The Instructional Experiences of Latinx Community College Students in a Developmental Mathematics Course Taught by an Adjunct Faculty at a Hispanic-Serving Institution

by

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Dedication

This dissertation is dedicated to my students, past and future. An important part of teaching is to learn new things. I have learned so much from each of you, and look forward to a lifetime of learning. You are the center of everything I do.

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Abstract

In spite of the high failure rate of Latinx students in developmental courses taught at community colleges in the United States, little is known about how mathematical instruction contributes to this problem. Less is known about how adjunct instructors teach these courses or about their students' accounts of their experiences. This dissertation investigated instruction in a developmental mathematics course taught by an adjunct faculty at a Hispanic-serving community college by (1) describing the student-instructor, student-student, instructor-content, and student-content interactions (Cohen, Raudenbush, & Ball, 2003); (2) documenting student perceptions of those interactions, their instructional experiences; and (3) analyzing the way in which these varied interactions and perceptions could be explained by the wealths students brought to the course (Yosso, 2005) and the systems in which students were situated (Bronfenbrenner, 1977; 1994). Three modes of instruction were enacted in the course, lecture (the most common), individual student work time, and student presentations. The instructor led the student-instructor interactions by checking, correcting, or validating students' work. Student-student interactions occurred only when students compared answers. The instructor-content interactions revealed mathematics as a disjoint set of problems solved with prescribed sets of steps. The student-content interactions consisted of practicing work already demonstrated by the instructor. Students' instructional experiences described a caring instructor who wanted them to succeed and hoped for more time to explore and practice problems and less time watching their instructor lecture, more interaction with peers, and more support to create a classroom community. The microsystems in which students were situated—school, work, and home—

influenced one another; various exosystems—instructor's teaching experience, supports available from the mathematics department for adjunct faculty, adjunct instructor's out of class obligations, and departmental course scheduling—had direct and indirect effects on instruction and on the students' instructional experiences and mediated the ways that students and the instructor adapted to and interacted with each other during instruction. Students' reported levels of aspirational, navigational, and social wealth interacted in ways that seem to influence their course outcomes: students with narrow aspirational wealth but broad navigational and social wealth knew how to find supports and balance the demands of the course whereas students with broader aspirational wealth and narrower navigational and social wealth thought that by attending the course and doing what was expected would result in positive outcomes. These demonstrations of cultural wealth aligned with the course outcomes: students in the first group who subverted the classroom cultural norms and pressed for changes passed; students in the second group who tended to align to and accept the classroom cultural norms failed. Thus, merely attending class and doing the work as instructors ask students to do may not be sufficient to pass a developmental class. The indirect influences of the exosystems require students to develop broader levels of social and navigational capital in order to be successful; this can be done by repeating college courses, an undesirable path or by providing explicit support to broaden students' navigational and social wealth. Engaging students during instruction could support these efforts, making explicit the supports and resources necessary to succeed. Finally, mathematics departments might need to re-evaluate the content of developmental courses and provide more and varied opportunities for adjunct faculty to receive support while teaching these courses.

Chapter 1

Problem Statement

The work of this study is extremely personal to me. Through my experiences teaching at two Hispanic Serving Institutions (HSIs) in California and through interactions with mathematics faculty, I have developed an innate drive to advocate for more opportunities within mathematics instruction for Latinx[1] students in developmental courses. I believe that through intentional and supportive instruction instructors can provide improved mathematical experiences for their students that may increase their learning and success in these courses. Like other instructors, I noticed that the content of the courses was difficult for students. But I also noticed that they experienced my course in different ways. Many students would often visit me during my office hours and during this time, would share information about their personal lives, including balancing school, work, and home responsibilities. I could see that the Latinx students in my class faced different struggles outside of the classroom than the other of my non-Latinx students. Those Latinx students worked multiple jobs, many hours a week in order to contribute to the family household or cared for siblings or children of their own which resulted in less time available for studying for the course. A few of them asked to use my office to study because they said they did not have a space to study at home and felt "comfortable" in my office. Some students were proud to have been the first in their family to be accepted to a highly lauded

