Quantitative Design Type: Independent Samples t-Test

This study represents a critical first step in understanding Latinx student experiences in a 100-Level terminal college math class. However, given the limited literature around instructional practices in the collegiate environment, RQ1 also looked closely at the descriptive statistics of the class in addition to an independent samples t-test between a control group and a treatment group. RQ1 explored the impact of a CRTP treatment within a 100-level terminal mathematics course, and then looked at the control group that received traditional instructional practices in separate 100-level terminal mathematics course. For this study, an Independent Samples t-test was utilized to determine if I can eliminate the null hypothesis to show that students perceive a difference between the utilization of CRTP in the control group, as compared to students' perceptions of CRTP in the treatment group.

Quantitative Model Development

Since this model looked at the perceptions of CRTP for all students, the qualitative section will be utilized to better understand the experiences of Latinx students within the control and the treatment class. As mentioned in Chapter Two, it was challenging to develop a broad understanding of a group as large and diverse as Latinx students.

Assumptions. Prior to running this test, three assumptions needed to be met. First, was the independence of errors (Spatz, 2016). In the context of this study, it implied that students from one of the groups are entering these mathematics courses with consistently and substantially different mathematical experiences that other groups. Since students were not strategically placed in the control or treatment group, and since student selection was randomized across these two courses, this assumption was met.

The second assumption for Independent Samples t-test was the assumption of normality of errors (Gamst et al., 2008). This assumption was satisfied by meeting our sample size requirements and visual inspection of normally distributed CRTP practices survey. From G*Power, an a-priori test was run to determine the number of subjects that would be necessary for this model. The statistical test chosen was the means: the difference between two independent means (two groups). The input parameters chosen were as follows: a two tailed test, with an effect size of 1, and an alpha of .05. From this, it was determined that for the quantitative portion of this study, I would need a minimum of 54 students. The two-tailed test was chosen so as not to presume one group would necessarily perform better than another. Throughout the study I was unable to gather 54 students and was only able to recruit 26 students. Fortunately, Welch identified that for independent samples t-tests, test groups can be as small as 6 subjects per group, assuming the assumptions have been met (1947, p. 28-35). However, Welch did indicate that inferences will be tenuous at best.

Normality was found by examining the skewness and kurtosis of the collected data. In trying to determine what acceptable levels of skewness and kurtosis may exist in educational environments, and specifically in mathematical environments, a skewness of ±2 and a kurtosis value of ±8 were found to be reasonable (Gamlem, 2019). For this study, skewness for all four domains and the overall CRTP perception metric were found to be between -1.6 and 1.46 implying that this data meets the requirement for skewness. Additionally, kurtosis was found to be between -1.47 and 2.58, again indicating the data is reasonably normal and can be used for analysis without transforming the data into z-scores.

The final assumption that was be met for an Independent Samples t-test is Homogeneity of Variance (Gamst et al., 2008). This assumed that distribution of errors is similar across groups. To test this, sample groups should be within a ratio of 1.5:1 (Gamst et al., 2008). These criteria were met, and a Levine's test was conducted to determine the F-value and its statistical significance. The null hypothesis for the Levine's test is that the two sample groups will satisfy the homogeneity of variance assumption; however, if the F-test produces a p-value less than .05, that will indicate that there is a statistically significant difference between the variances and will therefore require additional analysis. Fortunately, Independent Samples t-tests are robust with respect to violations of homogeneity of variance if group sizes are similar (within a ratio of 1.5:1).

For my study, the group sizes did fall within the ratio of 1.5:1, with 14 participants from the control group and 12 participants from the treatment group,

indicating the groups were of reasonably equal sizes. Additionally, Levine's test produced p values between 0.83 and 0.92, indicating that there was not a statistically significant difference between the variances of the control group and the treatment group.

        Variable Considerations. To calculate values for each independent variable, based on a series of questions from the Rhodes' (2016) survey, it was necessary to develop a method to incorporate the questions within the survey for each domain into a single value. All questions were averaged into a single value, representative of that respondent's perception of CRTP practices.

Quantitative Instrumentation

        To better understand the relationship between CRTP in a first year, non-remedial terminal math course, I utilized a survey design model to understand Latinx student's attitudes and opinions (Creswell & Creswell, 2018). The instrument used was borrowed from Rhodes' (2016) design around assessing collegiate instructors' usage of Ginsberg & Wlodkowski's (2009) four domains of CRTP in college, located in Appendix A. Rhode's instrument was validated with instructors of adult English to Speakers of Other Languages (ESOL) and English for Academic Purposes (EAP) (2017). Rhode's reviewed data from '15 state or community colleges, 2 universities, 8 school districts, and the Bay Area Regional TESOL (BART) (2017, p. 47). Therefore, the limited professional development that instructors received, and the results from this survey should be viewed through a descriptive lens. In other words, this survey is being utilized to describe the

99

experience of these students and should not be construed as measuring a latent variable, given the above constraints.

There were two challenges with Rhodes's (2016) instrument as constructed. First, the instrument is educator focused, meaning the questions are from the point of the view of the educator. Therefore, it was necessary to reframe these questions from a student perspective. In terms of copyright issues, Rhodes' (2016) survey falls under an Attribution-Non-Commercial 4.0 International head per the creative commons license. Secondly, the instrument was validated with instructors in ESOL programs. Most of the students in my study spoke English as a first language. It is critical to keep in mind that this survey may not be as adept at clarifying the experience of students in my sample since it has been modified to illuminate their experience, and since they are not ESOL students.

Instrument Validity and Construction. Rhodes' (2016) survey was found to have a Cronbach's alpha between .781 and .880 for instructors. I made the decision to adjust the survey to be used for students to understand their perceptions of their instructor's use of the four domains of CRT in college (2016). Rhodes' (2016) original survey contained 17 survey questions, focused on the four domains from Ginsberg and Wlodkowski (2009).

While the original instrument provided a good basis, there were a couple problems. There are three double-barreled questions, which essentially asked for input on two separate issues within one question, and may conflate answers (Survey Anyplace,

2020). Therefore, these questions have been broken into two distinct questions for the purposes of this survey. For example, question six of Rhodes' *Culturally Responsive Teaching Survey* was double-barreled, centering the instructor as the respondent. The question was adjusted as follows:

> Original Question 6: "I use mixed-language and mixed-cultural pairings in group work."
>
> Adjusted Question 7: My instructor uses mixed-language pairs in group work.
>
> Adjusted Question 8: My instructor uses mixed-cultural pairings in group work.

Survey Administration. To gather data from Latinx students in a non-remedial, first-year mathematics course, I designed a 33-question survey. The survey was administered by me during the first fifteen minutes of the students' class, during the first two weeks of April 2021, while students were still attending in person. Students were provided paper copies of the survey and had an opportunity to complete the survey during class. Responses were entered into Qualtrics. Students who did not wish to participate were given an opportunity to opt out and one student chose to opt out. Each question was designed on a sliding scale between 1 and 7. The rationale for choosing a sliding scale, as opposed to a Likert scale, grew from the desire to provide a wider spread of data in the analysis, as well as providing a better fit for students responding to an electronic survey (Finstad, 2010).

Sample Items. The first 19 questions within Rhodes' (2016) survey were broken into the four domains: *establishing inclusion* (8 questions), *developing attitude* (3

questions*), enhancing meaning* (2 questions*)*, and *engendering competence* (6 questions)

(Ginsberg & Wlodkowski, 2009; Rhodes, 2016). Remaining questions were

demographic in nature, focusing on the student spoken language at home, extra-curricular

involvement in university Latinx group, gender, and scholarships/grant awards received.

Additionally, questions regarding student's expected grade and intent to return in the fall

were asked. These questions allowed the students to remain anonymous, thus presenting

the lowest possible risk of harm from survey participation. These questions, along with

the remainder of the survey were completely optional for students and students had the

opportunity to opt out at any time.

Administration of the Survey. Working with the Dean of Mathematics and

an Assistant Professor at MSU, four sections of a non-remedial, first-year terminal

mathematics course were identified for our work. Since this project took place in the

Spring of 2021, concerns due to the Coronavirus pandemic were considered. For

example, the selected math course was being taught primarily virtually. However, the

Math 101 and Math 117/118 sections within this study are historically designed to better

support traditionally marginalized groups by providing class sizes of no more than 30

students direct access to an in-person instructor, versus the self-paced model or large

lectures the other sections use. Additionally, these classes gave students the option to

attend in person, or virtually, to provide better support to students (J. Hagman & R.

Morgan, personal communication, October 30, 2020; K. McLaughlin, personal

communication, June 5, 2020). While I am not sure how many students attended

102

virtually, I observed that an average class consisted of 4-8 students in person. Students who attended remotely, were given a link to complete the survey remotely through Qualtrex; however, zero students who attended class remotely completed the survey.

Administration of the survey took place in April 2021. The time was chosen so that instructors had adequate time to utilize a variety of practices to better support Latinx students, and students had an opportunity to experience a variety of teaching practices.

Conclusion for Research Question 1

At the conclusion of the study, the question 'How are student's perceptions of mathematics affected when Culturally Responsive Teaching Practices are utilized in a first-year, non-remedial mathematics course?' was examined utilizing an Independent Samples t-test and found that for some domains, there was a statistical difference between the means of domains and the overall utilization of CRTP within the selected courses. However, given the limited sample size and only 1-hour training, these differences need to be further studied and conclusions will be tempered to reflect this limited training.

Research Question 2

The second research question within this mixed-methods study was around Latinx students' perceptions of their instructor's use of CRTP to *establish inclusion, develop student attitude, enhance meaning*, and *engender competence* in a first-year, non-remedial math class. To explore Latinx student perceptions around instructor practices, a qualitative approach was utilized to help better understand how students perceived their

instructor's practice. This next section details how the outline was developed, who was interviewed, how the data was analyzed, and how credibility was established.

Qualitative Design Type

To utilize a mixed methods approach, data which is traditionally qualitative in nature must be collected. However, there must be a justifiable reason as to why qualitative data analysis is the preferred method over other forms of analysis such as quantitative. While the quantitative data provides researchers questions to effectiveness of programs, or differences between trials, quantitative data does not provide insight into the lived experiences of our subjects. For studies looking at traditionally marginalized groups, it is critically important to infuse their voices into the study (Creswell & Plano Clark, 2018, p. 128). I am interested in understanding how Latinx students perceive their experience in a first-year, non-remedial mathematics. From this understanding, there may be an opportunity to support instructors in making meaningful changes to their practice, capitalizing on methods that better capture Latinx student voice (Merriam & Tisdell, 2016, p. 6).

Qualitative Sample

To better understand Latinx student's experience in a first-year non-remedial, college level math class, I worked closely with a variety of Latinx students to capture a broad swath of the Latinx student experience. To best gather Latinx student voices, purposeful sampling was utilized (Merriam & Tisdell, 2016). Four students were selected to participate in the qualitative research portion of this student. Of the four students, I was

able to find one male and one female from each course to participate in this study. The initial demographic survey was designed to allow students to select the gender they are most comfortable identifying with. Additionally, selected students represent a broad cross section of non-STEM college majores represented in a first-year non-remedial college math class (Rincón, 2018). This was to ensure that students pursuing a variety of academic pathways have an opportunity to reflect on the relevancy of their mathematic experience in pursuit of their major.

Within this selection of students, it was necessary to consider other student characteristics such as gender identification, non-native English speakers as well as English speakers, students who have received scholarships and those who have not, as well as students who participate in extra-curricular activities, and those who do not. (Baldwin, 2015; Barbera, et al., 2017; Brown et al, 2017; Cruz et al, 2019). The value of these character traits was that they paint a more complete picture of the experience faced by Latinx students. By designing parallel questions between the qualitative and quantitative research questions, I ensured that Research Question 3 aligned both questions strategically, so I can integrate the results to better understand our participant's experience in conjunction with the broader data set from the RQ1. To collect these complex stories, a group interview coupled with individual interviews were utilized to capture both group experiences and individual experience. The group interview was conducted in late February 2021. The individual interviews occurred in April 2021. In

this way, this study examined the collective experience of our Latinx subjects as well as their individual experience (Merriam & Tisdell, 2016, p. 233).

Since the focus of this dissertation is on Latinx student perceptions in a first-year non-remedial mathematics course, a convenience sample of Latinx students in multiple sections of two specific math courses were invited to participate through an initial survey instrument, administered at the beginning of the course. The instrument collected information on student gender, first-language, participation in extra-curricular activities, and receipt of scholarships or grants. Convenience was chosen over other sample methods, given the limited time, potential respondents, and impacts of COVID-19 (Merriam & Tisdell, 2016).

Qualitative Data Collection. Before Latinx participants were identified, the researcher must address reliability and validity (Maxwell, 2013), as "[i]nternal validity in all research hinges on the meaning of reality" (Merriam & Tisdell, 2016, p. 242). To best relate the Latinx students experience within their class to the larger Latinx population, there must be a clear framework with which to assess their experience. In this way, the framework of CRTP provided the common language between all participants (study subjects and researcher) to help elevate their experience.

The CRTP framework has four pillars: *establishing inclusion, developing attitude, enhancing meaning* and *engendering competence* (Ginsberg & Wlodkowski, 2009). To gather perceptions from Latinx students, questions from each pillar have been adapted to help illustrate the Latinx student experience in a first year, non-remedial college math

106

course, all pulled from Ginsberg & Wlodkowksi's (2009) CRTP framework. These represent a sample of the questions presented in the initial questionnaire, found in Appendix B.

1) *Establishing Inclusion*:

    a.   How are the thoughts, feelings, interests and needs of every individual in the class invited, listened and responded to, acted on, and honored, if at all?

    b.   How are collaboration and cooperation incorporated into daily activities?

    c.   Do you perceive your instructor's delivery of content to be inclusive and representative of a larger world view? Why or why not?

2) Developing Attitude:

    a.   Were you invited to discuss culturally relevant terminology? For example, preferences around terms like Hispanic, Chicano, Latino/a/x?

    b.   How has your voice influenced activities projects/assignments in your class, if at all?

    c.   How have projects, research, and deep, authentic problem solving been incorporated, if at all, in your classroom?

3) Enhancing Meaning

  a. What structures, if any, are present to help you consider the content

    of your learning with regards to your lived experience and

    understanding of the world?

  b. How are intriguing problems utilized in class, if at all? (Problems

    that are relevant to you and cause you to think beyond just getting an

    assignment done).

 4) Engendering Competence

  a. How does the assessment process connect to your frame of

    reference and values?

  b. How does the instructor allow students to demonstrate their

    learning of content?

Qualitative Data Analysis

    After Latinx students were identified and had chosen to participate, it was critical to ensure that their voices, experiences, and reflections were captured accurately. First, all interviews will be recorded using zoom built in recording. Additionally, a small voice recorder was utilized to record the conversations as well (Creswell & Poth, 2018). At the conclusion of the interviews, TranscribeMe!, an online transcription service was utilized to transfer the recordings to a word for word transcription. Next, the researcher listened to the recordings while reviewing the transcriptions to ensure what was said was reflected in the transcription.

Utilizing the framework of Culturally Responsive Teaching Practices, a deductive coding approach was utilized (Ginsberg & Wlodkowksi, 2009). In this approach, the themes had already been identified. From CRTP the themes were: *establishing inclusion, enhancing meaning, engendering competence* and *developing attitude* (Ginsberg & Wlodkowski, 2009). In addition, codes emerged from conversations that I had not planned for, in which case those were also be identified and recorded. This happened when multiple students' comments had a similar theme, that I had not planned for already.

Codes were summarized in Microsoft Excel Spreadsheets, by grouping specific codes in each sheet within a single workbook. Captured within each code sheet, were statements, reactions, and other data from the recordings and transcriptions which will help align the statements of all subjects to specific codes, which will begin to help frame the Latinx student experience in a first-year non-remedial collegiate mathematics class.

Qualitative Trustworthiness & Credibility

To best understand the perceptions of Latinx students in a first-year, non-remedial math course at a public university, I had to be willing to examine my own biases (Maxwell, 2013). To begin examination of potential validity threats, the research question must lend itself to examination through qualitative means and have a need to be better understood. Research Question 2 states: "What are Latinx student perceptions of their instructor's use of Culturally Responsive Teaching Practices in College to establish inclusion, develop student attitude, enhance meaning, and engender competence in a first-

year, no-remedial math class?" The reason this question was critical, as presented in chapters one and two, was that despite the increasing Latinx community within the United States, the percentage of Latinx students attaining a four-year degree was still far below their White peers. Often, mathematics presents a roadblock for first-year college students (Callahan & Belcheir, 2017; National Center for Educational Statistics, 2019).

To better understand why current mathematic instructional practices were or were not resonating with incoming Latinx students, it was necessary to capture their voices and stories to better understand what they were experiencing. While their voices may not necessarily represent the entirety of the Latinx community, their voices were critical in understanding these student's stories and experiences (Gutierrez & Rogoff, 2003). It is here, that the first real potential validity threat is present: as a researcher who identifies as a White male, I have been privileged to exist in an educational system that sees my skin and gender and assumes that I belong (Gay, 2018, p. xxiii). From my own experience, I have heard, and even repeated phrases such as "mathematics is agnostic to gender, culture, race, or ethnicity."

While I have begun to recognize the importance of gender, culture, race and ethnicity can have on the delivery of mathematics, I am aware of my journey towards recognizing different voices in the conversation around how to better support our students. This means not dismissing comments, simply because they do not resonate with my own experience; rather, I must work to delve deeper into Latinx student comments around how to better support their needs in traditional mathematics classes—even when it

may go against my personal disposition. Additionally, I am working to recognize that no one person's experience transcends an entire cultural group.

Therefore, while my hope was to better understand the Latinx student experience in college math, I must remember that these are the stories of a handful of Latinx students, whose experiences were their own. As future research continues to explore Latinx student experience, the stories of the students I worked with can help paint a more complete picture; however, their experiences are simply their experiences, informed by their own histories, which may be informed by their gender, English Language Acquisition status, socio-economic status, and other mitigating variables that may not be captured within the scope of this paper.

Another threat to validity is around the method of data collection. The first part of the qualitative analysis was a semi-structured group interview. While this aided in providing a space for participants to share ideas, and collaborate in developing the narrative of the experience, it may have also prevented some students from sharing their specific truths, especially around sensitive areas such as how their identities influenced their experience. As a result, I followed up during one-on-one interviews to delve deeper into individual experiences, with the intent to better understand each individual's unique experience (Maxwell, 2013).

Ensuring validity in qualitative analysis of data is just as critical as mitigating validity threats early on. To address validity after the data has been collected, the researcher is required to examine codes and themes that arise from artifact collection,

interviews and focus groups (Creswell & Poth, 2018). To ensure that the codes and themes identified were representative of the participates experience, member-checking was utilized to verify the results. Member-checking is when the researcher provides the participants the summary of the data and askes for their interpretation as to its validity in capturing the participants voice (Creswell & Poth, 2018; Maxwell, 2013, p. 126).

Conclusion for Research Question 2

The intent for asking 'what are Latinx student's perceptions of their instructor's use of CRTP to establish inclusion, develop student attitude, enhance meaning, and engender competence in a first-year, non-remedial math class' was to capture student voice to elevate their experiences and how CRTP impacted student learning, and ultimately affected retention. By utilizing group and individual interviews, and then coding the responses to identify themes, and finally reviewing findings with students, there was an opportunity to better understand which practices resonated with specific students, and why (Creswell & Poth, 2018).

Research Question 3

For reasons stated in chapters two and three, regarding the inability to distill the quantitative data into more meaningful data for subpopulations of Latinx students, the blending of the qualitative data with the quantitative data provided a more nuanced understanding of the quantitative results coupled with the qualitative feedback.

For Research Question 3 (RQ3), the qualitative data and the quantitative were integrated to identify areas of convergence and divergence between the two data sets

(Creswell and Plano Clark, 2018). Integration occurs when the preceding two research questions are used to compare qualitative and quantitative results with each other to better understand the topic at hand. Research Question 3 states, "What do Latinx student perceptions of the four domains reveal about the relationship between these domains and student success in the class?" In this question, the intent was to examine the relationship between the Latinx student community's experience of 100-Level terminal math class where CRTP may or may not have been utilized, and examine those results compared to a smaller population's perceptions of how their instructors utilized those same practices. The goal was to better understand how students react at the end of the math course, to provide instructors with the learning necessary to better support Latinx students in the future.

Mixed Methods Design: Integration Rational

The strength in mixed methods design comes from the integration of qualitative and quantitative data sets (Creswell & Plano Clark, 2018). Depending on the chosen mixed-methods design, integration takes on a variety of different forms. In the context of a present convergent mixed-methods design, integration is intended 'to obtain different but complementary data on the same topic' (Creswell & Plano Clark, 2018, p. 68; Morse, 1991, p. 122). Once both sets of data have been obtained, the opportunity to compare the data sets presented itself to the researcher and allowed the researcher to better understand multiple facets of a single problem. Creswell and Plano Clark (2018) explained:

113

Integration of qualitative and quantitative data sets is a critical component of a

mixed methods design and has four stages a researcher must consider prior to

conducting research: the intent for the interrogation, the interrogative data

analysis procedures, the representation of the integration results, and the

interpretation of the integration results. (p. 220)

Mixed Methods Data Analysis

To analyze mixed-methods data, the research needed to bring both the qualitative

and quantitative data forward in a way that allows the reader to review the data side-by-

side (Creswell & Plano-Clark, 2018). For this study, joint display is a method that

provides an opportunity to explore emergent themes from the qualitative research

question with the quantitative results. In Table 3.1, the first column represents themes of

the findings from research question two. The remaining columns represent the number of

responses that align to the specific themes, aligned to the four CRTP domains.

The quantitative portion of Table 3.1 comes from an analysis of Research

Question 1. The intent of the last row, titled 'Summary' is to provide the statistical

significance, based on the Independent Samples t-test, as well as a summary of the

quantity of comments in each domain aligned to specific themes. Finally, I will use this

document to compare and contrast the number of responses within each domain to the

results of RQ1, to explore how these results support each other or open the door for

further exploration.

Table 3.1 *Latinx Student Perceptions of Culturally Responsive Teaching Practices*

	Establishing Inclusion	Developing Attitude	Enhancing Meaning	Engendering Competence
Themes				
Theme 1				
Theme 2				
Theme 3				
Theme 4				
Summary				

Note: Table 3.2 is the completed version of this table, adjusted to meet the page dimensions

Table 3.2 *Quantitative and Qualitative Integration*

	Establishing Inclusion	Developing Attitude
Themes		
Conceptual understanding of material	(+B) Individualized pacing (-C) Unintentionality	(+C) Student Q/A (+B) Supportive relationships (-B) No relevancy (-T) Limited Student Q/A
Affirm students are not alone with regards to the challenge of mathematics	(+C) Student-Student discussions	(+T) Examples of mathematicians struggling
Real world application of mathematics		(-B) No relevancy
Who can do mathematics	(+T) Examples of mathematicians of color (-C) Narrow definition of mathematicians	(+T) Students called mathematicians (-B) No discussion on identities (-B) No student-student projects
Mathematics as it relates to student's passions and pursuits		
Multiple pathways to success	(+T) Advocate instructors	
Summary	Control: 1 Positive, 2 negative Treatment: 2 positive, 0 negative Both: 1 positive, 0 negative t(26) =-3.111, p<0.005	Control: 1 Positive, 0 negative Treatment: 2 positive, 1 negative Both: 1 positive, 4 negative t(26) =-0.09, p>0.05

116

Table 3.2 *Quantitative and Qualitative Integration*

	Enhancing Meaning	Engendering Competence
Themes		
Conceptual understanding of material	(-B) Limited co-construction (-C) Lecture (-B) No student input to content (-T) Ineffective group structures	(+B) Actionable assessment feedback. (+T) Student reflection (-T) Rigid class autonomy
Affirm students are not alone with regards to the challenge of mathematics		(+T) Advocate instructors
Real world application of mathematics	(+C) Election practices	(-C) Inauthentic content leading to poor retention
Who can do mathematics		
Mathematics as it relates to student's passions and pursuits	(+T) Job related article selection.	
Multiple pathways to success		(+C) Flexibility on final assessment
Summary	Control: 1 Positive, 1 negative Treatment: 1 positive, 1 negative Both: 0 positive, 2 negative t(26) =-0.66, p>0.05	Control: 1 Positive, 1 negative Treatment: 2 positive, 1 negative Both: 1 positive, 0 negative t(26) =-3.33, p<.05

Conclusion for Research Question 3

Integrating qualitative and quantitative data is critical for a mixed methods research study (Creswell & Plano-Clark, 2018). To understand the impact of CRTP in a first year, non-remedial terminal mathematics course, and how these four domains relate to student definitions of success, there must be an opportunity to explore both qualitative and quantitative datasets together. Using the joint display in Table 3.1, it is possible to begin to explore how students' responses in research question two can support, or challenge, the data that is collected in research question 1.

Chapter Conclusion

This dissertation has three primary research questions:

1. How are student perceptions of mathematics affected when Culturally Responsive Teaching Practices are utilized in a first-year, non-remedial mathematics course?

2. What are Latinx student perceptions of their instructor's use of Culturally Responsive Teaching Practices to establish inclusion, develop student attitude, enhance meaning, and engender competence in a first-year, non-remedial math class?

3. What do Latinx student perceptions of the four domains reveal about the relationship between these domains and student success in the class?

To address research question one, an Independent Sample t-test was used to compare student perceptions of CRTP in a Control group, where instructors received no

professional development, to instructors in a Treatment group, where instructors did receive professional development around CRTP. Using G*Power (version 3.1.9.6), a minimum sample size was determined to support statistically significant conclusions. Finally, a discussion around how to determine the strength of the correlation between four domains and specific Latinx subpopulations and the statistical significance of those conclusions was presented.

The methodology around how to answer Research Question 2 has also been explained. The process utilized qualitative data-collection techniques, by developing codes for the qualitative interviews in advance of the study. These codes are based on Ginsberg & Wlodkowski's four CRTP (2009). Finally, through member-checking, emergent themes were critiqued and evaluated for their reliability in articulating individual experiences of Latinx students in a non-remedial, first-year mathematics course.

Finally, research question three integrated both the quantitative data and the qualitative data through a joint display (Creswell & Plano-Clark, 2018), to more deeply explore how student's perceptions informed the data.

Chapter Four: Data Analysis

I worked to understand how the frameworks of Culturally Responsive Pedagogy (CRP) and Culturally Responsive Teaching Practices (CRTP) could help support Latinx students in a first year, non-remedial terminal mathematics course (Ginsberg & Wlodkowski, 2009; Ladson-Billings, 1995). To explore the relationship between CRTP and Latinx student's perception of mathematics, I designed three research questions:

1) How are student perceptions of mathematics affected when culturally responsive teaching practices are utilized in a first-year, non-remedial terminal mathematics course?

2) What are Latinx student perceptions of their instructor's use of culturally responsive teaching practices to establish inclusion, develop student attitude, enhance meaning, and engender competence in a first-year, non-remedial terminal math class?

3) What do Latinx student perceptions of the four CRTP domains reveal about the relationship between these domains and student success in the class?

To answer these three questions, I utilized a convergent mixed methods design, running qualitative and quantitative data collection simultaneously. In chapter four, I begin by analyzing the quantitative data (RQ1), then analyze the qualitative data (RQ2),

and conclude by merging the quantitative and qualitative data to study similarities and differences between them.

Control Group versus Treatment Group Perceptions of CRTP – Quantitative Analysis

Hypothesis

For my first research question, I was curious how students perceive the instructor's inclusion of culturally responsive teaching practices within a first year, non-remedial mathematics course. The interest behind this approach is to better support students in first-year, non-remedial mathematics courses to improve student retention. In choosing an Independent Samples t-Test, I hoped to discover whether the Null Hypothesis could be rejected, in favor of a finding that there is a statistically significant difference, which can help mathematics instructors better support their students.

For context of this study, the Null Hypothesis assumed that students in one class do not perceive a greater usage of Culturally Responsive Teaching Practices by their instructors, as compared to students in another class. The key difference between the two groups was that one set of instructors has received instruction around CRTP as part of their training, while the other set of instructors has not. As such, equation 4.1 and 4.2 comparing the means of two groups against each other. Equation 4.1 is the null hypothesis, which assumes the two means are not substantially different. Equation 4.2 indicates that there is a difference between the control and the treatment groups.

$$H_0: m_{CRTP} \approx m_{Controlx} \tag{4.1}$$

$$H_1: m_{CRTP} \neq m_{Controlx} \tag{4.2}$$

Predictive Variables and CRTP

I began by examining who was present in these courses. Student enrollment in the two courses was based on academic advisor recommendation. From this, it appears that MSU was trying to address large-scale systems issues that may impede Latinx student success and supporting instructors with professional development around CRTP. If MSU was indeed trying to address system inequities within their course offerings, this should be immediately apparent through a simple demographic analysis of who is taking these courses. Additionally, the fact that some instructors received professional development around CRTP indicates that MSU is trying to address inequities within the classroom as well. In the chapter two literature review, I discussed several factors that influence how instructors and institutions view their students, thus influencing the student experience: college readiness versus college eligible; the intersection of gender and post-secondary success' involvement in extra-curricular activities; and the value of in-class Latinx communities (Cruz et. al, 2019; Hodora, 2015; Pak, 2018; Ponjuan & Hernandez, 2020; Zelkowski, 2011). The power with CRTP is that instructors who utilize these strategies naturally leverage their students' strengths despite the systemic inequities that have stood in the way of success historically (Ginsberg &Wlodkowksi, 2009; Ladson-Billlings, 1995). For example, Ginsberg and Wlodkowksi refer to opportunities within *establishing inclusion* where instructors build in opportunities for students to share personal

122

anecdotes, introductory exercises or any other activity that allows students to see each other as 'complete and evolving human beings' (2009, p. 107). In the case of the treatment group, Ximena referred to weekly check in during a time called 'highs and lows'. During this time, students talk about what has been happening to them this week, both the positive and the negative (Interview, 2021).   `

As a result, before transitioning into the descriptive statistics, it is necessary to explore the class demographic make-up, in terms of the above criteria, and explore the descriptive statistics through a more well-informed lens.

Demographics of Math Classes. For this study, two courses were selected. For one course, the instructors received some training on CRTP prior to teaching. This class was considered the treatment class and is identified in Table 4.1 as CRTP. For the second course, instructors received no training, and were simply given a textbook to teach from. This was called the "control." In both courses, there were a total to two sections, each with different instructors.

One challenge I had with the training component is that I was not present for the training. Were instructors in the treatment group taught explicit CRTP moves and theories, or were they just learning good instructional practices? Is one hour truly enough to make a substantial change in their instructional practice or were there inherent differences in how they approached their instructional duties that students observed more positively?

Table 4.1 illustrates the students in these two courses, and their parents'
educational attainment. Note that for each cell, the numerator represents the number of
men who identified the highest level of education for their immediate family in a
particular category, while the denominator represents the number of women who
identified the highest level of education for their immediate family. The rows represent
student self-identified racial identity. So, for the first cell, 0/2 represents 0 Latino men in
the CRTP reported that their immediate family did not receive a high school degree,
while 2 Latina women in this category reported that no one in their immediate family has
received a high-school diploma.

Table 4.1 *Student Reported Highest Level of Education for Immediate Family*

Race	Class	Gender Male/Female					
		Did Not Complete HS	HS or GED	Some College or Associates Degree	Four Year Degree	Some Graduate School	Graduate Degree
Hispanic or Latinx	CRTP	0/2	0/0	0/0	0/1	0/0	1/0
	Control	0/0	1/0	0/0	0/0	0/0	0/1
White	CRTP	0/0	1/0	2/0	1/0	0/0	0/1
	Control	0/0	2/0	2/0	1/1	0/0	3/0
Asian	CRTP	0/0	1/0	0/0	0/0	0/0	0/0
	Control	0/0	0/0	0/0	0/1	0/0	0/1
Black or African American	CRTP	0/0	0/0	1/0	0/0	0/0	0/0
	Control	0/0	0/0	0/0	0/0	0/0	0/0
Mixed Race	CRTP	0/0	0/1	0/0	0/0	0/0	0/0
	Control	0/0	0/0	0/0	0/0	0/0	0/1
Total		0/2	5/1	5/0	2/3	0/0	4/4

When students begin to consider college, there is a high correlation between students whose parents attended college and students who decided to attend college (Duncan & Murnane, 2011; Ryan & Ream, 2016). Kiyama notes that one way in which colleges and universities can mitigate this inequity is to engage a student's innate knowledge and skills—a term she refers to as a "funds of knowledge," to leverage the student passions and interests to help address this inequity (2010).

What this chart shows is that eight out of 25, or 32%, of students self-identify as first-generation students. For MSU in general, one in four students identify as first generation. Through my conversations with the department, there was no discussion around what defined "success" in terms of student demographics and enrollment in the program; however, given that 32% of students identify as first generation as compared to the 25% of MSU students who identify as first generation, it does appear that this program is doing better at reaching students who may be the first in their family to pursue post-secondary degrees (MSU, 2021).

A second observation from Figure 4.1 comes from the demographic make-up of the class.

Figure 4.1 *Math Course Ethnic Demographics Versus MSU Campus*
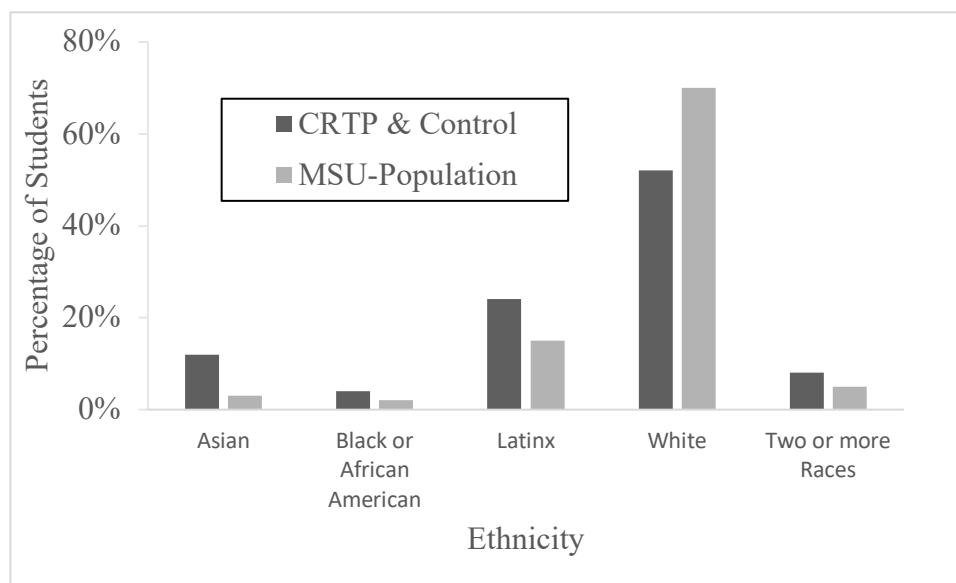
Note. For the Spring, 2021 semester, these math courses had only one student who completed the survey and identified as Black or African American. MSU campus data was pulled from NCES, 2018.

While initial conversations with department leadership indicated that these two classes were aimed at marginalized groups, White students comprise a majority in these classes (52% of the students surveyed in both classes identified as White, while only 32% identified as Latinx or Mixed Race) (K. McLaughlin, personal communication, June 5, 2020). When examined against the general population of MSU, 70% of students identify as White. On the other hand, while these sections maintain 24% Latinx enrollment, the university only has 15% of students who identify as Latinx. In fact, all traditionally marginalized groups appear to be better represented in these courses than in the general MSU population. Like the first-generation groups, the question remains: Is this enough?

Potential Variables. In chapter two, I identified several established variables that cause educational systems to historically underserve Latinx students and adversely affect their success in post-secondary institution. These variables included: (a) gender and collegiate success, (b) English Language Acquisition, (c) extra-curricular activities, and (d) receipt of scholarships/grants (Pak, 2018; Pratt et al., 2019; Perry & Hart, 2012; Ponjuán & Hernandez, 2020; Saenz & Ponjuán, 2008). Given what prior research has said regarding the benefit of CRTP embedded within classrooms, I wanted to understand if changes to the system could positively influence a student's trajectory and whether that influenced groups of students differently?

Sample sizes were too small to focus on significance for only on Latinx students. Therefore, for the Individual Sample T-test, I looked at all students within the control group and the treatment group, to determine if there was a perceived difference in their instructor's use of CRTP. However, to help tell the story of the Latinx students within the class, I also want to look closely at the demographic data for the Latinx students.

Latinx Gender and Perception of CRTP. When I examined the descriptive data examined when comparing Latino versus Latina students, it revealed the sensitivity Latino students have around the inclusion of CRTP within a first year, non-remedial mathematics course, as shown in Figure 4.2.

Figure 4.2 *Latinx Perception of CRTP in Treatment and Control as Differentiated by Gender*
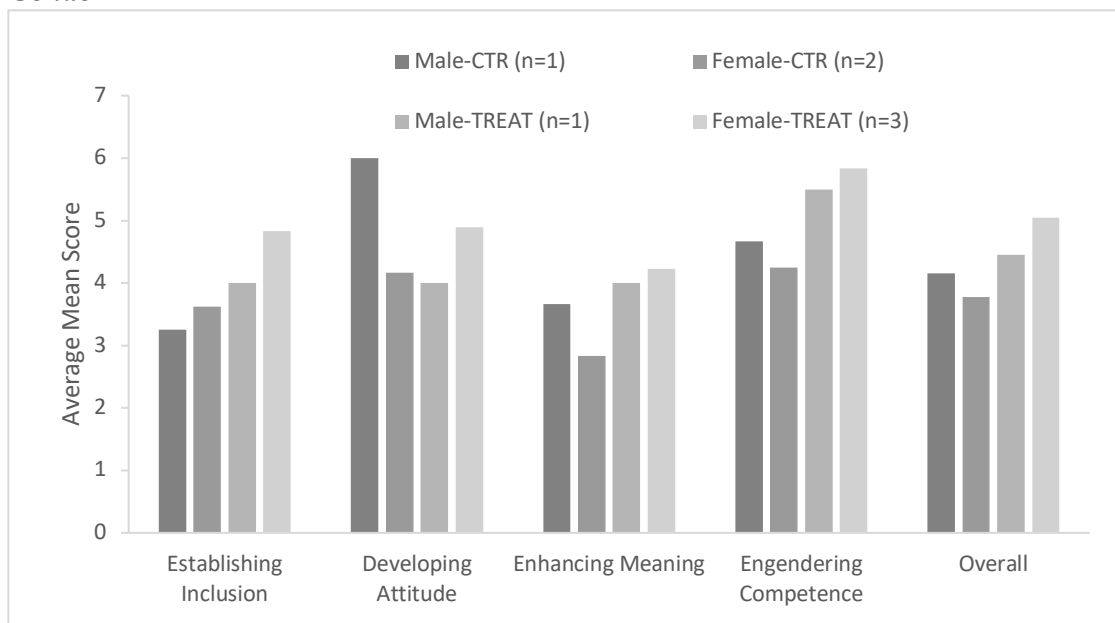
Note. ᵃThe Overall metric was calculated using a weighted average based on the number of questions in the survey aligned to each domain. The individual domains were calculated with a simple average for all members of the group.

This data must only be examined as these individuals' experiences with these courses, as the sample sizes are very low. Except for the *developing attitude* domain, the remaining three domains (*establishing inclusion, enhancing meaning* and *engendering competence*) all show the treatment classes perceived a greater usage of CRTP than the control group. However, it is critical to remember that this data reflects a majority White demographic, and therefore is skewed in favor of White student's perceptions. Further, the women in these groups noticed the inclusion of CRTP with an average mean of 0.72 to 1.58 points higher than those in the control class, on a 7-point scale. The comparison

between the two men was much smaller, with a difference in means between the domains of 0.33 to 0.83.

Language and Perception of CRTP. Universities have traditionally failed to retain students when trying to provide remedial opportunities for English Language Learners, due to extra time and money students are required to spend to gain access to college-level course work (Hodora, 2015). Ginsberg and Wlodkowski (2009) argue for addressing this challenge by embedding opportunities for students to engage with their work in their native language. For this study, only four students identified as having grown up in a family where a language other than English was primarily spoken at home. Of the four, two spoke Spanish, one spoke Tagalog (an Austronesian language), and one spoke Indonesian. On the survey, question 8 asked students if their instructor ever used "mixed-language groups." The two Spanish speaking students were in agreement that instructors did not use mixed-language grouping, while the Tagalog and Indonesian speaking students neither agreed or disagreed with the statement.

Extra-Curricular Involvement and Perception of CRTP. Pak (2018) identified that building strong relationships throughout the university community is beneficial to supporting student retention, while Ginsberg and Wlodkowski (2009) advocate for building a community within the classroom to aide in retention. In considering these two parts of community (inside and outside the classroom), this study examined how the perceptions of students in extra-curricular activities may differ from those who do not participate. As Pak (2018) noted, student responses to classes were more positive when

they were involved in extra-curricular activities. Additionally, since extra-curricular activity involvement is predictive of student retention, did students perceive a difference in the inclusion of CRTP based on their extra-curricular involvement? There were two questions, 29 and 30, which asked students about their participation in extracurricular programs, such as El Centro, Greek life, recreation leagues, service organizations, etc. When I examined only the Latinx students from the larger treatment and control groups, there continues to be a more positive trend with Latinx students perceiving a greater inclusion of CRTP within the treatment group, as showing in Figure 4.3.