[1] The term Latinx is a newer term in educational research. Spanish is a paternalistic language that groups people under the masculine form of adjectives (e.g., Latinos when there is a mix of men and women, but Latinas when there is only women). The phrase Latina/o or Latin@ breaks that masculine-centric term, but does not include those who identify outside of the gender binary. Therefore, I use the term Latinx to encompass Latin@ identities beyond a

university while others were ashamed that they placed in developmental mathematics, after being one of the smartest students in their mathematics classes in high school. It seemed to me that these facets of my students' lives greatly shaped their attitudes and success in the mathematics courses I taught. I also recognized the power and impact that my teaching had on my students: I was able to learn more about them, came to understand that each had unique challenges and struggles, and found ways to incorporate changes that aimed to meet their needs. Some students would often comment on how they had never been in a classroom where they were challenged to think rigorously about the mathematics and were expected to be a part of the development of thought, rather than the listeners on the side. Throughout my teaching experience, I found ways to connect with my Latinx students and acted as a mentor; many of these relationships often lasted until they graduated from the college.

Simultaneously, interactions with some colleagues and other mathematics faculty revealed a different take on the performance that Latinx students had in their classes and manifested aversion towards, and resistance to, using teaching practices that would be inclusive of all these students needs. Some faculty blamed the students for their performance; in their opinion, some of their average- or lower-achieving students did not put the needed effort in the courses and seemed to not take their class seriously (e.g., did not participate during class lecture, did not come to office hours). Blaming students was particularly concerning to me on two fronts. First, the majority of faculty I interacted with worked at an institution that had at least 50% of the full-time enrollment students identifying as Latinx; because it is more likely that Latinx will place in developmental math, the chances they had to interact with these students in math classes were high. Second, many of these anecdotal conversations occurred during a series of

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gender binary. In this study, whenever a student self-identifies, I will use the term Latina or Latino as they have identified themselves. See Salinas & Lozano (2017) for more information.

professional development workshops that I led that were specifically aimed at using equitable practices in community college mathematics instruction. I wondered how such sentiments may have manifested during instruction and whether and how Latinx students were aware of the views of these faculty: How did they perceive their interactions with the instructors, with other students, or with the mathematical content?

While community colleges are well known for being *teaching institutions*, that is, institutions that care about teaching, research has documented that in reality there is very little support for their faculty to improve their knowledge of instruction (Grubb, 1999). It is also known that even though a high proportion of mathematics faculty at community colleges have advanced degrees in mathematics (Blair, Kirkman, & Maxwell, 2018) they, like their peers in post-secondary settings, have limited training in teaching (Wagner, Speer, & Rossa, 2007). So it may not be surprising that community college mathematics faculty may not understand the need for pedagogical approaches that are sensitive to the personal circumstances of the students they interact with every day. I believe that by learning more about what Latinx students experience in the mathematics classrooms, the field will be in better position to create programs that would support instructors in order to improve Latinx student experiences in mathematics instruction.

These personal experiences have driven me to propose this study. I sought to fully describe instruction and then to fully account for Latinx students' experiences of that instruction in a developmental math course at a Hispanic serving institution. As we will see in what follows, I am not alone in recognizing that Latinx students experience mathematics in ways that either advance or hinder their mathematical understanding, which affects their progress towards accomplishing their academic goals.

U.S. Census Bureau data from 2010 reveals that the Latinx population is the fastest growing ethnic minority group in the United States (Ennis, Rios-Vargas, & Albert, 2011). Indeed, between 1980 and 2010, the Latinx population grew from 14.6 million to 50.5 million people, making the Latinx population the largest minority group in the United States (Passel, Cohn, & Lopez, 2011). Given this rapid growth, there has also been an increase in Latinx student enrollment in K-12 education. In 2014, one of every four U.S. students was Latinx, comprising nearly 13 million students (Krogstad & Fry, 2014). States such as California, Texas, Florida, New York, Illinois, and Arizona are known to have the highest number of Latinx students, therefore requiring them to meet the needs of a higher number of Latinx students (Gándara, 2015). In particular, 53% of students in K-12 in the state of California are Latinx (Solórzano, Acevedo-Gil, & Santos, 2013), which is the largest student group (Valencia, 2015).

As the population increases in the United States, so does the need for students to attain degrees in higher education. The job market increasingly requires higher-level degrees as demands within occupations are changing (Reed, 2008). Turner and colleagues (2007) reported that, in 2007, 54 million adults lacked a college degree. They argued that this is problematic for the nation due to "increasing global economic competition and the rapid pace of technological change" which affect the educational qualifications needed for the workforce. President Barack Obama's American Graduation Initiative reported on the importance of community colleges to meet the demands for higher numbers of college degrees. He called for an additional five million degrees earned by the year 2020 via community colleges (The White House, 2009). Johnson and Sengupta (2009) projected that by 2025, the state of California will be one million college degrees short of what is necessary to support its economy, which includes technology, agriculture and government. Only 16% of working adults in California between the ages of 25-

64 have an associate's degree or higher (Moore & Shulock, 2010, p. 1), implying a great need for higher numbers of college degrees in the state of California. As the K-12 population increases and diversifies, higher education programs must be prepared for this change in order to supply this mighty call.

In 2013, the National Center for Education Statistics (NCES) reported that immediate college enrollment of high school graduates was not measurably different between Latinx students (66%) and non-Latinx White students (67%). In fact, the undergraduate enrollment rates for most groups decreased between 2010 and 2013, whereas Latinx student enrollment rates increased by 13% (NCES, 2015). However, college completion rates have yet to reflect this gain in Latinx student enrollment, as Latinx students have a much lower college completion rate than their peers. In 2014, only 15% of Latinx students had completed a Bachelor's degree or higher by the age of 29 compared to 22% of Black students, 41% of non-Latinx White students, and 61% of Asian/Pacific Islander students (NCES, 2015). There is even lower degree attainment within STEM; according to the National Science Foundation (2006), only 7.3% of Latinx students earned Bachelor's degrees in STEM compared to 65.1% of White students (as cited in Cole & Espinoza, 2008). These trends are particularly striking in California, a state that has the largest number of Latinx college students (Hagedorn, Chi, Cepeda, & McLain, 2007). Interestingly, about 80% of California Latinx postsecondary students are enrolled in community colleges (Moore & Shulock, 2010), showing the highest community college enrollment of all ethnic groups, including their non-Latinx White peers (Sólorzano et al., 2013). They are also more likely to enroll in community college than at a four-year institution (Moore & Shulock, 2010).

These trends suggest that community colleges are a particularly important setting for situating this study. Something is *not* happening to support *all* students in mathematics in postsecondary education. The majority of students who enroll at community colleges start in developmental courses. These courses cover topics generally taught in high school (e.g., arithmetic, algebra) and although these courses are offered to bring students to the preparation level needed for college mathematics (Bettinger, Boatman, & Long, 2013), they can impede student success because they act as gatekeepers to higher-level mathematics courses, are non-credit bearing, and can be costly (Larnell, 2013). Of all students enrolled in community colleges in California, 85% place below transfer level mathematics, which means that they will need to complete more courses than their peers. (California Community Colleges Chancellor's Office, 2012). Among students who place in such courses, Latinx students generally enter with lower levels of readiness (Crisp, Reyes, & Doran, 2015). More than 75% of Latinx and Black students enroll in developmental mathematics courses compared to 55% of their White peers (Bettinger & Long, 2005) and they enroll in *lower* level developmental mathematics courses than their White or Asian peers (Bahr, 2010). White and Asian students are more likely to successfully complete such courses compared to Latinx and Black students (Bettinger & Long, 2005). Among students enrolled in developmental courses, Latinx students who start at a community college are less likely to complete a degree than those that start at a four-year institution (Nora & Crisp, 2012).