Figure 4.3 *Latinx Perception of CRTP in Treatment and Control as Differentiated by Extra-Curricular Involvement*
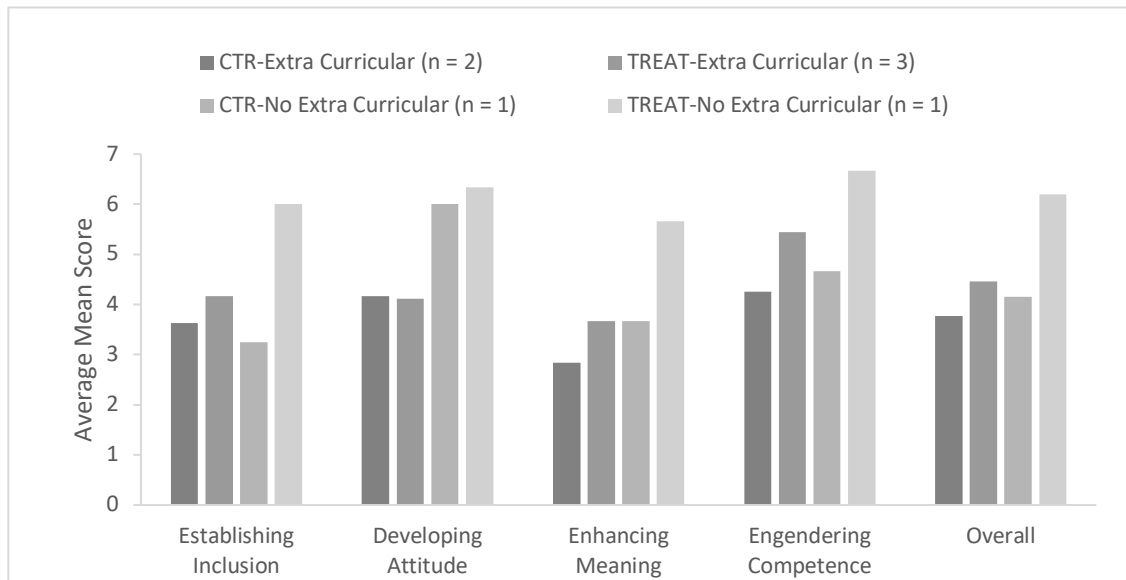
Note. [a]The Overall metric was calculated using a weighted average based on the number of questions in the survey aligned to each domain. The individual domains were calculated with a simple average for all members of the group.

As we saw with the gender groupings, the *Developing Attitude* domain is the only domain where a student in the control group had a more favorable response to CRTP,

despite not being in a class where those practices had been explicitly taught to instructors and the student did not participate in any extra-curricular activities. Otherwise, for the other domains we see a positive relationship between student perceptions of CRTP included within the classroom, as compared to their peers in the control group. What is interesting, however, is the comparison between the students who participated in extra-curricular activities as compared to those who did not.

Students who did not identify as part of extra-curricular activities reported a higher perception of the teachers use of CRTP in both the control and the treatment group, as compared to their peers who did participate in extra-curricular activities in the *developing attitude, enhancing meaning* and *engendering competence*. Yet, students who participated in extra-curricular activities reported higher inclusion of CRTP aligned to *establishing inclusion*.

Scholarships and Grant Awards. The final area of consideration was the impact of scholarships and grant awards on student perceptions of CRTP. As one of the strongest predictors of student retention, the intersection of scholarship/grant award with perception of CRTP is an interesting exploration (Pratt et al., 2019). Again, since this sample size is so small, it is not possible to draw more generalizable conclusions; however, for the Latinx students who participated in this survey, initial findings showed that students who received grants were less likely to perceive the inclusion of CRTP, as compared to those who did not receive grants in the treatment group as shown in Figure 4.4.

Figure 4.4 *Latinx Perception of CRTP in Treatment and Control as Differentiated by Scholarships or Grant Award*
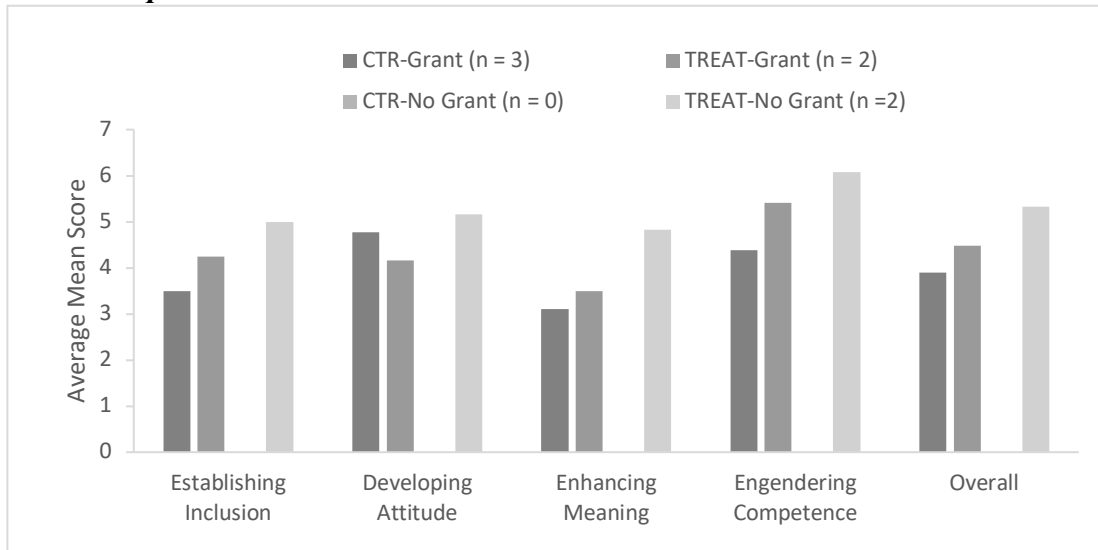
Note: The Overall metric was calculated using a weighted average based on the number of questions in the survey aligned to each domain. The individual domains were calculated with a simple average for all members of the group. Additionally, all students in the control group were awarded a grant and/or scholarship to study.

Descriptive Statistics

In Table 4.2, descriptive statistics are provided for the control group. Table 4.3 has the descriptive statistics for the treatment Group. In both tables, the descriptive statistics are broken into Latinx versus Non-Latinx.

Table 4.2 *Means, Standard Deviations, Skewness, Range, Percentiles for Control Group (Latinx/White, Asian, Black Group)*

		Establishing Inclusion	Developing Attitude	Enhancing Meaning	Engendering Competence	Overall
N		3/11	3/11	3/11	3/11	3/11
Mean		3.5/4.01	4.78/5.52	3.11/4.39	4.39/4.68	3.9/4.5
Std. Deviation		0.33/0.75	1.17/0.58	0.51/1.03	0.63/0.77	0.28/0.65
Skewness		1.46/0.23	0.42/0.18	0.94/-0.03	-1.6/0.25	-0.78/0.17
Std. Error of Skewness		1.23/0.66	1.23/0.66	1.23/0.66	1.23/0.66	1.23/0.66
Range		0.63/3.13	2.33/1.67	1/3.33	1.17/2.17	0.55/2.3
Minimum		3.25/2.5	3.67/4.67	2.67/2.67	3.67/3.67	3.6/3.4
Maximum		3.88/5.63	6/6.33	3.67/6	4.83/5.83	4.15/5.7
Percentiles	25	3.25/3.75	3.67/5	2.67/3.67	3.67/4	3.6/4.1
	50	3.38/4	4.67/5.33	3/4.33	4.67/4.5	3.95/4.55
	75	./4.38	./6	./5	./5.33	./5.05

134

Table 4.3 *Means, Standard Deviations, Skewness, Range, Percentiles for Treatment Group (Latinx/Non-Latinx)*

		Establishing Inclusion	Developing Attitude	Enhancing Meaning	Engendering Competence	Overall
N		4/8	4/8	4/8	4/8	4/8
Mean		4.63/4.77	4.67/5.75	4.17/4.5	5.75/5.54	4.9/5.11
Std. Deviation		0.92/0.47	1.12/0.85	1.04/1.05	0.65/0.88	0.87/0.65
Skewness		1.9/2.25	1.89/-0.3	1.6/0	1.38/0.36	1.97/1.06
Std. Error of Skewness		1.01/0.75	1.01/0.75	1.01/0.75	1.01/0.75	1.01/0.75
Range		2/1.5	2.33/2.67	2.33/3.67	1.5/2.5	1.8/2.15
Minimum		4/4.38	4/4.33	3.33/2.67	5.17/4.33	4.4/4.25
Maximum		6/5.88	6.33/7	5.67/6.33	6.67/6.83	6.2/6.4
Percentiles	25	4.06/4.5	4/5.08	3.42/4	5.25/4.88	4.41/4.7
	50	4.25/4.63	4.17/5.83	3.83/4.5	5.58/5.42	4.5/4.98
	75	5.56/4.84	5.83/6.33	5.25/5	6.42/6.46	5.79/5.46

I will begin with the means for the control class (Table 4.2). In this class, Latinx students perceived the usage of CRTP, on average, to be less than other students within the class across all four domains. While Latinx students had a higher standard deviation within the *developing attitude* domain (1.17 as compared to .58), overall Latinx student responses were more consistent as indicated by a smaller standard deviation for all other domains and the overall standard deviation. In short, these three Latinx students were in greater agreement that there were fewer CRTP taking place within this class, as compared to their Non-Latinx peers. As noted earlier, one student indicated a much higher value for the *developing attitude* Domain, which was identified in Figures 4.2 through 4.4. Given the small sample size, this student's response had a greater impact on the overall scores. Additionally, the Latinx students in this group were positively skewed in all domains, except for *engendering competence* and overall score, indicating that for *establishing inclusion, developing attitude*, and *enhancing meaning*, the three Latinx students in the control group identified lower incidents of CRTP within the classroom from those domains. It is interesting to note, however, that for Latinx students in this group, skewness overall was negatively skewed, indicating more favorable responses to the four domains.

In the treatment class, the results are a more mixed. For the domains *developing attitude* and *enhancing meaning*, the four Latinx students perceived there to be greater usage of CRTP, while Latinx students perceived fewer instances of CRTP centered in the *establishing inclusion* and *engendering competence* domains. Like the control group, the

Latinx students in the treatment group were more aligned in their thinking as measured by lower standard deviations. This is true with all domains and the overall score, except for the *engendering competence* domain. The skewness of the results for this group are much closer to zero, indicating the distribution was more normal than the control group. Again, with such a small sample size in both cases, it is important to look at these results in the context of student experiences within the courses.

Independent Samples t-Test

Student Perception of incorporation of CRTP. To begin this analysis, I explored whether students in the treatment group perceived the use of CRTP from instructors who had received additional training on the usage of these practices more often than students in the control group. In the treatment group, instructors received professional development led by the university prior to the course, whereas instructors in the control group received no additional training.

As indicated in the methods section, several assumptions were met in order to perform an Independent Samples t-Test. First, the independence of errors was assumed (Spatz, 2016). For this study, it meant that students were strategically placed in one of these courses and had substantially different mathematical experiences. Since students had not been strategically placed in the control or treatment group, and since student selection was randomized across these two courses, this assumption is satisfied.

The second assumption for Independent Samples t-Test was the normality of errors. Gamlem (2019) found that if skewness was within ±2 and kurtosis within ±8,

137

data is reasonably normal and meets the requirements to run an Independent Samples t-Test. For this first analysis, we are only looking at the overall perception of all CRTP practices within the classroom, rather than at the specific domains (*establishing inclusion, developing attitude, enhancing meaning,* or *engendering competence*) (Ginsberg & Wlodkowski, 2009). As a result, when examining the overall skewness, I found that for both groups, skewness was within the ± 2 that Gamlem (2019) identified as reasonable skewness for this study, as shown in Table 4.4.

Finally, I assessed homogeneity of variance. Analyzing the overall usage of CRTP through student's perceptions, I assessed whether homogeneity of variance assumption was violated. I utilized Levene's statistic to measure homogeneity of variance. As shown in Table 4.4, homogeneity of variance can be assumed (Appendix D).

In other words, by retaining the null hypothesis, the data indicated that students in the treatment class did not have a statistically significant difference in population variance within their responses as compared to the control class, and therefore a comparison of the means for the various domains is an appropriate approach to determine what, if any, differences may exist. Additionally, given the relatively equal sample sizes (14 versus 12) a Levene's test provides another level of stability for the independent samples T-tests analysis and thus homogeneity of variance assumption is assumed. Given the limitations present in this study (survey originally targeted towards instructors, limited professional development around CRTP, class during the pandemic), this data should be viewed as descriptive and provide insights to future, more detailed studies.

Table 4.4 *Classroom Descriptive Statistics: Control and Treatment*

		N	Mean	Std. Dev	Skewness	Kurtosis	Levene's Test for Equality of Variance	
							F	*p*
Domain A - Establishing Inclusion	Control	14	3.902	0.707	0.576	2.579	0.047	0.831
	Treatment	12	4.719	0.617	1.397	1.247		
Domain B - Developing Attitude	Control	14	5.357	0.756	-0.610	0.276	2.666	0.116
	Treatment	12	5.389	1.043	-0.078	-1.473		
Domain C - Enhancing Meaning	Control	14	4.119	1.075	0.298	-0.997	0.251	0.621
	Treatment	12	4.389	1.013	0.323	0.094		
Domain D - Engendering Competence	Control	14	4.619	0.732	0.275	-1.264	0.002	0.961
	Treatment	12	5.611	0.786	0.276	-0.745		
Overall	Control	14	4.368	0.635	0.521	-0.096	0.011	0.919
	Treatment	12	5.038	0.695	1.010	0.085		

139

Analysis of CRTP perceived by Students. With the assumptions met as shown above, I performed Independent Samples t-tests on the various domains and the overall domain. The null hypothesis for this study was that students would not perceive any difference between instructors who received training in CRTP and those that did not. Table 4.5 shows the results of the Independent Samples t-tests.

Table 4.5 *Independent Samples t-test between Control and Treatment Classes*

	t-test	*p*
Domain A Establishing Inclusion	-3.111	0.005
Domain B Developing Attitude	-0.09	0.929
Domain C Enhancing Meaning	-0.655	0.519
Domain D Engendering Competence	-3.33	0.003
Overall	-2.568	0.017

Starting with the overall effect of CRTP and students perceived usage within the classroom, the 12 participants who received the treatment ($M = 5.038$, $SD = .695$) as compared to the 14 participants who were in the control class ($M= 4.368$, $SD = .635$) perceived a greater utilization of CRTP by their instructors, $t(26) = -2.568$, $p<.02$. As shown, this indicates that the null hypothesis is not supported for the overall perception of CRTP within the classroom, and that there is a statistically significant difference

between the two groups when instructors received PD around CRTP. From closer examination of Table 4.4, we see that students in the treatment perceived more instructor utilization of CRTP than those in the control. Further, students in the treatment group had a statistically higher perception of their instructor's utilization of domain A, *establishing inclusion* and domain D, *enhancing meaning*, than their peers in the control group. There were no statistically significant differences between domain B, *developing attitude* and domain D, *engendering competence.*

Summary

For the 26 students in four sections of two courses specifically designed to meet the needs of students who have traditionally been underserved, there was a statistically significant difference between the perceptions of students who were in classes with instructors who received CRTP professional development, as compared to students in classes with instructors who did not receive the PD.

In the treatment group, students perceived a greater utilization of the *establishing inclusion* domain as well as *engendering competence* domain. While the other two domains did not show statistically significant differences, students in both courses alluded to COVID-19 restrictions preventing them from engaging with each other, as well as tight restrictions from the math department on their instructor's ability to adapt the content to align to student interests and needs.

Four Student Experiences in a Two Mathematics Courses – Qualitative Analysis

The second research question was, "What are Latinx student perceptions of their instructor's use of culturally responsive teaching practices to establish inclusion, develop student attitude, enhance meaning, and engender competence in a first-year, non-remedial terminal math class? To begin to answer this question, Latinx students were provided an opportunity to share their experiences in a non-remedial first year, terminal mathematics classroom. By utilizing purposeful sampling, four students volunteered to participate in discussions around their experiences (Merriam & Tisdell, 2016). All four students identified as Latinx or identified as two or more races, with Latinx as one of the racial identities. Additionally, two students were from the control group and two students were from the treatment group. Finally, all students who volunteered to be part of the study, had an opportunity share how they identified their gender. From the initial questionnaire, all students identified as either male or female. Out of these volunteers, a male and a female student were selected from the control group and a male, and a female were selected from the treatment group to participate in both group interviews and individual interviews.

To answer research question 2, I begin by developing a picture of the four students who participated in the interviews, to help provide deeper context. Students were given the opportunity to self-select their pseudonyms; however, no students requested any names. As a result, I created all pseudonyms to protect the identities of the four students.

Willow

Willow was a Political Science/Ethnic Studies student, who self-identified as female and identified as Black and Hispanic. Willow's family was not new to the college experience and members of her immediate family have earned graduate degrees. Like her immediate family, Willow was interested in continuing her studies into graduate school by focusing on Peace Studies and International Security. During her time in high school, Willow attended an elite performing arts school, where she had the opportunity to work with mathematics teachers who built strong relationships with their students. As Willow indicated, "My math teachers there did a really good job of trying to understand where our background was. There was always that connection of understanding our priorities, where our perspective is coming from" (Focus Group). When Willow was not in class, she was active outside of class, participating in multiple clubs and organizations across MSU.

When I first met Willow, she was a student in the control group, and this was her second time taking this course. After I initially presented this research opportunity to the class, Willow approached me to discuss her interest. She shared her thoughts around culturally responsive education, and the importance of CRTP in addressing existing inequities within the university system. More than the other students, Willow's desire for strong relationships really shined through. For Willow's second attempt at this class, she noted that she felt more connected and a part of this math class. Willow described her first experience: "over 75 students in one of the big galleries, and we had four TAs

143

walking around, but I definitely didn't feel connected, or like I wanted to necessarily ask my TAs questions" (Interview).

Willow prioritized the relationships with her instructors. When asked how she defined success for this course, Willow stated:

> At first, I think that it was just to pass the course, to get the course credit. Obviously, I want to maintain my GPA as much as possible. So that, to me, was success. While being in this class, my goal has become more incremental in the way that it's just really dope if I can understand this concept. To me, these smaller goals will lead to me passing the class, and I think that I've started to understand that because of the layout. (Interview)

Willow's definition for success is articulated here, especially through the word *incremental*. Willow doesn't see success as just completing the class. Rather, her definition of success comes from a stepped approach, where each new topic that she masters adds to her confidence and sense of success. These "incremental" achievements not only bolstered her ability to see a pathway to succeed in mathematics but spoke to her ability to complete her degree. As stated above, this wasn't Willow's first time through this course. However, unlike her previous experience, this time was positive. As I examined Willow's other responses, I anchored these discussions within Willow's personal definition of success.

Willow's Perception of CRTP - Established Inclusion. In terms of CRTP, Willow shared experiences that aligned well with the *establishing inclusion* domain, in

which instructors used a constructivist approach to create knowledge; however, her experience comes from high school. She spoke of her high school teacher's ability to intentionally tie student interests into the mathematics to further student understanding.

It is interesting to see how instructors in the control group may approach this domain. One of the questions I asked regarding *establishing inclusion* was "Has course work emphasized the human purpose of what is being learned and its relationship to your personal experiences and current situation?" (Ginsberg & Wlodkowski, 2009). Willow referred to an activity with 15 pre-defined topics or student choice of a topic (Appendix E). For students who were not sure what they wanted to study, topics included things like:

1) The Collatz Conjecture

2) The Goldbach Conjecture

3) The Catalan Numbers

4) Mersenne Primes

In Willow's case, she chose to further study poker rules:

My topic is poker rules. So, the probability of dice rolling and stuff like that…we will turn in a final paper instead of a final exam. So, I think that would be really interesting because I've only taken exams in my math classes. I am curious to see how this plays out." (Interview)

Willow is more attuned to the *engendering competence* perspective in this case, which identifies strategies where the assessment process is designed to instill confidence in a

145

student, rather than the content engaging student core interests. While this doesn't necessarily tie back to *establishing inclusion*, Willow seemed aware that the math content took precedence over what the question was aiming for—specifically, how is this content relating to your personal experiences? When I tried to return to how Willow's instructor established inclusion through activities and content, Willow brought up a Harry Potter example and nodal analysis wherein students try to find the shortest path between multiple vertices (in this case, rooms at Hogwarts, a fictional place within the Harry Potter stories). These activities resonated with Willow; however, when I asked if her instructor had built these examples from his knowledge and understanding of her or her classmate, Willow indicated: "I think he just got lucky and found something that resonates with the group" (Interview). In other words, while Willow's instructor was providing opportunities for students to leverage pre-existing knowledge in some context, this action alone did not indicate whether the instructor intentionally learning about the students or rather picked a topic Willow happened to find interesting. This contrasts with her experience from high school, where her math instructors intentionally sought to better understand students, and then built relevant experiences from those understandings.

Willow's Perception of CRTP- Engendering Competence. As mentioned above, Willow's experience within her class around *engendering competence* was situated around the class' final assignment (Appendix E, Figure E.1). Within this project, the instructor provided a framework through which students could build a project around their own interests and also provided students a list of options from which to choose.

146

Additionally, students were given the opportunity to learn from their peers, as final presentations were given to the whole class. The final presentation gave students an opportunity to explore something they were interested and to learn from their peers.

Specific to *engendering competence*, this class eliminated the final exam, and choose to do final presentations. Willow mentioned that she was curious how this approach would play out. Like the Harry Potter example, the instructor happened upon strategies that benefitted students, without really getting to know them. While the example of the final presentation was another form of *engendering competence*, there are other ways the instructor could have leveraged student strengths in demonstrating content knowledge and learning to better support students had he discussed it with the class early on.