The most common way to measure student success in higher education is through academic achievement, such as GPA, course completion, the need to repeat courses, student persistence, and degree attainment (Howard, 2010; Valencia, 2015). This scholarship also seeks to predict such "success" using students' previous academic preparation, socio-economic status, mathematics placement test scores, and SAT scores (e.g., Bahr, 2010; Crisp & Delgado, 2014;

Crisp & Nora, 2010; Nora & Garcia, 2001). Although such studies attempt to understand what contributes to the low success rates for Latinx students, they, however, do not help us to understand what happens *while* students are enrolled in a developmental mathematics class. The interactions and experiences that students have in a classroom can impact student learning (E. Cohen & Lotan, 1997) and those experiences in turn, can shape students in ways that can affect the quality of other subsequent classroom experiences they may have (Dewey, 1938). These interactions and experiences are what constitute instruction. Unfortunately, to this date, we know very little about what instruction looks like within the developmental mathematics classroom and what opportunities Latinx students are afforded within this space..

There are ample findings in the literature that suggest Latinx students are less successful than their peers in mathematics courses (e.g., Bahr, 2010; Crisp et al., 2015), however, I argue that the most important place to make an impact on these outcomes is inside the classroom. In order to better meet the needs of students who have been historically underserved in our educational system, we must have an understanding of how students experience these classes as mathematics instruction serves only one purpose: to help support mathematical learning of all students.

The purpose of this study is to better understand the experiences that Latinx students have when enrolled in a developmental mathematics course at a community college. Because there is little research that accounts for how instruction occur at community college developmental math (Mesa, 2017), a first major task of this dissertation is to present a description of what instruction looks like within the classroom. Once we have come to understand how instruction is enacted, we need to account for the perspectives that students have of these interactions. This qualitative case study focuses on how Latinx students experience an intermediate algebra course, attending to their perception of instructional experiences

Moschkovich (1999) posed four considerations for ways to improve mathematics instruction for Latinx students: (1) honor the diversity of Latinx students' experiences, (2) know the students and their experiences, (3) avoid deficit models, and (4) provide opportunities for mathematical discussions (p. 9). While these are suggestions for ways to improve mathematics instruction in K-12 classrooms, it is essential to learn directly from students in postsecondary mathematics classrooms if they have varying or different needs of support within the classroom.

This dissertation is organized into ten chapters. Chapter Two reviews literature and presents the theoretical framework for the study. Chapter Three describes the methods used to carry out this study. Chapter Four describes the various environments that influence the study. Chapters Five, Six, and Seven, are devoted to describe instruction in the classroom and the students' instructional experiences. In Chapter Eight I use the stories of two students in the classroom to exemplify two different sets of instructional experiences that bring to life the realities of the students' circumstances and how those affected instruction, which in turn shaped their outcomes in the course. Chapter Nine discusses the findings and Chapter Ten is devoted to conclusions and implications for future research.

Chapter 2

Literature Review and Conceptual Framing

This qualitative case study focuses on how Latinx students experience an intermediate algebra course, attending to their instructional experiences, and to the ways in which these experiences influence instruction. Central to this investigation is the notion of *instruction*, which has been notoriously ill-defined in the research literature and has not been understood through the perspectives of students—a key component of instructional interactions. Characterizations of *Latinx students in postsecondary mathematics education* and in particular within developmental math courses assume a deficit perspective of the students who take developmental mathematics, highlighting their lower success relative to their White or Asian counterparts, without coming to understand the circumstances that shape the conditions in which the students take a community college mathematics course.

In this chapter I review literature that situates these two areas. First I describe how mathematics instruction has been investigated at the community college. Specifically I describe how mathematics instruction has been viewed via delivery methods, curriculum models, and through direct observation of classroom instruction. Next, I describe how studies have investigated Latinx students in mathematics education. Specifically I describe two larger areas of research focusing on Latinx student performance and Latinx students in developmental mathematics. I then describe the conceptual framework that guides the study, followed by my research questions.

Mathematics Instruction in Community Colleges

While it is more thoroughly investigated in K-12 settings, more studies are beginning to look at and understand what mathematics instruction looks like at community colleges (Mesa, 2017). Attention to instruction is not new. In 1985 A. Cohen said that mathematics instruction in community college was ripe for change. Fueled by the reforms in the K-12 setting (NCTM, 1980), he optimistically forecasted that instruction would be reducing its focus on procedural and symbolic manipulation and would encourage making key connections between mathematics and their world. Thirty-three years later, many community college mathematics classrooms are still dominated by lecture and emphasize the application of procedures without meaningful connections (Grubb, 1999; Cox & Dougherty, 2018). Mathematics instruction in post-secondary institutions has been very heavily lecture-based, following a Socratic, “sage on the stage” view of learning where the instructor is deemed as the “one who has the knowledge and transmits that knowledge to the students” (King, 1993, p. 30). In the year 2006, the American Mathematical Association of Two-Year Colleges (AMATYC) developed a set of standards to help guide two-year college mathematics faculty teaching introductory college-level math. The standards remind faculty that during instruction, “students should understand mathematics as opposed to performing memorized procedures. Knowledge cannot be ‘given’ to students. Students should construct their own knowledge, and monitor and guide their own learning and thinking” (AMATYC, 2006, p. 6). Continuing their vision forward, AMATYC believes that moving towards a more student-centered approach to instruction will help foster deeper understanding and empowerment for students. “There is ample research evidence that engaging students in problem solving, reasoning, and sense making will yield improved mathematical proficiency, statistical proficiency, and quantitative literacy” (AMATYC, 2018, p.6). AMATYC promotes instruction that includes teaching with technology, active and interactive learning, making connections across mathematics, using multiple instructional strategies, and providing opportunities for students to experience the mathematics.

In reviewing the literature, I found three areas in which instruction is considered when teaching developmental mathematics specifically. First, instruction is described through the various delivery methods. This refers to the format in which the course is taught (e.g., face-to-face, online, flipped). Second, instruction is seen as part of a particular curriculum used, that is, entire courses are focused and designed around specific curriculum that helps students complete their developmental courses more quickly. Finally, instruction is seen as what occurs inside the classroom. The first two sections focus mainly on student outcomes, while the third focuses on the classroom and the processes that happen within.

Instruction as Delivery Methods

Many studies investigate instruction based on the delivery options of the course. Due to the large number of students who are required to take developmental mathematics, many institutions have incorporated various ways to deliver content to students. Such courses include face-to-face instruction, online instruction, hybrid instruction (a combination of face-to-face and online), self-paced learning, or accelerated courses. Studies have shown that the retention rate for students enrolled in online or hybrid versions is lower compared to those courses that meet face-to-face (Zavarella & Ignash, 2009; Ashby, Sadera, & McNary, 2011) and that students who are enrolled and complete online or hybrid courses tend to perform lower than those enrolled in face-to-face courses (Ashby et al., 2011). Zhu and Polianskaia (2007) found that there were no major differences in performance between students enrolled in online and face-to-face courses, but that students need support in making the decision for what type of course best suits their needs because not all students are aware of their instructional needs.

Another way that community colleges have considered developmental mathematics instruction is by offering accelerated courses, shortening the time that it takes for a student to enroll in college-level mathematics. Jaggars, Hodara, Cho, and Xu (2014) found that students enrolled in accelerated courses were more likely to complete their developmental mathematics courses faster, but that they required additional and different resources than those in regular face-to-face instruction. Concretely, the coursework in accelerated courses is more rigorous as students must learn the content faster, but this results in students needing more supports (e.g., academic, affective) to successfully progress through the coursework. While some colleges have incorporated accelerated coursework, others have instigated “stretch” or extended courses, namely that a one-semester course is taught in two semesters. The idea is to give students more time to learn the content that they need to be prepared for mathematics. Ngo and Kosiewicz (2017) analyzed the effects of students taking extended courses at four colleges and found that they were not only spending more money on an additional course while at the same time not receiving credit for their courses, but they did not see significant differences in their long term persistence at the colleges.