We also had the opportunity to talk about the homework process for students in the control Group. Here, Willow alluded to the fact that there has been a change from the first time she took this course. In the first iteration, students received homework assignments, put the final answer into the computer and received instant feedback. In the current class, students had to upload all their work to their teacher. While the second approach took more time to receive feedback, Willow felt she was learning more. Again, from our conversation, much of the decision for this change appeared to have come from the instructor, rather than the students. This was a positive change, and allowed Willow to learn from her mistakes, increasing her understanding of the material and retention of the material; however, there was a missed opportunity to better *engender competence*

147

within students by working with students to identify assessment strategies that met their needs (Ginsberg & Wlodkowski, 2009).

Willow's Perception of CRTP – Enhancing Meaning. An instructor's ability to deepen student understanding of content is critical to the student's ability to perceive themselves not just as participants, but co-creators of knowledge. Part of the issue facing Latinx students within mathematics, is U.S. instructors have historically taught mathematics with a Euro-Centric lens, where creators of mathematical knowledge were White and male (Alcantar & Hernandez, 2020). One step to countering that narrative is to center students as the creators of knowledge within mathematics. When I asked Willow about how her instructor supported students' ability to create knowledge, Willow indicated that much of class was lecture, and opportunities for student-to-student engagement was limited due to COVID-19 (Interview).

Going further into a constructivist approach to *enhancing meaning*, I asked Willow about opportunities where collaboration took place…either between students or between student and teacher. Willow indicated that because of COVID, there was little to no collaboration between students; however, there were opportunities for student-to-instructor collaboration. However, when she thought back to prior math experiences, she said "We didn't have a lot of student-to-student collaboration" (Interview). As in the other two domains, there were opportunities where students were invited to have discussions with their peers; however, this came across as unintentional and more a product of good fortune, than a planned activity. For example, Willow identified times

where extended conversations would occur around questions about problem sets or challenges with homework. The next step, as Willow indicated, would be to have the professor engage students more authentically in deeper conversations beyond, "Does anyone have any questions?"

Willow's Perception of CRTP – Developing Attitude. One key for CRTP, is for instructors to develop a culture where student's identity is brought into the learning environment. *developing attitude* represents a "complex, teacher-learner interactive allowing individual search and reflection – frequently with integrated subject matter. Perceived value is amalgam of teacher and learner preferences" (Ginsberg & Wlodkowski, 2009, p. 142). I asked Willow how her instructor infused identity into class through discussions around culturally relevant terminology. And if it was missing, I inquired whether those discussions would have made a difference in her experience. Willow responded,

> I think that identity is really important, and that it would have added a lot of connection...to us and the professor, but then also [the student's identity] just connects you to the material more, because then at least I feel valued in this space, or I feel heard in this space. (Interview)

As before, Willow's connection to *establishing inclusion* shines through in this response. Willow conveys a strong need to be heard and valued, thus ensuring that she is included within the classroom, but this also blends nicely with the *developing attitude* in this case, as Willow sees her voice and her value as helping her develop the attitude "I

149

belong here." As mentioned earlier, Willow's definition of success was an "incremental" approach, where she gained confidence and understanding, then moved up to the next task. Here, Willow provided the structure for how her instructor could develop her attitude in pursuit of her goals: by bringing her voice and her personal experiences more into the classroom.

Willow summed up her experience this way: "If you connect what we were learning more to me as a person, instead of me as a learner, *that* is the idea of a student" (Interview). Or, rather than thinking of the student as a recipient of knowledge, think of the pieces that make the student human and build around those pieces.

Willow did mention that MSU is taking a more pro-active response, working with students and faculty to begin announcing their pronouns, but there is less focus on ethnic identities. Therefore, while there is a systemic change taking place with regards to pronouns, there is an opportunity for improvement with regards to ethnic identity both at the university level and at the classroom level here, from Willow's perspective.

Benjamin

Benjamin was a member of the control group. As a first-generation student, who identified as male, Benjamin was not involved in any extra-curricular activities. Benjamin was also a member of the control group. During our first conversation, Benjamin shared that he was a Sociology major, and had an interest in politics. Therefore, as the control class covered voter theory in the first few weeks, he found very

relevant experiences within the content. During this first conversation, Benjamin began to hint at what he was looking for in terms of a successful math course:

> I guess, for me, sometimes I kind of just question 'when is this going to be useful to me in real life?' [In the past], we'd be learning about unit circles or things like that and, of course, they're useful depending on your job, but when [my instructor is] talking about how Congress works and how states elect their representatives …that's real life to me because that's useful for me to know in the future if I do get into politics.' (Focus Group)

This quote represents a missed opportunity for Benjamin's instructor. For Benjamin, an interest in politics existed and could have been leveraged to expand beyond the text, shifting the center of knowledge from the instructor to the class, and afforded students' opportunity to expand the *developing attitude* domain.

> When I asked Benjamin to state his definition of success for the course, he replied:

> The biggest transition from high school to college was… [getting] really high grades. And the course matter, if I understood it, great. If I didn't, then as long as I passed, it was fine. Now, I want to understand what I'm learning. I want to know what this is really for. Because I feel like, if this is all stuff that I can use if I do understand, [then] I really care about what's being taught. (Interview)

This shift in his thinking from high school to college was present in our first conversation and maintained through the second. In high school, there was a sense that whatever

151

information was placed in front of Benjamin, he would go through the motions to earn a good grade; however, when we talked, there was a new desire to truly understand the content. His position is clear in his responses to the question of whether his instructor presented content that represented a larger world view. While Benjamin conceded that his instructor really focused on the United States for voter theory only, he wanted to learn about other countries and their systems: "[I don't] necessarily only want to learn about the United States. It would be interesting to know how other countries would view the content or what they would do with that information" (Interview).

Benjamin's Perception of CRTP – Established Inclusion. Prior to college, Benjamin indicated that his high school math experience was far from ideal. His high school experience highlighted an issue with the current state of mathematical education facing students: teacher pacing (Sears, 2018). In Benjamin's case, he felt left behind in pre-calculus: "The teacher would continue to do lessons because the majority of the class knew what was going on" (Interview). In Benjamin's college level math class, however, his instructor's ability to *establish inclusion* occurred on two levels. First, on the relationship level, which validated student thoughts and feelings through a nurturing, inviting environment; and how those feelings manifested perceptions of workload. With regards to Benjamin's feelings in class, Benjamin confirmed that the instructor provided a supportive environment, where students recognize they are in this experience together. With regards to homework, Benjamin noted that his instructor "doesn't assign tons of homework because he…has a realistic view of students" (Focus Group). Both pieces

152

validated Benjamin's thoughts and feelings, around his experience within the control Group.

As Ginsberg and Wlodkowski (2009) note, instructors who *establish inclusion* also help students see the human aspect of the material. In Benjamin's case, meant he needed to see how voter theory worked in other countries, not just the United States. To that end, this is one area where the instructor missed an opportunity to better establish inclusion with Benjamin.

Benjamin's Perception of CRTP – Engendering Competence. As with Willow, I asked Benjamin to frame what his definition of success would be. Benjamin's response was similar to Willow's; specifically, he was interested in understanding the content: "I define success in this class if I can leave this course knowing that I actually knew what I was doing" (Interview). In framing this next section, I center the discussion around Benjamin's definition of success.

Within the *engendering competence* domain, Benjamin had a challenging time understanding how the assignments were relevant or tied to his interests or major: "I just don't see anything [assessments, homework, or testing] that are tied towards my interests or any of the students' interests or majors." Through Ginsberg and Wlodkowksi's (2009) framing, *engendering competence* provides students an opportunity to contextualized material for their lives, experiences, and frames of reference (p. 268). Again, part of what Benjamin hoped for was an opportunity to truly understand what he was doing. However, when it came time to really demonstrate his learning, the instructor failed to provide an

153

opportunity to frame his learning in a relevant and meaningful context that Benjamin could apply to his life.

Benjamin's instructor was limited to how they were able to assess student knowledge, due to departmental restrictions the class. Homework, quizzes, and tests were to be done individually, and did not allow the students to explore the content through their individual interests. Given this limited approach to how students could demonstrate their knowledge, I inquired about how Benjamin's instructor helped him achieve his definition of success, if at all. Benjamin responded:

> There are times where it seems like I do get the [points I missed]. It could simply be I'm not exactly understanding what the question is asking. And then, he'd say 'Why'd you get it wrong?' And then he explains what [I didn't understand]. It's more clarity of what the question is asking. (Interview)

However, while this is good for short-term understanding of the assessed topic, this does not actually help the student frame the concept within a frame of reference useful to their long-term growth and acquisition of mathematical concepts. As a result, while Benjamin's instructor did a decent job within the *engendering competence* domain, and partly supported Benjamin in better understanding the content, there was a missed opportunity to help Benjamin tie the content to previous experiences/knowledge that he brought to the class.

Benjamin's Perception of CRTP – Enhancing Meaning. In contrast to Willow, Benjamin perceived opportunities for students to co-create knowledge together: "Usually

154

we bounce off each other's questions, comments, and then we move on to the next section or whatever it is when we're all in agreement of knowing what's going on" (Interview). Benjamin's comment illustrates a lecture-driven approach to mathematics, but the instructor did provide opportunities for the class to engage in discussion about the content. When I asked about how Benjamin's classmates informed his problem-solving process, he alluded to the back-and-forth conversations within class:

> It's an open discussion and anyone can just say something. There's times that someone will ask a question about 'Well, why isn't it done that way?' …to counter what is being told, just to see what [the instructor will] say. For me, to get rid of all of these why nots and clarify the content.' (Interview)

When compared to Benjamin's definition of success and the CRTP domain of *enhancing meaning*, he perceived an effort was made to enhance meaning. Benjamin's definition of success was around his ability to understand the content. Through class conversations where students tried to poke holes in theories through the "why isn't it done this way" approach, they were testing the bounds of the mathematics they were learning. Benjamin appreciated this approach. Ginsberg and Wlodkowksi (2009) note that *enhancing meaning* has two parts: learner engagement and challenge. In Benjamin's class, learners did have the opportunity to engage, through meaningful discussions about the content, which required students to evaluate approaches. The evaluative component was clearly highlighted in the quote above and represents an area where the instructor provided a class structure which nurtured this dialog and learner engagement. The second piece,

challenge, is not just about the complexity of content, but rather the "application of current knowledge to situations that require development or extension of them" (Ginsberg & Wlodkowski, 2009 p. 193; Wlodkowski, 2008). In this later criterion, Benjamin's did not report ways the instructor provided students with an opportunity to extend their knowledge: "There hasn't been a situation where I feel like I've used my voice to influence any progress or anything. Everything's structured…and it's already set in place" (Focus Group). Benjamin did have ideas of how the instructor could have provided students an opportunity to challenge their students more in alignment with Ginsberg & Wlodkowski's (2009) definition of challenge. He noted: "Instead of textbook things, maybe things like a project on how this could be used in a real-life situation" (Focus Group). As mentioned by Willow earlier, the opportunity to adapt the class to students' interest/voice was limited.

      Benjamin's Perception of CRTP – Developing Attitude. Another area where there were differences between Willow and Benjamin come from the *developing attitude* domain. Willow alluded to how she valued identity and would like to have seen her identity represented in the material more, as it would have helped her feel valued. By contrast, Benjamin indicated that was not the case for him: "There was no invitation to discuss [culturally relevant] terminology like that. I don't think it would have made a difference for my own experiences. I don't really have a preference on terminology that is used for me or others" (Focus Group). While this part of the CRTP domain of *developing attitude* did not resonate with Benjamin, he did speak highly of how his

156

instructor supported students through a particularly challenging assignment. In this second area of *developing attitude*, Ginsberg and Wlodkowski (2009) highlight the importance of instructors having a hopeful view of students. Benjamin felt that his instructor was very supportive:

> We had this super quiz. It was everything from week one… Two days before we were supposed to take the quiz, [our instructor] asked if we wanted to do the lecture of this next chapter, or if we wanted to have a full class day of review… That class, I got a lot of a refresher for the early weeks, where I kind of forgot how to do things. I felt good about it; I felt more prepared. (Interview)

> Benjamin's instructor gave the class a choice for how to proceed, rather than simply using a predetermined process. Benjamin appreciated that; however, Benjamin's definition of success was "I want to understand what I am learning" (Interview). Based on this, it would have been interesting to develop a better understanding of what Benjamin meant by "understanding what I am learning," as the low retention of content seems to be contradictory to Benjamin's definition of success.

Another aspect of the *developing attitude* domain was incorporating projects that aligned to student interest and required authentic problem-solving experiences. Like Willow, Benjamin did not see this in the control class: "there hasn't been a situation where I feel like I've used my voice to influence any progress or anything. Everything is structured and has these due dates. It's already set in place" (Focus Group).

157

Ximena

Ximena is a non-traditional student who identifies as female and Hispanic.
Ximena joined the military after high school. After leaving the military, Ximena enrolled
at MSU. Growing up, Ximena lived in a larger West Coast city and primarily spoke
Spanish at home. In elementary school, she was identified as a gifted mathematics
student and placed in advanced mathematics courses that challenged her. Ximena took
pride in the fact that she and another student were "in competition" with each other
(Interview). Her success continued through middle school. Ximena mentioned that during
her eighth-grade year, she was not required to take mathematics.

When she began her first year of high school, everything changed. She recalled
classes of forty, comprised of students across all grade levels, some taking the course for
a second or third time. This contributed to a distracting learning environment, and she
quickly began to have retention challenges. Additionally, she felt her instructors were
unable to cover much of the material. In her words, "this is where I really started to fall
apart" (Interview). She barely passed Algebra II and Geometry. She begrudgingly joined
Pre-Calculus her junior year at the behest of her counselor but begged to drop from the
class three weeks in. Ximena recalled that if her Pre-Calculus teacher had been more
encouraging or had her parents spoken English and been able to help her navigate high
school, she may have persisted. However, as Ximena noted, "[My parents] didn't really
graduate high school. They never went to college. And, when [parents] are who you turn

to for help, and they can't help you, what do you do? There's no money for tutors. What do you do?" (Interview).

In high school, Ximena had the opportunity to join a program known as the Academy, which focused on students who were interested in college pathways:

I just wanted to get the hell out [of my old school]. I knew that I really wasn't going to be able to learn much going to a school that I did, because a lot of the school's problems kind of overwhelmed the learning, especially in the classroom. When I joined the Academy, it was like a world within that school, and it was like I was able to focus more. I had straight A's and I excelled. Then, because that program was meant for you to go to college, and when I didn't, everyone was so surprised. But, I didn't have money. (Interview)

As former member of the military, Ximena earned her Associate degree, with the military covering the costs. Ximena also shared that the military helped her learn about financial aid and how to register for classes. After leaving the military, Ximena transferred all her credits from her Associates Degree to MSU. She has used scholarships and a full-time job to pay her way through her undergraduate degree (Interview). Her hope is to use the GI Bill to cover the cost of a Ph.D.

When we met, Ximena was pursuing a Psychology degree. She had adopted a methodical approach to navigating the various systems within her university, leveraging the knowledge she gained from the military. Ximena kept her course requirements for graduation on her refrigerator, referred to it at the beginning of each semester, and

159

consulted her advisor to make sure she stayed on the right track. At the end of the semester, she checked off each course. She attributed this approach to her time in the military.

For Ximena, success was defined similarly to Benjamin and Willow. Specifically, Ximena was more concerned with understanding the content, as opposed the letter grade. As we begin to explore Ximena's comments around CRTP, it is important to remember her framing of success.

Ximena's Perception of CRTP – Establishing Inclusion. Ximena alluded to this domain in our conversations around her experience from high school, specifically stating that had her Pre-Calculus teacher encouraged her, she probably would have stayed in class. Fortunately, Ximena's instructor in the treatment class encouraged her and intentionally designed activities that called out struggles of real mathematicians, and showed a more diverse group of mathematicians:

My instructor calls us mathematicians. I mean, I know I'm no mathematician, but I appreciate the confidence. I really do…It's really sweet and it's encouraging. We have weekly journals and sometimes our instructor will say 'okay, watch this video,' and she had us watch TED Talks. One of them was a mathematician who I thought was just naturally good at math. And the video that our instructor showed was the exact opposite of that. It was someone who had a passion for math, but [the person in the video] was like, 'I wasn't always good at it.' So, it kind of broadened my perspective on what an actual mathematician is—especially

160

when [the person in the video] failed a really high-stakes exam. I was like, 'You guys do that?' (Interview).

The first video that Ximena shared with me, was titled "Meet a Mathematician–Candice Price." In this episode, Dr. Price shared her experience as a Black Female navigating her undergraduate degree and receiving positive affirmations that she should continue studying mathematics after a Pre-Calculus instructor saw her potential. For Ximena, this created a welcoming environment where Ximena was not only bonding with her peers over the challenge of mathematics, but Ximena's instructor was creating a place where Ximena belonged and could contribute: "People are so used to seeing males or people of Caucasian descent in the majority of STEM careers. And then, when you do see people of color, its Asians" (Interview). In essence, Ximena's instructor helped Ximena construct an inclusive view of mathematics where she belonged and mattered.

What was interesting with Ximena, though, was her answer to the question, "Does [seeing people of color in mathematics] make a difference to you?" Her response indicated that while it was nice, it was really the affirmation that mathematics was hard for these mathematicians that mattered most. Similar to Benjamin, a validation of the challenges associated with mathematics resonated loudly and bolstered students' confidence that they were not in it alone.

While Benjamin and Willow's instructors provided a respectful environment, there was no intentional attempt to include the voices and stories of individuals from different racial backgrounds. Students in Benjamin and Willow's classes did have an

161

opportunity to develop their understanding of content better, but they never had an opportunity to see their Latinx identities as co-creators of content. Dr. Price identified as a Black female, and this did provide Ximena an alternative view of who could do mathematics, which shifted the narrative that mathematics comes from "people of Caucasian descent" to a broader definition of who is a mathematician. At least for Ximena, this proved to be a welcome addition to class and helped her begin to see herself not only as a mathematician as her instructor said, but as a valued member of her college community.

Ximena's Perception of CRTP – Developing Attitude. As mentioned earlier, the *developing attitude* domain examines how instructors nurture their students and "affirm learners' assets and strengths" (Ginsberg & Wlodkowski, 2009, p. 84). Ximena was asked to share how her instructor supported her, especially with challenging assignments. For Ximena, her instructor worked hard through the semester to establish confidence and shift Ximena's mindset about who she was. While Ximena shared that she doesn't see herself as a mathematician, she appreciated the confidence communicated by her instructor in calling students "mathematicians" (Interview).   Ximena mentioned that her instructor never referred to grades, but rather focused on ensuring students "feel confident in math and retain everything" (Interview). As described above, Ximena believed her foundation in mathematics was weak, which led her to hate mathematics during high school (Interview). Of course, this was a departure from her time in elementary school where she was confident and enjoyed math.

162

Returning to Ximena's challenging assignment, there was one assessment that her instructor supported her with. As a reminder, the control class and treatment class were special sections of a much larger course where most students do not have access to individualized instruction. For Ximena, the special section provided her with an instructor who advocated for her when she was failing one of her exams. Due to Ximena's struggles, there was a pre-determined deadline to complete the exam that was quickly approaching. Ximena indicated that had it not been for her instructor's advocacy to extend the deadline, Ximena would not have passed the exam or the course. Here, Ximena's instructor was constrained by how Ximena could demonstrate her knowledge on a particular assessment; yet the instructor was able to be flexible about the timeline, advocate for Ximena, and ultimately created a solution that supported Ximena and gave her the time she needed to learn the material (Ginsberg & Wlodkowski, 2009). This flexibility is critical in *developing attitude* and allowed Ximena to feel success on her time and her terms.

This calls back to Ximena's connection with Dr. Price. In the "Meet a Mathematician" video, Dr. Price talked about her struggles with mathematics. These two pieces—a supportive instructor and a prestigious mathematician showing students it is okay to struggle with mathematics—created an environment conducive to Ximena's success in mathematics and college. Ultimately, Ximena paid her instructor the highest possible compliment:

I hope one day she becomes a math teacher, because I think a lot of young

students could benefit from a teacher like that. That's so supportive and not going

to give up on their students, no matter how much their students think they want to

give up (Interview).

Another component of the *developing attitude* domain was providing students

with the opportunity to engage with each other. Similar to Willow and Benjamin, Ximena

alluded to the fact that COVID-19 had really prevented students from working directly

together much. Ximena's instructor confirmed this in a separate conversation, indicating

she had to remove some of the group project tasks for this class, in order to maintain

social distancing (Interview).

In summary, similar to Willow and Benjamin, Ximena's relationship with the

instructor was vital. In all three cases, students identified their instructor's willingness to

support them on challenging task; similarly, COVID severely limited students' ability to

work together on tasks. That said, Benjamin was still the only student who saw a rich

dialogue with students in his class; Willow and Ximena reported a lack of dialogue with

peers.

Ximena's Perception of CRTP – Enhancing Meaning. *Enhancing meaning* for

students means that students and instructors are co-creators of knowledge, each taking

turns acting as teacher and as learner (Ginsberg & Wlodkowksi, 2009, p. 202). For

Ximena, while the full opportunity to engage in authentic experiences was limited due to

COVID, she did reference one example where her instructor provided an environment

164

where she and her instructor were able to build upon each other's understanding of mathematics.

In an assignment, tied to the "Meet a Mathematician" video, Ximena made a connection between this video and her passion. In Ximena's case, she was interested in "social justice and in minority communities" (Interview). She was able to tie this passion back to linear and exponential models of fundraising for political campaigns. Further, Ximena found an article related to this work and shared it with her instructor, who took the time to read it and share her thoughts. While this example represents the extent to which Ximena perceived the inclusion of the *enhancing meaning* domain within her class, it also represented a departure from Willow and Benjamin. For Benjamin, the *enhancing meaning* domain was engaged partially through class discussion. Mostly these were opportunities for students to ask questions, around a central topic, trying to understand the mechanics of how that topic worked (e.g., process, algorithm, etc.).

In Ximena's example, we see where students were not only learning the content but learning how to apply the content to their interests and share those interests back with their instructor. In other words, students were not just learning an algorithm to solve a problem; they were learning how to start applying mathematics to their interests and pursuits, thus *enhancing meaning* of the content through a constructivist approach to understanding the content. This allowed students the opportunity to analyze, apply and activate prior knowledge—all well-known strategies for increasing higher cognitive levels in students (Athanassiou et al., 2003). In turn, this can provide students with the

confidence and skill to not only master classes but incorporate the practice into other courses in their collegiate careers. Finally, this aligns to Ximena's definition of success, allowing her to understand what she is doing and giving her confidence that she can be successful:

> I don't really care about the letter grade. It's more so I want to understand math problems and retain them. That's what's so important to me because it's easy to just sit there and go for good grades. I'd rather have an understanding and actually feel confident with what I'm doing, know what I'm doing. (Interview)

Ximena's Perception of CRTP – Engendering Competence. One area where Ximena's experience in the treatment group highlighted a divergence from the CRTP model, is around the *engendering competence* domain. As mentioned within the *developing attitude* domain above, Ximena's class was tied to external requirements, which had students and instructors follow a pre-determined assessment schedule and format. These predeterminations include required assessments and homework assignments with little room for modification. Ximena was fortunate that her instructor worked to embed opportunities to expand the content beyond the class, through videos and activities that required Ximena to explore math in area of interest. However, the majority Ximena's grade was determined by quizzes and assessments. This narrow definition of achievement aligns well with students who wish to measure their success through grades; however, for Ximena, her desire was centered on understanding content and feeling confident about her ability to use it. The Unit 3 assessment, that required her

166

instructor to advocate for an extension, represented one way in which assessments contributed to a feeling of inadequacy:

> Well, if [the assessments] weren't timed, it would be better because I feel like I wouldn't be so stressed when I have to take them. And I guess, if in the beginning of the test—if it would ask you non-math questions, maybe kind of like fill-in-the-blank questions about yourself, maybe that'd help me calm down. (Interview)

Like Willow and Benjamin, this was one area where both the control group and the treatment group were impacted by larger systems. Despite the intent to adapt this course to better support students, instructors were still tied to systems that operate externally to the class itself —systems such as assessment timelines and pre-determined homework assignments that leave little opportunity for instructors to adapt the content to meet their student's interests. Fortunately, Ximena's instructor had professional development around CRTP that gave her some opportunities to find a place within the curriculum where she could allow students to demonstrate their learnings in authentic and meaningful ways.

Sam

Sam was a Natural Resource Major and came from a family with some college background. As a student, he identified as male and Hispanic, as well as a military veteran. Additionally, Sam did not participate in any extra-curricular activities or academic groups on campus. When I first met Sam, he was frustrated with how the class was progressing. A misunderstanding of the assessment process and heavily weighted

167

chapter assessments had derailed his progress in class and led to him miss a number of

assessment points. He reported:

> I didn't realize that in order to take the review exams for the next chapter, you had
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> to pass the proctored exam. So, I got the review exam done, and then I was like,
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> 'Oh well, I have until May 7th to complete these proctored exams.' So, I moved
>
> ahead and was working on the next chapter's content because I was getting that
>
> pretty quickly, and spent a week on that and then realized, 'Oh, I can't take the
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> review exam that's due Friday, until I pass the proctored exam,' and I haven't
>
> really looked at that material since the following week. So then, I go back to take
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> the proctored exam, and it took me multiple tries. I ended up missing out on those
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> three points that are going to be a big deal towards the end of the semester,
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> because you have to get at least 57 points. And, if you pass the review exam
>
> within the due date, you get an extra 3 points, so that adds up to 12 points. And
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> then I can only miss two questions on the final exam, or I'm not going to pass the
>
> class. (Focus Group)

While Sam was nervous about his progress through the class, he was also frustrated by

the arbitrary nature of how points were assigned. When I asked if he could demonstrate

his learning in other ways, he indicated that he didn't think he could, but he was going to

talk with his instructor. I reached out a couple weeks later and learned that his instructor

had turned down any alternatives to re-assessing and earning the lost points. While it

wasn't clear if it was an instructor or departmental decision, the policy was not designed to support Sam in a situation where an honest mistake had been made.

As we continued through the semester, I met with Sam again. Things had changed for the better. Sam referred to the same Dr. Price video as an opportunity to expand his view of who could do mathematics. Despite this, Sam's concern of passing the class still weighed heavily on his definition of success, though there was a desire to understand the content and its application in life. During our second visit, he explained his idea of success:

> I guess it could be two things. Just passing the class, which is kind of how I feel like it's just going to end up being, is I'm going to pass the class. And if I were to have to do most of these problems, probably 50%–75% of them, I don't think I'll be able to remember how to do them after summer. Wasn't enough time, and in two weeks to go through an entire chapter and really understand it all and have it locked in your brain is not enough for me personally.
>
> The second definition for success would have been really understanding why we're learning this and where this is going to be beneficial down the road in our lives, instead of just, get this done as quick as you can. Don't fall behind because you got to get those three points or else you're going to be stuck in a hole. (Interview)

Clearly, Ben still had concerns around his ability to pass the class, but he had begun to look forward to understanding the material. Despite this, he still concluded this statement

with a focus on the points, not the content he readily acknowledged he was likely to forget.

Sam's Perception of CRTP – Establishing Inclusion. During our first meeting, Sam and I discussed how student feelings and needs were being incorporated into class. Sam noted that his instructor did a good job circulating in class, talking with each student, and also followed up via email throughout the week to check in on students and ensure they were doing okay. Sam especially appreciated the two-way communication, allowing him to reach out to his instructor for help. For Sam, the instructor was *establishing inclusion*. Along these same lines, Sam indicated that he felt his instructor was creating an equitable environment when it came to asking and answering questions. Sam's only concern was really around assessment, and if there were other ways to demonstrate mastery of the content. Again, from our follow up conversation, after he had an opportunity to talk with his instructor, he discovered there was no flexibility with regards to how he could demonstrate his knowledge.

What was surprising to me in Sam's case, was that his experience with testing was similar to Ximena's, especially concerning the stress induced by the timed assessments; however, unlike Ximena, his instructor didn't provide extensions or other opportunities. While both in the treatment group, Ximena and Sam were in different sections of the treatment class and had two separate instructors. While both instructors received the same professional development prior to the start of the year, here is a case

170

where one instructor went above and beyond to help the student, and it made a meaningful difference to the student's experience.

Sam's Perception of CRTP – Developing Attitude. I asked students to reflect on how student thoughts, feelings and needs were being heard and responded to. For Sam, he referenced the fact that his instructor frequently circulated around the room, asked and answered questions, and sent emails regularly to keep students up to date.

However, his early negative experience colored Sam's experience throughout term. I asked Sam about the feedback he received from his instructor with regards to his work, and if it aligned to his definition of success. For Sam, he would have appreciated more constructive feedback, not just "Hey you're getting these modules done. Good job, you're on the right track" (Interview). What I appreciate about this statement, was it speaks more to Sam's second part of his definition of success, mainly around understanding the content, rather than the score. Again, compared to Ximena's experience, where she felt the focus was more on the content of the material, and less about the progress through the material, in Sam's case, he felt his instructor appeared to focus heavily on what it took to pass, rather than understanding the material.

Sam's Perception of CRTP – Enhancing Meaning. Similar to Willow, Benjamin, and Ximena, Sam indicated that the ability to co-create knowledge was limited due to COVID-19 and mandated social distancing. Sam mentioned that on the first day of class, the instructor tried to use breakout rooms within Zoom, and provided students with problems to work through together. For Sam, though, this exercise was a lost opportunity,

as his group struggled to get going: "I think we kind of split into groups on Zoom and just kind of worked through problems. But, none of us really knew how to begin" (Interview).

Another aspect of *developing attitude* was engaging in discussions around specific terminology around how students would like to be identified by (Latino, Hispanic, etc.). However, when Sam was presented with this question, he didn't think it was necessary to have this kind of conversation. In fact, he believed it could have negative impacts: "I don't think we really talked about preferences around terms. I don't know if it would have made a difference. Maybe it'd make people feel a little more comfortable, but they could also feel like maybe they're just being mocked" (Interview). When I asked what he meant by saying students might feel mocked, he said, "I don't know, just because everyone is so sensitive nowadays" (Interview). As we continued to talk, there was more clarity around how Sam was thinking. Again, in terms of how Sam defined success, he was most interested in points and grades. Therefore, Sam's reply made sense:

> It is nice to know they care and stuff, but with the class period being so short and math being my most difficult subject for me, I really want to take that time that we have to wrap my head around the concepts that have been driving me crazy on the days that I'm not in class, so I can go home and understand and move forward. (Interview)

While the conversation around specific terminology was not a critical piece to developing Sam's attitude with regards to the content, he did reference the Dr. Price video as having a positive effect on his sense of belonging to the class:

> It is meaningful, in a way. When you think about mathematics, growing up seeing mathematicians like cartoons and stuff like that, it's always just old White people just hanging around a white board, just doing math or it's photos of Einstein and that's basically all I'd ever see. (Interview)

Sam presented a complex view of *developing attitude* here. When asked directly about CRTPs, and the inclusion of relevant terminology, there appeared to be a negative view; yet he identified an appreciation of mathematicians who do not look like the "old white guys" that he was used to. This speaks to Sam's preference for having more indirect opportunity to adjust the view that mathematics is done by "old white guys," as opposed to directly discussing relevant terminology in class.

Sam's Perception of CRTP – Engendering Competence. As described above, Sam's experience did not necessarily show areas where instruction was adjusted based on the needs of the students (Ginsberg & Wlodkowski, 2009). Rather, Sam's experience was one where there was a very clear pre-determination of what was expected and how it would be measured, with no flexibility on how/when assessments would take place. As a result, this created a lot of fear and concern for Sam, especially in a class critical to his continued success in MSU (Barbera et al., 2017; Callahan & Belcheir, 2017). Additionally, because of Sam's experience, the learning from this course was relegated to

173

what Sam needed to do to pass, rather than preparing him to see how this knowledge could be used.

Additional Themes

While a deductive-coding approach was utilized, framed around the CRTP pillars identified by Ginsberg & Wlodkowski (2009), there was always the possibility of emergent codes/themes. During conversations with Ximena and Sam—both older students and military veterans—the theme of tutors arose. For both students, the Department Adult Learner and Veteran Services (ALVS) at MSU, provided critical support. As Ximena described, ALVS provided students with access to free tutors. Sam noted, "At the beginning of the semester, the tutor was helping a lot. And then, once the problems started becoming more like you could do the whole entire thing on the calculator the class was helping more than the tutor" (Interview). In a similar vein, Ximena credited her access to a tutor for helping her succeed: "If I didn't have a tutor, I don't know how well I'd be doing right now in those classes" (Interview, 2021).

In both situations, there is an added benefit with providing students access to tutors to help them navigate the content; however, these supports were not provided to the students, rather the students happened upon them. For example, in Sam's case, a friend told him about the tutoring service. For all four participants, I asked about their instructors providing access to out-of-class resources. All four students reported very little out of class support, beyond office hours and online communications.

174

Visualization of Participants and Themes

In addition to the codes/themes identified above, I was curious as to which course provided a richer experience around CRTP, based on student responses. While participants were asked the same baseline questions, there were times where the interview deviated from the originally designed questions. For example, Ximena and Sam's discussion of tutors raised additional questions, which were not present for Willow and Benjamin. Specifically, I framed some of the original questions, around Willow and Benjamin's experience with their tutors. Despite these deviations from the original interview script, students were provided opportunities to engage with the same baseline questions, which should have provided them equal opportunity to share experiences with CRTP, if present within their classroom.

Figures 4.5 and 4.6 show a comparison of the men and women participants, and their responses broken down into the themes presented. Themes that appear in the middle of the chart represent themes coded to both participants. What can be seen from these figures in both cases was the treatment students had more responses that aligned to the CRTP by two to three times as much. While it would be hard to correlate the one hour of professional development to the increase in anecdotal examples that the treatment group provided, these figures provide a compelling view that students in the control group may have had more opportunities to speak to the power that the professional development provided; by contrast, students in the treatment group had more anecdotal examples related to CRTP themes than students in the control group.

175

Figure 4.5 *Emergent Themes from Latino Students*
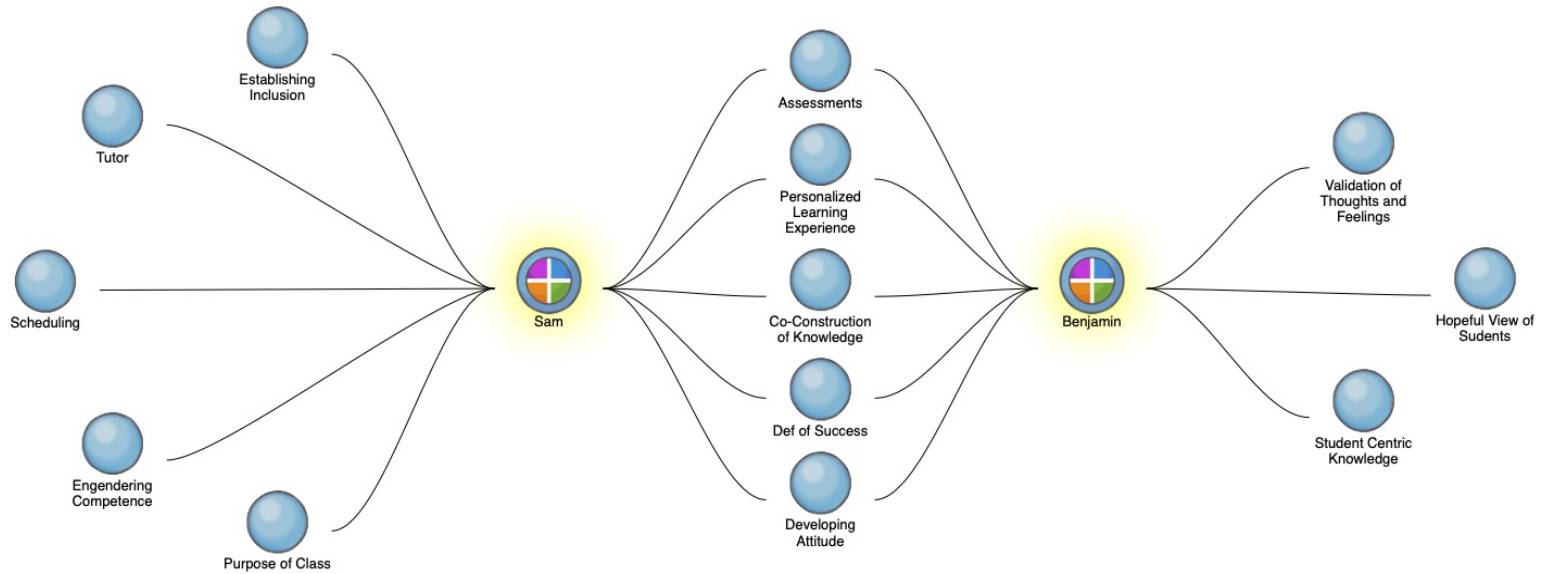
Figure 4.6 *Emergent Themes from Latina Students*
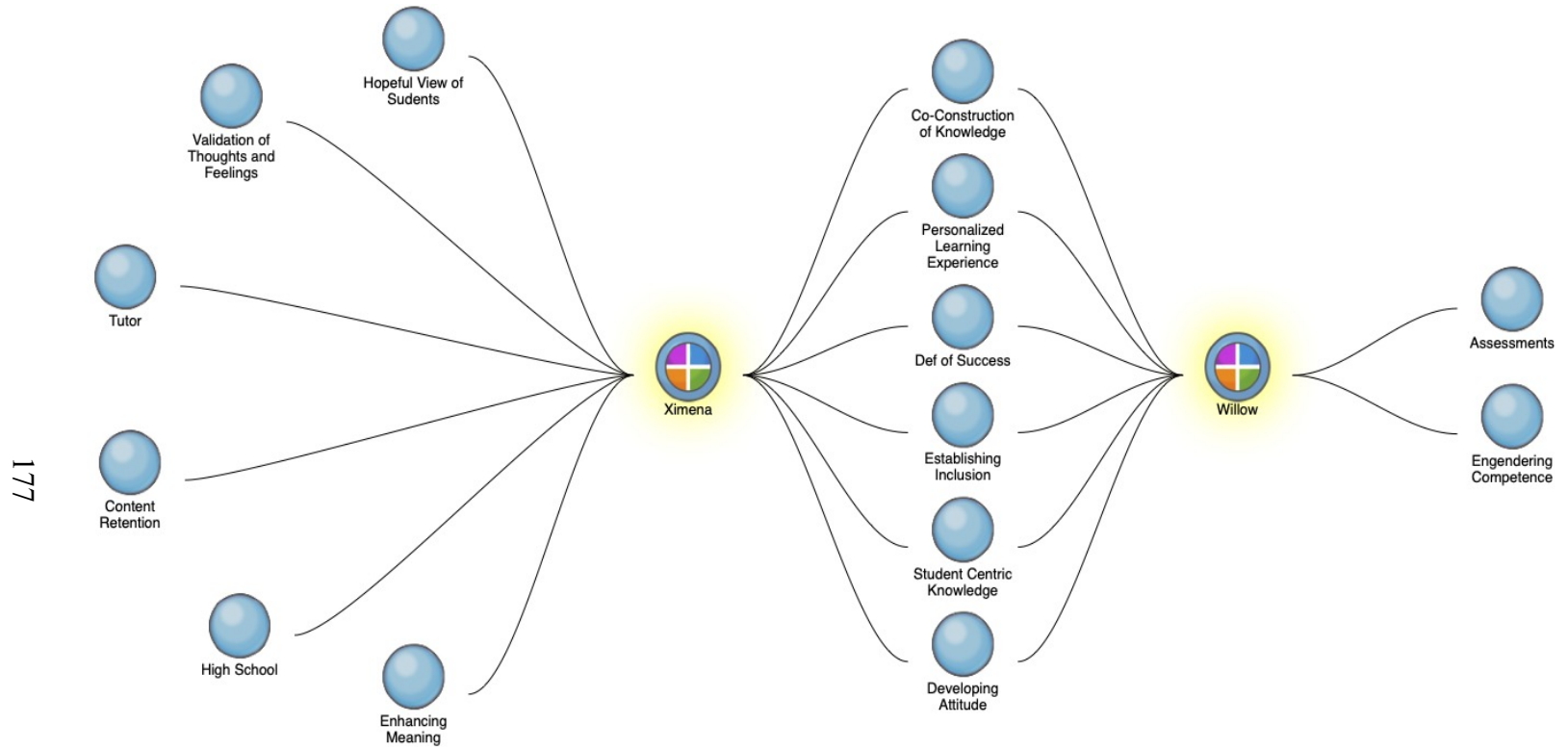
Integration of Quantitative and Qualitative

For RQ3, I was interested in examining how RQ1 and RQ2 interacted with each other to understand how Latinx students perceived the four domains to help understand the relationship between these domains and student success in the class. More specifically, in instances where students perceive greater utilization of CRTP, did these practices align to student definitions of success? To answer this question, I identified each student's definition of success, and then examined their responses with those themes in mind. Lastly, did student responses help me better understand how the instructor's use of CRTP helped students be more successful, and did these practices appear more pronounced in the areas that were found to have a statistically significant difference from the control group.

Helpfully, Creswell and Plano Clark (2016) offer strategies to address potential validity threats for Mixed Methods, convergent designs:

- Create parallel questions addressing same concept.

- Use same sample sizes for qualitative and quantitative strands.

- Use convergent data analysis (joint display) to compare results

- Engage in strategies to understand disconfirming results. (p. 251)

For this study, the questions presented to students were in alignment with a CRTP survey developed by Rhodes (2016) and thus were parallel in questioning the same concept. Additionally, sample sizes for both the quantitative strand and the qualitative strand were relatively equal (14 versus 12 in the quantitative strand; 2 versus

2 in the qualitative strand). Next, it was necessary to integrate the data and identify

areas where the quantitative and qualitative strands supported each other. Additionally, it

was important to identify where the quantitative and qualitative strands seemed to

contradict each other.

For all four students interviewed, a few themes emerged as how they would

define success:

1) Developing a conceptual understanding of the material.

2) Affirm they are not alone in the challenges when it comes to the

material.

3) Find real world application of the math.

a. Broaden who can do math form "old white guys" to a more

representative demographic.

b. See how math relates to their passions and pursuits.

4) Pass class

In Figure 4.6, a '+' notation represents a comment that students perceived a

positive aspect of that theme within a specific domain. A '-' indicates students had a

negative view of that theme within the domain. C is short for control group response; T

is short for treatment group response; and B indicates both groups had similar responses.