While many studies investigate benefits of taking alternative delivery methods of developmental mathematics, Kosiewicz, Ngo, and Fong (2016) stated that more work needs to be done to consider the benefits of students taking courses offered in alternative modes of delivery. Their work found that variations in modes of delivery only really help those students who are the most prepared in developmental mathematics classroom. This implies that for the average student in developmental mathematics, these alternate forms of delivery are not as beneficial as face-to-face instruction. Given that the passing rates for developmental mathematics are already quite low (Bahr, 2010), it is important to produce detailed descriptions of mathematics classroom instruction so that researchers can envision what needs to be changed in order to better support the needs of *all* students. For this reason, I chose to focus my study on the most representative delivery type: face-to-face instruction.

Instruction as Curriculum Models

Because developmental mathematics courses are non-credit bearing and they increase students' time to degree completion (Larnell, 2016), there has been a need to make sure students reach college-level courses quickly. According to Bailey, Jeong, and Cho (2010), a high proportion of students do not enroll in a college-level mathematics course (86%, 71%, and 56% of students are required to take three, two, or one developmental mathematics courses, respectively) and over half fail to complete their first developmental mathematics course. To address this problem the Carnegie Foundation and the Dana Center have developed alternative, co-requisite curriculum models that provide course options that allow students to develop their mathematics skills while also gaining college-level credit. Carnegie and WestEd created two curricular pathways, Quantway and Statway, that effectively reduce the time students spent in developmental mathematics courses. The programs support students placed in developmental mathematics in developing quantitative literacy and statistical reasoning, teaching mathematical skills that are relevant for various occupations. Their curriculum "takes a holistic, systemic approach as a multifaceted change initiative to tackle complex problems in developmental math education" (Yamada & Bryk, p. 201). Successful students in either pathway can gain college-level math credit in one year. Yamada and Bryk (2016) reported improved outcomes for students who enroll in the Statway courses. These courses have been designed to address the challenges of many first-generation college students as they navigate their first experiences in college (Merseth, 2011).

The Dana Center at the University of Texas-Austin created a similar course pathway, the Dana Center Mathematics Pathway (also known as the New Mathways Project), to ensure that students are prepared to use quantitative reasoning skills in their careers and personal lives, empowering them as mathematical learners, and shortening time to degree completion (Charles A. Dana Center, 2018). This course design fosters productive persistence, while also supporting their access to college-level coursework as soon as possible. Rutschow and Diamond (2015) found that students who enrolled in the New Mathways courses showed higher success than with students who enrolled in traditional developmental mathematics courses. However, the number of students enrolled in the two types of courses was not comparable (N=233 for New Mathways compared to N=16,160 for traditional courses), which suggests that more work needs to be done to make stronger claims about the outcomes of taking such a course.

The implementation of these alternative pathways to developmental mathematics is still in its infancy. There is not enough empirical evidence to suggest the long-term benefits of the Quantway, Statway, or New Mathways programs. These programs require a significant investment (e.g., financially, time) for many colleges to make, and require professional development and training for faculty to appropriately incorporate them. What is more, there have not been any studies that understand how these pathways may benefit underrepresented minorities such as Black, Latinx, and female students. While there are anecdotal references to helping first-generation college students, more work needs to be done to understand the benefits that underrepresented minorities gain from taking such redesigned curriculum. Given this, a majority of students across the nation are still exposed to traditional course structures, which utilize face-to-face instruction and course sequencing. Therefore, in my study, I choose to focus on standard courses because the various redesigned pathways are not yet ubiquitous in community college mathematics departments.

Classroom Instruction

Few studies have investigated what happens inside the classroom at community colleges, though this area of research has been growing since 2010. From those few studies that have observed mathematics classrooms, it appears that lecture is a dominant instructional mode. Burn, Mesa, and White (2015) observed 10 successful community college calculus courses in different institutions, witnessing that many of the classes were dominated by “interactive lecture” where instructors were constantly “engaging” students by asking them questions throughout their lecture. Mesa (2017) acknowledged that faculty often see these types of interactions during lecture “as a natural part of the process of learning and feel strongly that their community college students need to work out their questions *during the lesson* so they can be ready to work on the material once they leave the classroom” (p. 960). However, many of the types of questions that are asked are limited to procedural knowledge of the mathematical content, providing a surface-level understanding of the mathematics, limiting opportunities to grapple with more conceptually rigorous ideas (Mesa, 2010). Mesa, Ullah, Mali, & Díaz (2017) analyzed 15 video-recorded class sessions from six different instructors teaching intermediate algebra and college algebra at three different community colleges. They aimed to understand the cognitive demand of the mathematical questions posed by instructors during instruction as well as the opportunities that instructors created to support or discourage student participation via their mathematical questioning. They found that a majority of the questions asked students to recall facts or to apply procedures previously demonstrated. About 15% of the 1,494 questions posed were authentic or quasi-authentic, questions that ask students to confront a situation where there is no obvious solution path. However, oftentimes instructors did not give enough wait time to allow students to consider more challenging questions which contributed to more of the questions posed being labeled as inauthentic, those that seek students to recall known facts or procedures. Students in their study did not ask many questions, but when they did, their questions were categorized as authentic in nature more often than those their instructors posed. These findings are important for two reasons. First, because interactive lecture dominates most community college mathematics classrooms, there are missed opportunities to develop meaningful mathematical conversations during instruction. Second, students have demonstrated their abilities to pose authentic questions, which indicates their abilities to contribute meaningfully to the instructional space as well as to push for higher levels of rigorous thinking.

Through classroom observations, Mesa (2011) compared the classroom interactions between developmental courses and college-level STEM courses at one community college. She found that the two types of courses were comparable in that they incorporated interactive lecture, inviting students to answer questions posed throughout the lesson, and also spent comparable time on activities that students solved jointly at the board. However, in the developmental courses, the instructors solved more activities during instruction and students were exposed mainly to problems that required students to understand procedural knowledge. Comparatively, students were not expected to engage with the mathematics at the same levels shown in the STEM courses, which is problematic as STEM intending students in developmental mathematics are not being exposed to the type of mathematical thinking that they will soon be expected to demonstrate. Students in developmental mathematics are completely capable of engaging in deep and meaningful mathematical thinking, and it is important to create "opportunities for developmental students to show that they can answer mathematics questions may increase students' sense that they *can* engage with the content" (Mesa, 2011, p. 42). Mesa noted that both types of courses could increase opportunities to allow students to explore, find patterns, and reasoning through situations, as both types of courses did not support the playful nature of mathematics.

Cox (2015) studied instruction in six developmental mathematics classrooms at two different community colleges to understand what it meant for a student to learn mathematics in these courses. She found that the two colleges offered different instructional activities and engaged in different classroom discourse, providing divergent learning opportunities. In the first college, students routinely engaged in what she called "remedial pedagogy," in which learning math comprised of memorizing and applying rote procedures. In the second college, the instructors pushed students to demonstrate their conceptual understanding and adaptive reasoning. In this case, the instructors were able to use the knowledge of their students to influence future courses and discussions, catering the space for the students' intellectual needs. Cox found that the students in the second college had higher passing rates than students in the first college. Instructors in the first college blamed the students for their underperformance, attributing it to lack of outside of class studying and therefore "not getting the rules." In contrast, instructors in the second college did not blame the students for underperformance. Instead, they recognized that learning mathematics is a complex multi-layered process and that each student faced unique struggles in their learning development. Instruction across these two colleges was very different, affording students different opportunities to learn through varying pedagogical goals, structure of instructional activities, and differences in classroom discourse.