So, +B before a comment indicates that both groups have a similar positive response to

the theme within the specified domain.

Table 4.6 *Quantitative and Qualitative Integration*

	Establishing Inclusion	Developing Attitude
Themes		
Conceptual understanding of material	(+B) Individualized pacing (-C) Unintentionality	(+C) Student Q/A (+B) Supportive relationships (-B) No relevancy (-T) Limited Student Q/A
Affirm students are not alone with regards to the challenge of mathematics	(+C) Student-Student discussions	(+T) Examples of mathematicians struggling
Real world application of mathematics		(-B) No relevancy
Who can do mathematics	(+T) Examples of mathematicians of color (-C) Narrow definition of mathematicians	(+T) Students called mathematicians (-B) No discussion on identities (-B) No student-student projects
Mathematics as it relates to student's passions and pursuits		
Multiple pathways to success	(+T) Advocate instructors	
Summary	Control: 1 Positive, 2 negative Treatment: 2 positive, 0 negative Both: 1 positive, 0 negative $t(26) = -3.111, p < 0.005$	Control: 1 Positive, 0 negative Treatment: 2 positive, 1 negative Both: 1 positive, 4 negative $t(26) = -0.09, p > 0.05$

Continued

Table 4.6 *Quantitative and Qualitative Integration*

	Enhancing Meaning	Engendering Competence
Themes		
Conceptual understanding of material	(-B) Limited co-construction (-C) Lecture (-B) No student input to content (-T) Ineffective group structures	(+B) Actionable assessment feedback. (+T) Student reflection (-T) Rigid class autonomy
Affirm students are not alone with regards to the challenge of mathematics		(+T) Advocate instructors
Real world application of mathematics	(+C) Election practices	(-C) Inauthentic content leading to poor retention
Who can do mathematics		
Mathematics as it relates to student's passions and pursuits	(+T) Job related article selection.	
Multiple pathways to success		(+C) Flexibility on final assessment
Summary	Control: 1 Positive, 1 negative Treatment: 1 positive, 1 negative Both: 0 positive, 2 negative $t(26) = -0.66$, $p > 0.05$	Control: 1 Positive, 1 negative Treatment: 2 positive, 1 negative Both: 1 positive, 0 negative $t(26) = -3.33$, $p < .05$

Quantitative and Qualitative Integration-Discussion. To integrate this data, I looked at emergent themes that arose from our conversations regarding their experiences and student's definitions of success. Comments within each of the domains were categorized by theme and compared to the student survey to identify areas of congruence and dissonance. The follow section investigates each theme to better understand how the quantitative and qualitative data relate.

I attributed positive or negative values to the findings, based upon student's responses. If students responded favorably to some item, such as individualized pacing being helpful, I ascribed a '+' to that theme. Similarly, if students indicated that something was a negative experience, for example the assessment piece, I ascribed a '-' to that theme.

Conceptual Understanding of Material. All four students stated that their primary definition of success was not grades but rather about understanding the various concepts they were taught. As a result, this represents probably one of the most important themes, as it provides a metric of their success. Within the *establishing inclusion* domain, we see that in both control and the treatment courses, students felt instructors utilized systems which allowed students to move independently through content, to an extent. Students who were able to grasp a certain topic in class, could move ahead at their own pace; however, there were times when students came up against time constraints for pacing and the acquisition of knowledge. In the control class, there were efforts to establish inclusion through relevant problems; however, these were often unintentional

and were a result of "good luck" rather than strategic planning on behalf of the instructor. Such was the case for the Harry Potter example that happened to align with student's interests.

Within the *developing attitude* domain, neither group saw great relevance with regards to the content they were learning, which did not aide students conceptual understanding of the material. However, students in both courses indicated that instructors worked to build supportive relationships by being approachable, friendly, and expressing belief in student capabilities. In the control class, students had the opportunity to engage directly with the instructors through a well-designed question and answer process, while students in the treatment class shared that there was not a class wide question/answer process in place. In the treatment class, questions were handled more in a one-on-one process with the instructor.

Within the *enhancing meaning* domain, much of the work that would involve co-construction of knowledge through student-to-student interactions was limited due to the pandemic at the time. As a result, students in both groups indicated that there was very little student to student interaction, which limited class opportunities for group work. The control group indicated that lessons were heavily focused on a lecture style format, while the treatment group did refer to early attempts to engage in group work; however, the structures were ineffective.

Finally, both groups benefited from regular, actionable feedback, as opposed to the same courses most students attend, where answers are put into a computer, and the

answers are either right or wrong, with no feedback (*engendering competence)*. In the

treatment group, students were provided opportunities to reflect on their work. Taken

together, the opportunity to reflect on work combined with instructors' actionable

feedback, provided the structures necessary for students to further their conceptual

understanding of material, in pursuit of their primary definition of success.

Affirm students are not alone with regards to the challenge of mathematics.

One area that three of the four students shared that transcended control or treatment, was

the sense of comradery that arose when students realized they were not the only ones who

found math challenging. Therefore, the second theme that resonated was students sense

of community, centered around a common struggle within mathematics. For the control

group, students referred to an early discussion at the beginning of the semester, where

instructors asked students to share their experiences with mathematics. Willow indicated

that this experience put her at ease, as she felt comforted by the numerous individuals

who also struggled with mathematics.

In the *Developing Attitude* domain, Ximena and Sam shared similar experiences.

While they were not conducted amongst the students, both Sam and Ximena alluded to

the "Meet a Mathematician" video, which featured a Black female who referenced some

of her struggles with mathematics, even though she had a Ph.D. in the field.

Interestingly, both Sam and Ximena did note that it was this individual's experience in

mathematics that resonated with them more than the fact that she was not the

184

stereotypical mathematician; however, her race did come up later in our conversations around *establishing inclusion* around who can do mathematics.

Finally, students in the treatment group were provided instructors who advocated on the student's behalf, when they had issues completing assessments, which further supports the *engendering competence* domain. The students felt that their instructor's belief in their abilities provided support beyond simply answering questions during class.

Real World Application of Mathematics. The third theme that emerged was around applicability to real world content. Unfortunately, in both courses, most students saw limited relevance to the mathematics they learned. Benjamin referenced his appreciation of the election strategies module the control course, which is why I coded a positive connection with real world application of mathematics under the *enhancing meaning* domain; however, Ben mentioned that this example was limited in scope, as he was also interested in international election strategies as part of his career pathway.

For the most part, however, Benjamin and Willow made comments that content was independent of student interests and as a result, weakened their ability to retain and engender their competences around the content. This was evident through another comment Benjamin made regarding midterm review. Additionally, Benjamin described needing to learn the material for the test, and then forgetting it after the term.

Who Can Do Mathematics. One of the interesting themes that emerged was around who can be a mathematician. As a White male, the comments around this piece really stuck out, especially when in two different conversations students shared activities

185

that shifted their perception that math was done by "old White guys." As a result, examining this theme across the four domains presented an opportunity to see how this narrative is being challenged or supported. This framing of who can do math seemed to be a very easy change instructors might make, with benefit to Latinx students.

The first area where this theme has a strong emergence is within the *establishing inclusion* domain. Here, instructors in the treatment group were very intentional about including opportunities to see mathematicians that went against the "old White guy" narrative. While both Ximena and Sam mentioned they appreciated seeing a high-achieving mathematician talk about their challenges with mathematics, they also both alluded to the fact that the video also expanded their definition of who could do math.

While the video was a great example of intentionally embedding content to support Latinx students, there were few other examples where instructors intentionally created opportunities to broaden student perspectives around who can do mathematics. Willow referred to her appreciation for the instructor calling students mathematicians, making her feel like she belonged. However, within the *developing attitude* domain, students from both courses indicated there was no discussion about identity, or preferred nomenclature around terms such as Latino/a/x. To be fair, there was mixed consensus as to whether this would have been beneficial or not, as Sam indicated he preferred spending time on the content of the class. However, Willow did believe that this would have benefited her experience, which also aligns with Ginsberg and Wlodkowski's (2009) work around the *developing attitude* domain. Additionally, Willow alluded to a

186

campus-wide movement to begin incorporating discussions around pronouns; however, she noted it did not extend to students' racial identification and thought it could be expanded to further discuss their cultures and identities.

Mathematics as it Relates to Student's Passions and Pursuits. Within the *enhancing meaning* domain, the treatment group benefitted from expanding the content of the course beyond the mathematics. In these courses, students were tasked with finding an article related to their field of interest and share it with the instructor. This activity provided a clear link to how math could be relevant to the students' future pursuits and resonated with Ximena especially. Interestingly, few other comments appeared in any of the domains which provided clarity around how instructors in the control group or the treatment group were ensuring students were seeing how mathematics could be applied. When looking at the overarching theme of real-world application of mathematics, we see that students in both courses reported the course content had no relevance to their future careers within the *developing attitude* domain. This explains the challenge facing students in both the control and treatment groups, in seeing how course content might benefit them in the future. It also highlights the challenge to instructors to provide students with a reason to learn the content beyond "doing well on the test."

Multiple Pathways to Success. The final theme that emerged from the conversations was around multiple pathways (or lack thereof) to success. Ximena's comment about her instructor's willingness to reach out to the testing center to get Ximena extra time on a test was one example from the treatment group around how

187

students can demonstrate their knowledge; however, it only looked at how an instructor could provide students extra time to show their learnings on a pre-determined assessment. Interestingly, in the control group, Willow mentioned that the final exam was a project, where students could propose a topic or choose one of the preselected topics. This activity provided more flexibility to students to demonstrate their learning and make the content relevant. However, Benjamin and Sam both reported they did not see multiple ways to demonstrate their learning, and even expressed frustration around the structure of the classes despite being in different courses.

Summary of Integration of Quantitative and Qualitative Results. After examining each of the themes against four domains, I was curious if the significance of the domains made sense considering student comments. As mentioned in the quantitative section, the following domains were different between the treatment and the control group, as evidenced by the Independent Samples t-test run on the course survey: *establishing inclusion, engendering competence,* and overall CRTP utilization. When examined against comments made by students, in both the *establishing inclusion* and *engendering competence* domains, the treatment group had more examples of how those domains were used in the class.

Additionally, the *enhancing meaning* domain showed the treatment and control groups had a similar quantity of responses in the qualitative portion of positive practices that were utilized within the classroom—thus, supporting the minimal difference between the two courses for the *enhancing meaning* domain. However, it is interesting to note that

the responses for the treatment group in the *developing attitude* domain referenced more examples of the practices utilized within the classroom, yet this domain also resulted in an insignificant difference between the control and the treatment groups.

Chapter Five: Conclusions and Recommendations

The Latinx community continues to be one of the fastest growing demographics in the United States (Galdeano et al., 2012; National Center for Educational Statistics, 2019). Despite this rapid increase, and substantial increase in graduation rates from public PreK-12 public schools, institutions of higher learning continue to see disproportionately fewer Latinx students enroll and graduate (National Center for Educational Statistics, 2019). Furthermore, 45% of Latinx students who enroll in post-secondary institutions do not earn a degree with 6 years (National Center for Educational Statistics, 2017).

One barrier continuing to impede student success in primary, secondary, post-secondary, and graduate institutions is mathematics. Mathematics and English have been considered gatekeeping courses, where students either perceive they belong because they are successful in these courses, or they develop a sense that they do not belong (Barbera et al., 2017; Callahan & Belcheir, 2017; Musoba & Krichevskiy, 2014). While researchers have explored how CRTP can be used to center students within the construction of content knowledge in the PreK–12 setting, CRTP research has been fairly limited in post-secondary gateway courses, especially in non-STEM pathways (Baldwin, 2015).

Although PreK-12 institutions have begun to better support Latinx students towards graduation and attainment towards high school diplomas, there are still opportunities for improvement, by aligning high school graduation requirements to first-year collegiate success (Stohs & Schutte, 2019). One strategy to bridge this divide is to begin incorporating more CRTP within Prek-12 systems, and that begins with ensuring that education preparation programs are incorporating CRTP theory into their coursework.

To frame this study, I utilized Culturally Responsive Pedagogy (CRP) and Culturally Responsive Teaching Practices (CRTP) as shown in Figure 1.3 and Figure 5.1 (Ginsberg & Wlodkowski, 2009; Ladson-Billings, 1995). CRTP is framed around Ladson-Billings (1995) work; hence, the four-domains are bounded by the CRP pillars shown on the vertices of Figure 5.1. Throughout this chapter, I refer to both frameworks.

Figure 5.1 *Integration of Culturally Relevant Pedagogy with Culturally Responsive Teaching in College*
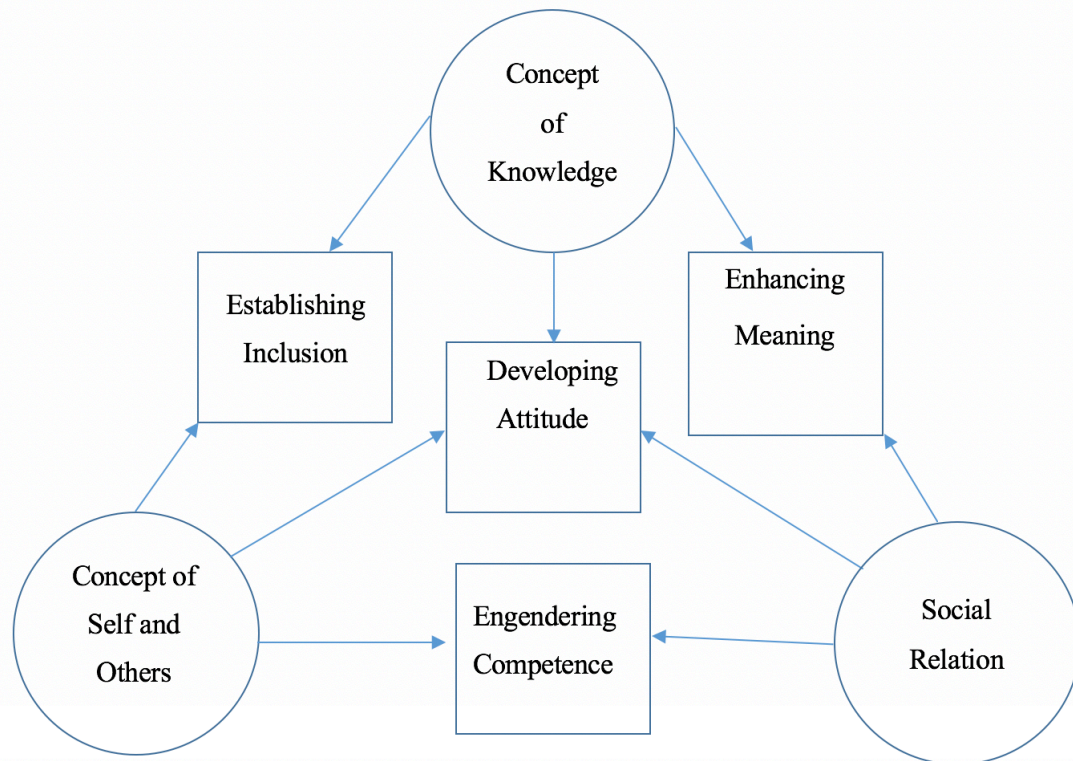
Benefit of CRTP for White Students

Much of this dissertation has focused on the value of CRTP and their impacts on traditionally marginalized groups, such as Latinx students; however, there is also value for CRTP for our White students as well. For many of our White students, they have experienced a normalizing of Whiteness, wherein White students are beneficiaries of unearned advantages based simply on their skin tone. Additionally, White students often view the world through a lens that promotes a meritocracy (Hartmann et al., 2009; San Pedro, 2018). Students can begin to confront some of these hierarchical structures and examine their own privilege, making Whiteness visible, and beginning to provide

192

structures to discuss the inequities of our current systems. In other words, while CRTP has shown value for our traditionally marginalized groups, there are also benefits for our White students as well.

Research Questions

The purpose of this study was to better understand how CRTP impacts Latinx student perceptions of a first-year, non-remedial, terminal mathematics course. To better understand this question, I designed a convergent mixed-methods study around three questions: a quantitative question measured through an Independent Samples t-test (RQ1), a qualitative question studied through a focus group and follow up interviews (RQ2), and a third question integrating RQ1 and RQ2 to develop a comprehensive understanding of our Latinx student's experiences (RQ3):

1) How are student perceptions of mathematics affected when culturally responsive teaching practices are utilized in a first-year, non-remedial terminal mathematics course?

2) What are Latinx student perceptions of their instructor's use of culturally responsive teaching practices to establish inclusion, develop student attitude, enhance meaning, and engender competence in a first-year, non-remedial terminal math class?

3) What do Latinx student perceptions of the four CRTP domains reveal about the relationship between these domains and student success in the class?

193

Overview of Mountain State University, Data Collection, and Analysis

Mountain State University (MSU) was chosen due to its size, designation as a public university, and development of classes specifically designed to better support first-generation students and traditionally underserved students (K. McLaughlin, personal communication, July, 2020). At MSU, 15% of students identify as Latinx; of those students, 64% will graduate within 150% of normal time—or within six years (National Center for Educational Statistics, 2019). MSU's enrollment of Latinx students mirrors national trends of 18% Latinx students enrolling in four-year post-secondary institutions, despite their rank as one of the fastest growing communities in the United States (Galdeano et al., 2012; National Center for Education Statistics, 2020). As a result, MSU represents a good site to better understand what is being done to ensure Latinx students experience an authentic, meaningful college experience.

Overview of Methodology

I utilized a convergent mixed methods approach, which blended quantitative and qualitative data-collection techniques to develop a better understanding of Latinx student experiences. For RQ1, I modified a version of Rhodes' (2016) survey for *Teachers Inclusion of CRTP* to be used by students to reflect on their perception of CRTP within the classroom (Ginsberg & Wlodkowski, 2009; Rhodes, 2016). I utilized an Independent Samples t-Test to compare the treatment group against a control group. Due to the limited sample size, both groups comprised students from different races, not just Latinx. All assumptions for Independent Samples t-test were met (normality, homogeneity of

194

variance, and independence of errors) (Spatz, 2016). Given that the professional development the treatment instructors received was only an hour long, results from the t-test should be viewed as descriptive, rather than as a conclusive statement on CRTP.

For RQ2, I created interview questions that aligned Rhodes' (2016) adapted CRTP survey. For RQ2, I chose questions that were like survey questions chosen for RQ1. This prepared me for RQ3, where I would need to integrate the results of RQ1 and RQ2 (Creswell & Plano Clark, 2018). To ensure questions were parallel, I utilized the four domains of CRTP: *establishing Inclusion, developing attitude, enhancing meaning*, and *engendering competence* to group similar themes together. Finally, to best gather student voice in this project, I utilized two types of interviews. The first was a semi-structured, focus group where students from the control group were interviewed together, and students from the treatment group were interviewed together. After the initial group interviews, I conducted one-on-one interviews with participants (Merriam & Tisdell, 2016, p. 233). All interviews were transcribed, coded, and analyzed through the four domains of CRTP. I identified themes and patterns and employed member-checking to ensure I had adequately captured student voice (Creswell & Poth, 2018; Maxwell, 2013, p. 126).

To answer RQ3, I utilized a convergent, mixed methods approach to integrate he responses from RQ1 and RQ2. This allowed me to study similarities and differences between the results (Creswell & Plano Clark, 2018). Again, since I utilized parallel questions from RQ1 and RQ2, I was able to better understand both what was happening

195

at a larger scale through RQ1, and why it may be happening through in-depth research with four students for RQ2.

Synopsis of Major Findings

In the analysis, I found statistically significant difference in the *establishing inclusion* domain, the *engendering competence* domain, and overall use of CRTP. There were no statistically significant differences between the *developing attitude* or *enhancing meaning* domains. However, results needed to be tempered with the fact that the survey utilized was primarily used with instructors and focused on ESOL courses, not mathematics or students in those courses. Additionally, while the findings did indicate some statistical significance, there are questions around what caused this significance. Did a one-hour training around instructional practices which could be good teaching or CRTP really yield substantial differences? Or, are the differences attributed to the different instructors, independent of training? Also, whose voice is truly represented within the study quantitative results. The classes were predominately White students, and while the intent of a mixed methods approach is to better understand the quantitative results from a Latinx perspective, the quantitative results can be potentially misleading.

This study began by exploring the results of a quantitative survey distributed to 26 students in two courses, across four different sections. Two sections were identified as the control and two sections were the treatment. For the treatment sections, instructors received training around CRTP, while instructors in the control group did not receive any training. Results of the survey showed that the 12 students who participated in the

treatment class ($M = 5.038$, $SD = .695$) as compared to the 14 participants who were in the control class ($M= 4.368$, $SD = .635$) perceived a greater utilization of CRTP by their instructors, $t(26) = .017$, $p<.05$ (Rhodes, 2016).

Additionally, I found that students in the treatment group identified two domains where instructors provided a statistically significant different experience, as compared to their peers in the control group: Domain A – *establishing inclusion* ($t(26) = -3.111$, p<.005) and domain D – *engendering competence* ($t(26) = -3.33$, p<.003). The remaining two domains*, developing attitude* and *enhancing meaning* showed no statistically significant differences. Possible reasons for these results were discussed in chapter four, including COVID-19 impacts and departmental restrictions for fidelity across sections. Additionally, it may be that the survey was not sufficiently calibrated for students since it was adapted from an instructor specific survey. These issues are beyond the scope of this study and are not fully explored here.

In the qualitative portion of the study, Latinx participants had an opportunity to share their experience, answering interview questions aligned with a modified questions from Rhodes' survey (2016). For RQ2, Latinx students in both the control and treatment groups, identified aspects of CRTP present in their mathematics course; however, difference occurred in how those experiences came to pass. In the treatment group, instructors intentionally embedded aspects of CRTPs in the course work. This included tasks where students applied the math they were learning to their lives—an example of *enhancing meaning*. For example, students in the treatment group were provided the

opportunity to research articles that tied mathematics to their individual pathways, and instructors introduced videos of mathematicians of color in class. In the control group, while instructors activated the enhancing meaning domain, it was not necessarily intentional. For example, while questions related to Harry Potter were meaningful to Willow, the connection to her interests occurred only by chance. Instructor intentionality was a key differential between control and treatment groups and may be attributed to professional development the treatment-group instructors received.

In areas where I found statistically significant differences, the students described instructors who intentionally embedded activities beyond the norm for the class. The two clearest examples were the "Meet a Mathematician" videos and articles related to student majors. Additionally, instructors moved into advocacy roles to better support students and keep them from failing, despite rigid systems in place at MSU. In areas concerning relationships between instructors and students, differences were not statistically significant. For the *establishing inclusion* domain, instructors created positive relationships with their students, were accessible outside of class hours for additional help, and genuinely cared about their students in the classroom.

Finally, the integrated quantitative and qualitative data exposed the potential power of representation through stories from Black and Latinx mathematicians, as well as the productive struggle even accomplished mathematicians face. Coupled with in-class discussions, a willingness to advocate for students, and supportive relationships between students and instructors, these affirmations offered clarity for why students within the

198

treatment class perceived statistically significant differences in their mathematics class experience, as compared to their peers. These findings may help universities better understand how best to support Latinx students in first year, terminal, non-remedial mathematics courses, and help students persist to earn a four-year degree.

Findings Related to Literature

Remediation versus CRTP as Instructional Support

The focus of the present study was on first-year, non-remedial, terminal mathematics courses and how Latinx students experience these courses. I chose this narrow focus in response to limited evidence suggesting that remediation provides a steppingstone to success (Bahr, 2008; Crisp et al., 2017; Goudas & Boylan, 2012). For many students in remedial math, fear of mathematics contributes to a negative view of the value and usefulness of mathematics in their lives. Interestingly, in this study, many students echoed a fear of mathematics; yet their inclusion in a credit-bearing, terminal mathematics class provided a different experience from remedial courses. First, the cost and time spent in mathematics during the Spring 2021 term accrued credit toward graduation, unlike students placed in remedial courses. Indeed, completion of a credit-bearing, first-year, non-remedial mathematics course is critical to Latinx student retention (Crisp et al., 2017; Musoba & Krichevskiy, 2013). Through its intentional construction of special sections designed for first-year or traditionally marginalized groups, MSU is making a demonstrated effort to improve student experiences in mathematics.

Even in literature where remediation was found to be beneficial, there are concerns that data did not clearly delineate that remediation worked. In a few cases where remediation was found to work, it primarily worked for students who were just below the cutoff for acceptance into college level mathematics (Bahr, 2010). However, research has found that students who just miss the cutoff perform as well in college-level mathematics, regardless of their time spent in remedial mathematics preparing them for college-level mathematics (Goudas & Boylan, 2012). Additionally, the time and money spent in the remedial class was more detrimental and potentially led to lower remediation than had the students simply started in college-level mathematics courses.

In this study, the issue of cost was raised by Ximena. In our conversation, she reported that she joined the military to cover the cost of higher education. Although no other conversations directly addressed the cost/time of college or remedial mathematics, students in the treatment group valued the CRTPs that were in place. For example, two students referred to their desire to understand and make meaning of the content beyond just getting a good grade. Instructors leveraged the *establish inclusion* domain to meet this need through the article-selection activity.

Instructors also shifted the narrative of who can do mathematics. For both students in the treatment group, conversations around the importance of the "Meet a Mathematician" video and its representation of diverse mathematicians. This shifts mathematics from something being done to students, to something students can participate in and create. When examined through the lens of students who identify as

"bad at math," these videos brought them into the creation of the content, making it relevant to their chosen fields. More important than just showing students a diverse slate of mathematicians, these experiences showed them accomplished mathematicians of color who were not savants; rather, they depicted real people who similarly struggled, persevered and became highly accomplished. While all four students did not have an opportunity to view the videos, all four spoke to the importance that social relation—a CRP pillar—played in their shared struggles in mathematics. In the control group, struggles were shared in group conversations at the beginning of the year.

Leveraging Student's Cultural Capital

Latinx students arrive at college with great aspirational, social, familial, and linguistic capital, (Ponjùan & Hernandez, 2020, p. 3). Throughout our conversations, students expressed limited opportunities to enhance their mathematical experience through these various capitals. As Ponjùan and Hernandez noted, cultural capital is often inherited for members of the privileged class, but non-Hispanic serving institutions often fail to leverage Latino student's cultural capital, either through adjustments to instructional practices or changes within longstanding policies to improve the college experience for BIPOC populations.

In both treatment and control groups, students described instructors who worked hard to build relationships with them and made attempts to valuable learning opportunities. Yet, there were times where course constraints prevented instructors from meeting student needs. Non-Hispanic serving institutions like MSU often fail to provide

201

the necessary adjustments to instructional practices and longstanding policies that would improve the college experience for BIPOC populations. For example, Benjamin noted a couple of policies that were instituted by the mathematics department for his class, specifically around grading practices. In an example of aspirational capital, Benjamin tried to work with his instructor to address a misunderstanding around assignments. While this instance did not result in a change in practice or policy, it highlights an opportunity for MSU to review how students are assessed and identify methods that leverage the capital Latinx students have developed over time: social capital, aspirational capital, or familial capital (Ponjùan and Hernandez, 2020, p. 10).

Building Community Within Class and Expanding on Academic Supports

Previous studies highlighted how Latinx students' "must develop a greater awareness to use institutional resources and improve their help-seeking behaviors" (Ponjùan & Hernandez, 2020, p. 10). However, universities and instructors can help Latinx students identify opportunities to expand their social capital and empower themselves. As Pak (2018) and Cruz et al. (2016) noted, extra-curricular activities are one method for building social capital by helping students develop support networks and communities. While these studies detail ways extra-curricular opportunities support Latinx students, I was interested in classroom strategies that support students. In either case (extra-curricular or curricular), studies point to the value of community building Latinx student's social capital, resulting in higher retention and success (Baldwin, 2015; Cruz et al., 2019; Rincón, 2018).

Students in both the control and treatment groups noted instructor attempts to build an inclusive environment; however, these actions were limited. Student appreciated how instructors focused on establishing a safe environment, facilitated conversations around struggles with mathematics, and created a welcoming culture. However, this was the extent of community-building efforts in both courses. Therefore, while it appears instructors attempted to *develop attitude* for students, much of the work transitioned back into completing mathematics assignments after the first week of classes (Ginsberg &Wlodkowksi, 2009). Unfortunately, this does not begin to address the social relation pillar from Ladson-Billings (1995) work and offers an opportunity for improvement in the future.

Academic Support

In addition to social supports mentioned above, Cruz et al. (2019) provides a critical but underexplored area for supporting Latinx student persistence: academic support. In their study, while 34% of students identified social-support systems as critical, and 34% of respondents identified a need, 36% of students reported a need for academic support (Cruz et al., 2019, p. 11). Similarly, students in the present research confirmed a desire for strong academic supports. Both Sam and Ximena expressed the value of tutors outside of class and all four students referred to the value of instructor office hours. Additionally, all four students identified that understanding the material was more important to them than achieving high grades, which aligns with Cruz and colleagues (2019). One student in Cruz's et al.'s (2019) study mirrors closely what I

heard with some of my students: "My peer coach has been there to guide me and push me to achieve my goals; she has also helped me in obtaining outside resources that I would not have received on my own" (Cruz et al., 2019, p. 12). Clearly, outside resources are critical to supporting Latinx student success; however, students at MSU were left to their own devices to figure out how to access various supports.

Implications and Recommendations for MSU Math Course Design

While some good things were happening at MSU, opportunities remain to improve engagement and support for Latinx students. When compared to traditional approaches, these courses provide better supports with a dedicated instructor for a much smaller group of students; unfortunately, those instructors are limited to rigid framework of assessments, timelines, and other systems that persist across the institution. Multiple students and instructors shared their experience around assignment completion: tasks were to be completed independent of who was in the class or interest of the students. Most students had to demonstrate their mastery of content through traditional assessments and didn't retain much of the information after the assessments. In the control group, there was limited applicability to student interests. Among the students I interviewed, passing was secondary to understanding. Students wanted to understand and apply the content they were learning. At MSU, we see a program that has provided additional support to students yet has not addressed the underlying challenge facing Latinx students: relevance, meaning, and belonging within the mathematics program. In much of the current literature around culturally relevant learning experiences, building

204

community and centering Latinx students within that community is critical. The present study confirms a continuing disconnect between what students need and what they are receiving (Pak, 2018), which may contribute to the low percentage of Latinx students who pursue post-secondary degrees. To see meaningful progress, MSU and other institutions must go beyond simple adjustments to the structure of supports, and fully adapt course content and approach to authentically engage and support Latinx students.

The Spring of 2021 was heavily impacted by COVID-19, which resulted in limited opportunities for students to collaborate or work together; however, despite the safety restrictions, there were opportunities for students to demonstrate their learning and find relevance in more meaningful ways. As these courses currently exist, MSU is still trying to push students through a narrow definition of success, a definition that is built upon success being defined as simply passing the class.

Opportunities for Establishing Inclusion

Another component of community, *establishing inclusion* buoys Latinx students and improves their post-secondary success and retention (Pak, 2018). While many of these studies focused on extra-curricular aspects of Latinx community support, students at MSU echoed themes from these studies.

Prior research has focused on policy adjustments that helped create learning communities aimed at improving student outcomes (Zerquera & Gross, 2015). Study participants alluded to the value of knowing they were not alone in their pursuits, especially in challenging content areas such as mathematics. Interestingly, for students in

this study, comradery around a shared mathematical struggle appeared more critical than the sense that they were part of the Latinx community within the university. This contrasts with what some of the research has indicated, where authors have elevated the need to highlight the culture with which students identify (Pak, 2018). Reviewing the data more closely, however, it may be possible that students were unaware of the value they placed on seeing members of their ethnic communities represented within their experience. For example, when I asked Ximena if seeing people of color in the video made much of a difference in her experience, she indicated that it was more the shared struggles that made Ximena feel like she belonged. However, later in the conversation, without being asked, Ximena mentioned it was nice seeing a female of color succeeding in mathematics, empathizing with the female's experience of feeling like she does not belong. Additionally, this one video appears in our conversation six different times, as an anecdote that Ximena pulls from in a variety of ways.

Similarly, Sam, who is also a member of the treatment group, referred to the "Meet a Mathematician" video expanding his definition of who could do mathematics. Yet, when asked directly about the importance of instructors addressing student ethnicity, Sam indicated student ethnicity didn't matter much in his experience with math. Despite these contradictory responses, Ginsberg and Wlodkowski (2009) point out student efficacy when instructors establish an environment where students are included in creation of content, rather than recipients of pre-existing knowledge. Sam and Ximena both perceive value in these experiences which expand their definition of who is doing

206

mathematics, albeit indirectly. In other words, for Ximena and Sam, their instructors activated the *establishing inclusion* domain, in a way that removed the distance between the content and the students.

In the control group, on the other hand, Willow talked about the missed opportunity for her instructor to leverage her passions and interests in cultivating an authentic experience for her math course. While Willow appreciated the sense that she was not alone, she and Ben were never presented with an alternative narrative around who "does math." As Ben mentioned, math is done by a "bunch of old white guys."

In general, much of this confirms existing literature that helping Latinx students see themselves in the work is beneficial to retention and success. An extension to this theory, however, is that students may also benefit from conversations with classmates who are also apprehensive with regards to mathematics and build an understanding that they are in this experience together—regardless of how they identify.

One opportunity that arose within the *establishing inclusion* domain during the time of COVID-19 was establishing community in online environments. While our conversations did not speak to how teachers can establish community in online environments, there were some comments that helped establish opportunities. During a conversation with Benjamin, he alluded to his instructors attempts at collaborative work at the beginning of the semester, while students were still working in a remote environment. Unfortunately, when students were placed into groups, Benjamin indicated they didn't really chat. Students were given a math problem to solve, and they struggled

207

to solve it. While Benjamin's instructor intended to provide opportunities for students to engage, he did not create environment for students to thrive.

For MSU to navigate future online environments, there will need to be an opportunity for instructors and students to establish a common vision and expectations around what is necessary for success. For example, when managed properly, digital breakout rooms give smaller groups a chance to authentically engage with each other. However, before any breakout rooms or small online groups are created, MSU instructors must develop expectations for how these rooms are to be used and what products will be shared after the breakout session (Fisher et al., 2021). This can occur by working with students to identify their goals, their strengths, and how to use the time in breakout rooms to build new conceptual understandings. By establishing these shared norms and expectations, students and instructors will lay the groundwork for how breakout sessions will go.

Opportunities for Developing Attitude

Unlike the *establishing inclusion* domain, the *developing attitude* domain did not show statistical significance between the control and treatment groups. In many ways, the *establishing inclusion* domain is a departure from Eurocentric teaching practices that have invaded post-secondary education. It represents the opportunity to develop a community of learners, where instructors and students cultivate the learning environment together (Gay, 2018; Ginsberg & Wlodkowski, 2009). In both courses, students shared that there was little relevance and few opportunities to collaborate with classmates in a

208

meaningful way. In reframing future courses, there is an opportunity to explore how instructors might work with students to identify course goals, student hopes for the class, and how instructors and students can negotiate opportunities for students to demonstrate their mastery of concepts in approaches that are relevant and meaningful to them. Certainly, students must complete required work; however, trying to find authentic, meaningful opportunities to captures student passions and interests, and weave those strengths into coursework, will provide students greater volition than simply moving through the syllabus each day.

For this work to be meaningful and authentic, instructors must also spend time with students throughout the semester, reviewing their progress—both in terms of content attainment, and in terms of meeting student's expectations of the class. This provides students an opportunity to share how their experience is progressing, as compared to what expectations were as outlined at the beginning of the semester.

Opportunities for Enhancing Meaning

Enhancing meaning was another domain where there was no statistically significant difference between the control group or the treatment group. As Ginsberg and Wlodkowski (2009) state, *enhancing meaning* is about creating opportunities to "engage, challenge and intrinsically motivate" students (p. 190). These three concepts are all about Latinx student's having an opportunity to actively engage in their learning. Yet, students were challenged by learning the content, not by *applying* the content; therein lies the necessary change. For the Latinx students within this study, these challenges were not

new. Indeed, research suggests they add to the narrative that they don't belong (Musoba & Krichevskiy, 2013). However, challenging students by applying the content to their respective fields, provides them an opportunity to find relevance within the material and intrinsically motivate students to develop a deeper understanding of the content (Ginsberg & Wlodkowksi, 2009). In conversations with participants, that challenge alone would have brought relevance to their experience within these courses and better situated the content within their frames of reference.

Opportunities for Engendering Competence

For the final domain, *engendering competence,* there was a significant difference between how the two courses were taught. Ginsberg and Wlodkowski identify "authenticity, effectiveness, and intrinsic motivation" as three components critical to student's ability to build their confidence (2009, p. 264). In both courses, study participants referred to a rigid system of assessments, with overwhelming time constraints in several instances. As a result of this rigid assessment process, authenticity was missing for students. A key difference in the experience for the treatment students, was around instructor advocacy and opportunities to reflect on how content could relate to students chosen pathways. While instructor advocacy provided at least one Latinx student an opportunity to succeed on a challenging assessment, there was still a lack of authenticity around the assessment process.

Interestingly, the reflections and article selections within the treatment group provided students an opportunity to make the material more authentic to their experience,

210

thus helping with the relevancy component of their experience in the course. In the control group, the opportunity to shift the final assessment to a final report on a topic of the students choosing provided students another method to demonstrate their understanding of the content in a meaningful and relevant.

In both courses, these were predetermined activities, made without student input to the product or method of demonstration. While this is a good first step in providing students with a relevancy regarding the content, it still leaves out the opportunity for students to engage with the creation of the assessment process. In both the control and the treatment groups, effectiveness is limited by the students interests in the structure and approach of the assessment.

What is interesting about this domain, is that the treatment and control groups had equal positive comments and negative comments around the *Engendering Competence* domain, while there was clearly a statistically significant difference in the larger groups through the quantitative instrument. Further studies would benefit from exploring the differences between how students were supported in approaching and successfully demonstrating understanding on assessments.

Findings

While many of the findings confirmed the value of CRTP, there are a couple of areas that are beneficial to point out, specifically around intentionality and how even small changes resulted in different experiences for Latinx students in the treatment class. For example, in the control group, some CRTPs were in place, especially around crafting

211

meaningful problem sets. Yet, these activities were not deliberate; rather, just an example of "good luck" tying content to relevant topics for students. Within the treatment group, experiences such as the "Meet a Mathematician" videos, or opportunities to reflect on their experiences provided students opportunities to find relevance and shift the narrative around who creates math. MSU indicated that their control group did not have the systems in place to train instructors in CRTP. Even so, at a minimum, ensuring instructors are hired who can develop structures to intentionally gather students interests early on, or providing a framework which includes time to gather student voice at the beginning of the semester, is an easy lift and can be incorporated without negatively impacting time constrained, contractual obligations referenced by staff (K. McLaughlin, personal communication, June 5, 2020). Further, given the limited scope of professional development for the instructors within the treatment group—and the overall significance of CRTP and its impact on student perception of the inclusion of these practices—there is an opportunity for department leaders to advocate for funding for instructors within the control group to receive additional support to better meet their student's needs.

Limitations

COVID-19. This study was conducted in the Spring of 2021. Thus, it was severely impacted by COVID-19 restrictions at MSU. The university put in place an option where students could either attend class in person or asynchronously via video. As a result, in person attendance was much lower than usual. During my visits, attendance ranged from four to nine students. The actual class size was closer to 20–25 students per

section; however, most students participated asynchronously. Despite working with instructors to share information about the study, only students who were in attendance on days I visited participated in the study, drastically decreasing the sample size and power of the study.

Risk of Assuming Uniformity. Further, treating any group as monolithic diminishes the unique experiences and diversity within the group. As such, these findings are intended to provide to the overall body of literature four Latinx students experience and their classmates only, rather than intended to stand alone.

Focus on Third-Year and Fourth-Year Students. A third limitation for this study is like limitations I identified for Pak (2018). Like Pak's study, many of the students in the treatment and control groups were Third and Fourth-year students. Research shows that the highest attrition rates occur during the first two years of college (Herzog, 2005; Kamer & Ishitani, 2019; Ishitani, 2016). For at least two students involved with the interviews, they intentionally choose to take this class later out of fear of the content or were taking it a second time (Interviews). Therefore, while students in the study provided important insights, as upper-class students, they have already found strategies to navigate college and are more likely to complete their degree.

Student definitions of success, especially around learning the content versus getting a good grade was useful. I would be interested to see first- and second-year student goals as means to understand how to support them early on and encourage better retention.

Implications and Recommendations for Practice

Improving the experience for Latinx students in a first-year, non-remedial, terminal mathematics class is critical to helping ensure universities better support more diverse student populations. Yet, much work of the university instructor is around producing research, not young scholars (Cormier & Bickerstaff, 2020; Robinson & Hope, 2013). As a result, professors, teaching assistants, or adjunct faculty members "who do not have an understanding of pedagogy may think about the content students should learn, but not the cognitive capabilities they should develop" (Berrett, 2012; Robinson & Hope, 2013, p. 4). This focus on scholarship over teaching needs to be addressed.

Classroom Recommendations

Broaden the Definition of 'Mathematician'. Classroom instructors and teachers have a lot they can do to better support Latinx students within the classroom. First, is shifting the mindset of students, around who can be a mathematician. Inclusion of videos like the "Meet a Mathematician" provided the context for students to start broadening their understanding of who can do mathematics. This provided a more welcome environment beyond the "old white guy" narrative that mathematics is sometimes burdened with. This simple change can be made by provide instructors with curriculum plus the additional videos, with little training.

Address Mathematics and Student Relevancy. Additionally, giving students opportunities to extend math into their areas of study helps establish relevance for the student and diversifies the opportunities for students to demonstrate their knowledge.

214

Ginsberg and Wlodkowski note that learning experiences where students personally engage with material rather than trying to understand abstract concepts allows a wider range of students to find success, based on their learning styles (2009, p. 162). Simple article reviews provide students an opportunity to learn about how math is incorporated in their majors, minors, or chosen field and begins to remove abstraction from the learning process.

Instructors can also work to develop more opportunities for students to collaborate within the classroom, through student designed projects and discussions. Allowing students and groups to weave the mathematics their learning into individualized projects can help students better engage with the content and combat the narrative of who does mathematics.

Connect Students to Resources. Ximena and Sam found support through the Adult Learning Program, which provided them access to tutors. However, this support did not originate in the classroom. Ensuring students have access to additional resources would be beneficial by including additional supports on a class syllabus. This could be as simple as developing a resource list for instructors to share with students, with information about programs, both academic and social, to connect students to systems which help their success in classes.

Continue Conversations with Students. Students identified that there was value in the beginning of semester conversations, and students in the treatment group appreciated the continuation of these conversations as the semester went on. The value of

mathematics instructors in continuing to engage in course long conversations allows them to continuously adapt the content to meet their student's needs, allows students to *develop attitude* and see themselves and their interests reflected within the content (Ginsberg & Wlodkowski, 2009, p. 130). Additionally, this action will lead to deeper relationships with their peers.

Additionally, work with students to identify how this course can meet their needs, and measure against these student goals throughout the semester. Participants within the qualitative section identified that they wanted an opportunity to learn deeply about the content and its application to their chosen fields. Therefore, there is value to measuring students' success in this course against a metric of relevancy, rather than simply what grade they earned. This information can continue to craft how adaptations to the program can be made, so the program can continue to evolve and meet student needs.

Portfolio of Recommendations. One of the products from this study was a 'Portfolio of Practices' that resonated with students. The first item should be a day one template, where instructors can engage with students to identify key terminology that students wish to utilize for their own identification. Determination of utilization of terms Latino/a, Latinx, pronouns, etc…are some opportunities that instructors can use to start framing a more inclusive environment. Willow mentioned that she appreciated MSU's intentionality with having students identify their pronouns; however, she acknowledges that there was not discussion around racial or ethnic identification and would have appreciate that as well (Interview, 2021).

216

Next, the *Meet a Mathematician* video links should also be provided. Students in the treatment group responded positively to these videos for multiple reasons, both in terms of affirming their struggles and broadening their definition of who can be a mathematician. Next, would be a framework around article selection tie to their majors as well as a rubric for success. Encouraging instructors to not only receive and review students' article choice but engage in a conversation/sharing of additional articles back to the student. This helps the student not only develop a deeper connection between how mathematics can work in their chosen field but helps *establish inclusion* by engaging the student in the discussion. Another item in the portfolio should be weekly discussion topics to help new instructors engage in conversations with students to refine classroom lessons and measure students' well-being throughout the semester. This also brings into the class student voice, which is critical to the *developing attitude* domain (Ginsberg & Wlodkowski, 2009, p. 130).

Ecosystem Recommendations

Hiring Recommendations. One method to ensure better pedagogical practices are incorporated within post-secondary mathematics classrooms is to prioritize prior teaching experience in hiring protocols (Cormier & Bickerstaff, 2020). The instructors within this study reported a desire to build supportive relationships with their students, which proved beneficial for all participants. However, in prior years, this has not necessarily been the case. As Willow mentioned, her prior experience with this same course was with an instructor who did not build relationships and was not as supportive

as her instructor this year. Furthermore, an intentional focus on recruiting more diverse

instructors would help to dismantle some assumptions around who can do mathematics.

Working with the mathematics department to identify potential candidate instructors

early on and build systems to support their transition into Masters/PhD programs where

instruction was a central component of their education could begin to build a more

diverse community within the mathematics department.

Assessment Recommendations. The department needs to acknowledge that if

they wish to develop a culturally responsive program, this must be done in deeper ways

than simply providing instructors. To *engender competence,* students and instructors must

work together to craft an authentic assessment experience that allows for students to

demonstrate their learning in more diverse methods than simply 'taking a test'. These

activities should come from a merger of student interest and course content. For example,

instructors could be given the latitude to develop authentic assessments with students at

the beginning of the year, that adhere to a pre-determined rubric. Emphasize components

that the department wishes to prioritize in terms of student learning yet allow the students

and instructors to develop how they can demonstrate this knowledge. This also allows

instructors to remove the artificial timelines that currently govern the assessment process.

Instructor Training. Research shows that graduate instructors and professors

would like to see more training around instructional practices (Robinson & Hope, 2013).

Additionally, research has shown that preparing graduate students with educational

practices that center the student, not the content, improves instructor efficacy, increasing

student success and decreasing negative student comments about the content (Robinson & Hope, 2013). Therefore, build in opportunities for new instructors to collaborate and attend professional development before and throughout the semester. An opportunity to learn about CRTP, share experiences and reflect will provide a greater opportunity to learn about CRTP and how to best implement them. For PreK-12 students, developing courses around CRTP and how to infuse their practice with these strategies and theories will help to support students even before they arrive in college.

Clarification of Intended Audience for Sections. In terms of student enrollment, MSU can work to make sure that students in these sections are representative of the students they are trying to attract. Talking with instructors, it appeared that while the message is that these courses are designed to help first-generation or traditionally marginalized students, a substantial number of students were not first generation and already had the supports to navigate college. While MSU recruited marginalized groups, there was still a White majority in these classes. MSU can work with advisors to better market this class to students who would benefit from a smaller, more intimate program, if their intent is to truly address inequities.

Universities could also provide instructors the opportunity to adjust timelines for assessments based on student need will better serve the students. The *engendering competence* domain was negatively impacted for three of four students because of the time constraints imposed on their assessments.

219

Transition from Grant Funding to More Stable Source. In conversations with the department chair and instructors, the funding model for these courses was grant based. As late as November, 2020 (J. Hagman & R. Morgan, personal communication, October 30, 2020). To support a more consistent message, ensure that advisors understand who should be enrolled in these courses and continue to improve upon instructional practice, department leaders need to prioritize funding for this program, and remove its dependency from grants. This will make long term planning, recruiting of graduate instructors and deep instructional changes more strategic.

Preparation Recommendations

Training Around CRTP. The next opportunity for improving the math program is to build in training around improving instructional practices. Many graduate students receive training around research and content, yet receive no training around pedagogy, even though graduate students and professors spend a great deal of time in the classroom (Robinson & Hope, 2013). Preparing graduate students with educational practices that center the student, not the content, improves instructor efficacy, increasing student success and decreasing negative student comments about the content (Robinson & Hope, 2013).

Implications and Recommendations for Policy

The cost of college continues to be a barrier for many students, especially for students who may need remediation. Research found that as tuition costs have increased, enrollment among Latinx students has decreased, even as the Latinx population has

grown during the same period (Lopez & Rivera, 2020). In the present research, at least

one student was working full time while attending college full time to make ends meet.

To address these challenges, MSU has provided multiple pathways to support students

and avoids placing students in remedial classes which dissuades students from

completion (Bahr, 2008; Crisp & Delgado, 2013; Fong et al., 2015; Ngo & Melguizo,

2016).

The challenge, however, is determining who should shoulder the increasing costs

of higher education. Lopez and Rivera (2020) argue that policymakers need to develop

better policies to support students, work with state and federal non-profits to raise funds

for specific groups of students and engage local community groups to raise funds for

students. Within these groups, however, a critical connection was missing: the

instructors. Time and again, instructors—those who work most directly with students and

have the most intimate knowledge of student needs—are being left out of policy and

student-support conversations (Bond, 2017).

One policy recommendation for MSU is to work closely with instructors to

revamp the course to meet its intended audience and develop financial supports that meet

student's needs. In this study, instructors echoed student frustrations with the current

structure of the course, as well as the racial make-up of the course, noting that often it

seemed like more demanding White students were gaining seats that should have gone to

first-generation or marginalized groups, despite what the department chairs were saying

(S. Golden, personal communication, February, 2021). Additionally, all four students

221

noted the positive relationships instructors developed with them. Instructor knowledge and awareness could be critical to reframing the program and providing the additional supports (community, financial, or others as identified) as needed to ensure that these courses which are intended to address current institutional inequities.

Implications and Recommendations for Future Research

Validity of Rhode's Survey in More Diverse Settings. As mentioned in Chapter 3, Rhode's survey really focused on instructor's perception of their utilization of CRTP with an ESOL setting (Rhodes, 2016). While the Cronbach's alpha was found to be strong in those settings, there needs to be further research around the validity of this study within a mathematics course. Additionally, looking at the strength of the survey, when framed around the student's perception of CRTP within the context of a mathematics class.

Expand CRTP Research. Baldwin (2015) noted that research into CRTP within college classrooms is limited. Further, classes like mathematics and English have a considerable impact on student perceptions of their value within post-secondary institutions (Mosoba & Krichevskiy, 2013). The present study highlighted a need to ensure that instructors have the knowledge and skill to incorporate CRTP, which work to *establish inclusion* and *engender competence* for Latinx students, as evidenced by statistically significant differences between control and treatment in this study. To build on this research, future studies might scale the study to look at a much larger cross section of Latinx students enrolled in terminal, non-remedial mathematics courses to

determine if these practices do indeed improve student retention and success. Additionally, exploration of which domains resonated for students from different cultural backgrounds, different countries of origin, as well as native and non-native English speakers could contribute to current research and improve instructional practices at the post-secondary level. Further, this study would benefit from being conducted in a more traditional, post-COVID-19 setting.

Intentionality represents another interesting finding from the present research. Students were acutely aware of whether their instructors were intentional in their efforts to embed CRTP. Future researchers might explore how intentional pedagogical practices impact student perceptions of CRTP and their inclusion within a first-year, terminal, non-remedial mathematics course.

Research shows that success in subjects like mathematics and English can have a profound impact on post-secondary retention and graduation among Latinx students (Bahr, 2008; Callahan & Belcheir, 2017; Ran & Lin, 2019; Whalen et al., 2010). Yet first-year, non-remedial, terminal, mathematics courses have not been well studied well (Baldwin, 2015). This is critical work, especially if we want to address systemic inequities that continue to privilege White students at the expense of Latinx students. PreK–12 systems have reduced gaps between Latinx students and White students in degree attainment, while post-secondary institutions have barely moved the needle (National Center for Educational Statistics, 2019).

Concluding Remarks

It may seem cliché but earning a college degree opens doors to career pathways that simply cannot be attained right out of high school. Of course, trade and work-force training are valuable and not all students desire to pursue college. Yet, when the racial makeup of most American colleges and universities reflects rates like the mid-1980s, it is fair to say that higher education is not doing enough to better recruit, retain, and graduate growing populations of Latinx students (Galdeano et al., 2012; National Center for Education Statistics, 2019).

Post-secondary research into instructional practices is limited, especially regarding retention of Latinx students (Baldwin, 2015). If universities wish to increase Latinx recruitment and retention, further work must be done to better understand the needs of incoming Latinx students. Furthermore, efforts to develop CRTP need to be expanded and studied to determine their potential impact on Latinx student college success.

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Appendix A: Demographic Survey

The follow survey questions were presented to students early in the study. The intent of this survey is to gather a representative group for the qualitative interviews based on gender, first-language spoken, participation in extra-curricular activities, and receipt of scholarships or grants.

Table A.1

Introductory Demographic Survey Tool.

Question	Question Type
Consent to participate in survey	Yes/No *If yes, survey continues. If no, survey ends.
What is your first language?	English Spanish Other (Please Specify)
What percentage of time did you speak in your native language at home?	Slider, 0-100%
What is your sex?	Multiple Choice: M/F/Pref
What is the highest level of education earned by your immediate family, defined as those you lived with during your childhood?	Multiple Choice: Did not complete High School High School/GED Some College/Associates Degree Four Year Degree Some Graduate School Graduate School
Do you participate in any extra-curricular programs? If so, please explain	Yes/No Follow up: Short Answer response
Are you a member of El Centro?	Yes/No
Please describe your plans for attending college and after college.	Short answer response
Do you intend to return Fall, 2021	Yes/No.
Consent for follow up interviews	Yes/No. *If yes, survey continues. If no, survey ends.
Name	Short Answer Response
Phone Number	Short Answer Response
Email	Short Answer Response

Appendix B: Group and Individual Interview Protocols

The first group interview, 2-5 students, will be framed around this tool.

Questions are aligned to the four Culturally Responsive Teaching Domains. The first

table, Table B.1, are questions meant for the group interview protocol, to be conducted in

late February, early March. Table B.2 is intended for individual interviews, to be

conducted in April 2021.

Table B.1

Group Interview Protocol, adapted from Ginsberg & Wlodkowski, 2009.

Culturally Responsive Teaching Domain	Question Number	Question
Establishing Inclusion	EI.1	In what ways has course work emphasized the *human* purpose of what is being learned and its relationship to your personal experiences and current situations?
	EI.2	Follow up: Does this approach help you feel like part of the learning community? How are the thoughts, feelings, interests and needs of every learning in the class invited, listened and responded to, acted on, and honored, if at all?
	EI.3	How are collaboration and cooperation incorporated into daily activities?
	EI.4	Do you perceive your instructor's delivery of content to be inclusive and representative of a larger world view? Why or why not?
Developing Attitude	DA.1	Were you invited to discuss culturally relevant terminology? For example, preferences around terms like Hispanic, Chicano, Latino/a/x?
	DA.2	How has your voice influenced activities projects/assignments in your class, if at all?

	DA.3	How have projects, research, and deep, authentic problem solving been incorporated, if at all, in your classroom?
Enhancing Meaning	EM.1	What structures, if any, are present to help you consider the content of your learning with regards to your lived experience and understanding of the world?
	EM.2	How are intriguing problems utilized in class, if at all? (Problems that are relevant to you and cause you to think beyond just getting an assignment done).
Engendering Competence	EC.1	How does the assessment process connect to your frame of reference and values?
	EC.2	How does the instructor allow students to demonstrate their learning of content?

Table B.2

Individual Interview Questions, adapted from Ginsberg & Wlodkowski, 2009.

Culturally Responsive Teaching Domain	Question Number	Question
Establishing Inclusion	EI.1	How did the instructor work to get to know you?
	EI.2	How, if at all, was time spent building a community within your class? What impact did this have on your perception of class?
Developing Attitude	DA.1	How has your voice influenced activities/projects/assignments in your class, if at all?
Enhancing Meaning	EM.1	How are intriguing problems utilized in class, if at all?
	EM.2	How do your classmates' perspectives inform your problem solving process, if at all?
Engendering Competence	EC.1	How does the assessment process connect to your frame of reference and values?
	EC.2	How does the instructor allow students to demonstrate their learning of content?

The following survey will be administered in late April 2021. The intent is to capture students' perceptions around their instructors use of Culturally Responsive Teaching Practices in college.

Table C.1 *Survey Instrument Based on Rhodes' Culturally Responsive Questionnaire, 2016*

Domain	Question Number	Question	Response Type
Consent to participate	Q1	Do you consent to participate in the survey?	Yes/No
	Q35	What math class are you taking this semester?	Multiple Choice: Math 101 – Social Sciences Math 117/118 Other (Please Specify)
	Q34	What is your current major?	Short Answer Response
Establishing Inclusion	Q2	My instructor includes lessons about the how students can integrate into the university culture.	Scale, 0-7
Developing Attitude	Q3	My instructor provides culturally appropriate images and themes.	Scale 0-7
Enhancing Meaning	Q4	My instructor asks students to explore their cultures with each other.	Scale 0-7
Establishing Inclusion	Q5	My instructor makes an effort to	Scale 0-7

		get to know my family through our conversations.	
Establishing Inclusion	Q6	My instructor makes an effort to get to know my background.	Scale 0-7
Establishing Inclusion	Q7	My instructor uses mixed-language pairs in group work.	Scale 0-7
Establishing Inclusion	Q8	My instructor uses mixed-cultural pairings in group work.	Scale 0-7
Engendering Competence	Q9	My instructor uses peer tutors to support me.	Scale 0-7
Engendering Competence	Q10	My instructor uses student-led discussions during class.	Scale 0-7
Developing Attitude	Q11	My instructor embeds students' experiences in developing mathematical activities	Scale 0-7
Developing Attitude	Q12	My instructor embeds student's experiences in classroom activities.	Scale 0-7
Establishing Inclusion	Q13	My instructor encourages students to speak their native languages in class.	Scale 0-7
Engendering Competence	Q14	My instructor has students work independently,	Scale 0-7

		selecting their own learning activities.	
Establishing Inclusion	Q15	My instructor spends time outside of class learning about the cultures and languages of the students.	Scale 0-7
Establishing Inclusion	Q16	My instructor includes lessons about anti-immigrant discrimination or bias.	Scale 0-7
Enhancing Meaning	Q17	My instructor supplements the curriculum with lessons about international events.	Scale 0-7
Engendering Competence	Q18	My instructor asks for student input when planning lessons and activities.	Scale 0-7
Enhancing Meaning	Q19	My instructor encourages students to use cross-cultural comparisons when analyzing material.	Scale 0-7
Engendering Competence	Q20	My instructor provides rubrics to students.	Scale 0-7
Engendering Competence	Q21	My instructor provides progress reports to students.	Scale 0-7
Consent to provide demographic information	Q36	Do you consent to share demographic info?	Yes (Skip to Q22) No (skip to end of survey)

Demographic Info	Q22	What race do you identify with?	Hispanic/Latinx American Indian or Alaskan Native Black or African American Native Hawaiian or Pacific Islander White Prefer not to Answer Other (Please specify)
Demographic Info	Q23	What is your first language spoken at home?	English (Skip to Q26) Spanish (Skip to 19.a) Other (Please Specify) (Skip to Q25)
Demographic Info	Q24	How often was Spanish spoken at home	Never to Always (Skip to Q26)
Demographic Info	Q25	How often was your native language spoken at home?	Multiple choice, 5 options Never to Always
Demographic	Q26	What is the highest level of education earned by your immediate family, defined as those you lived with during your childhood?	Multiple Choice: K, 1st, 2nd, ….BS/BA, MS/MA, PhD
Demographic Info	Q27	What is your sex?	Multiple Choice: M/F/Prefer not to answer
Demographic info	Q28	Did you receive any scholarships/grants?	Yes/No

Demographic Info	Q30	Are you a member of El Centro?	Yes/No
Demographic Info	Q32	Are you a member of any other clubs or organizations? If yes, what are the organization names?	Yes/No
Demographic Info	Q33	What grade do you expect to earn at the end of the semester?	A, B, C, D, F, I, W
Demographic Info	Q29	Do you intend to return to MSU in the Fall, 2021?	Definitely yes, Probably yes Might or might not Probably Not Definitely not

Appendix D: Tables

Appendix D.1

Student Reported Immediate Family Highest Level of Education

Ethnicity	Class	Gender						
		Male/Female						
		Did Not Complete HS	HS or GED	Some College or Associates Degree	Four Year Degree	Some Graduate School	Graduate Degree	Total
Hispanic or Latinx	CRTP	0/2	0/0	0/0	0/1	0/0	1/0	1/3
	Control	0/0	1/0	0/0	0/0	0/0	0/1	1/1
White	CRTP	0/0	1/0	2/0	1/0	0/0	0/1	4/1
	Control	0/0	2/0	2/0	1/1	0/0	2/0	7/1
Asian	CRTP	0/0	1/0	0/0	0/0	0/0	0/0	1/0
	Control	0/0	0/0	0/0	0/1	0/0	0/1	0/2
Black or African American	CRTP	0/0	0/0	1/0	0/0	0/0	0/0	1/0
	Control	0/0	0/0	0/0	0/0	0/0	0/0	0/0
Mixed Race	CRTP	0/0	0/1	0/0	0/0	0/0	0/0	0/1
	Control	0/0	0/0	0/0	0/0	0/0	0/1	0/1
Total		0/2	5/1	5/0	2/3	0/0	3/4	15/10

Appendix E: Supplemental Materials

The materials in this section are course documents that participants provided to help share their experience

Figure E.1 *Final Project from Control Group*

Cool Math Project

Your final project for this class will be to find any cool and interesting topic in mathematics to write a short paper on and present to the class. For full credit on this assignment, you need to:

1. Choose a topic to research further. It is required that you email your instructor to verify your topic by April 9.

2. Spend a couple of hours researching your topic.

3. Write a brief 2-3 page typed paper (12 point font, double spaced) about the topic you looked into. Your paper should:

   (a) Introduce your topic, its origins, and why people might care.
   (b) Discuss the math involved in your topic.
   (c) At least one question you have after researching your application. What still confuses you? What would you still like to learn more about?
   (d) Include a list of references you used at the end.

   You must upload your paper to Canvas by **Sunday, April 25th - Absolutely no exceptions**.

4. One day during the last 2 weeks of class you will briefly explain your topic to the class in 5-7 minutes. You should target your presentation to a math 101 student - someone that is familiar with the math basics but not the details.

5. Each day of presentations, write down 2 facts about each presentation given by your peers related to the mathematics. Also give a brief 1-2 sentence review of the presentation quality (was it well prepared, well timed, etc). For the facts and reviews, please use complete sentences. Turn a compilation of your reviews in to canvas as one typed PDF by end of day Friday May 7th.

6. Possible topic list:

   - The Collatz Conjecture
   - The Goldbach Conjecture
   - The Catalan Numbers
   - Mersenne Primes
   - Aleph Numbers (levels of inifinity)
   - Using mathematics in x sport
   - The Hairy Ball Theorem
   - The Infinite Monkey Theorem
   - Pascal's Triangle and its applications
   - Poker mathematics
   - Young Tableaux
   - Fractals
   - Cryptography
   - Dihedral Groups

262