In another study, Cox and Dougherty (2018) interviewed students in four pre-algebra classes and observed classroom instruction. Students had hopes to understand the logic and relevance of mathematics, fostering a real understanding of the subject. However, few students gained confidence with mathematics. Cox and Dougherty argued that the procedural nature of instruction did not support the types of goals that the students had for the course. Students appreciated that the instructors provided slow, step-by-step instruction, however, they did not leave feeling that they had learned much from that type of instruction. The authors suggest that researchers to consider what it means for a student who successfully completes a course that demonstrated mathematics as a set of procedures and rules, and how these students may not have really learned what they will need to support them in subsequent courses.

In a project that investigates the connections of mathematical instruction in intermediate and college algebra in community colleges to the learning outcomes of students (Watkins, Duranczyk, Mesa, Ström, & Kohli, 2016), the research team developed a video-coding protocol to analyze classroom instruction (AI@CC Research Group, 2018; Cawley et al., 2018; Lim et al., 2018). The group used the protocol to analyze 15 different class sessions, parsed into 7.5-minute segments, characterizing different features of instruction such as the ways the instructor makes sense of procedures, how students reason about, and make sense of, the mathematics, as well as the recognizing who (the instructor or students) does the mathematical thinking. They found that students rarely contributed to the class session orally or in writing and a majority of the segments (71%) demonstrated the instructor as the main person who contributed to the development of mathematical ideas. Preliminary findings suggest that more could be done to facilitate students' direct engagement with the mathematics, providing opportunities for students to make sense of the mathematics and contribute to development of mathematical ideas.

This literature shows that the instructor dominates much of the classroom instruction for mathematics at community colleges, with limited opportunities for engagement from the students even when their lectures are interactive. Cox (2015) showed that there are positive effects of having a classroom that caters to students' needs and that it is possible to teach mathematics without solely relying on lecture that promotes procedures. None of these studies investigate how students perceive instruction, gaining insight into how they interact with the instructor and the content in the ways that they do. There is also limited understanding to how the various environments shape instruction in the classroom as well as the decisions that students make during instruction.

Latinx Students in Mathematics Education

While there is much literature that focuses on features of being a Latinx student taking mathematics in the United States education system (e.g., language, culture), this section will describe two areas that are important for this study, the trends in Latinx student performance in mathematics and research that has addressed Latinx students performance in community college mathematics. I found that while we have learned there is a difference in student performance, research currently focuses on outside factors (e.g., college supports, socio-economic status) to explain the difference, instead of focusing on the day-to-day learning activities that happen within the classroom.

Latinx Student Performance

The differences in standardized learning outcomes for Latinx students are staggering (NCES, 2015), indicating to many scholars that the system is failing certain groups of students, because it is not giving all students have the same educational opportunities. However, much educational research has problematically called this performance difference an "achievement gap" for many marginalized groups of students, conveying a negative, deficit perspective of students of color which separates them from their White or Asian peers (Gutiérrez, 2008). This perspective places blame on students and not on the system in which they are situated (Milner, 2010). Through the lens of an "achievement gap," many researchers tend to ignore the inherent differences and disparities in educational opportunities that students face *within* schools, particularly within the classroom, focusing purely on outcomes. Framing student experience through the lens of an "opportunity gap" allows the researcher to examine what students actually experience in schools, which can result in a very different way of describing disparities among students (Flores, 2007; Milner, 2010). Milner (2010) argued that the term opportunity is "multifaceted, complicated, process-oriented, and much more nuanced than achievement" (p. 7). He believed that all people are a product of opportunity; therefore it is of utmost importance to consider whether or not every person has the same opportunities to succeed.

Flores (2007) indicated that within K-12 schools there are many inequitable opportunities to learn; there is inequitable access to state funding, to properly trained teachers, or to a school culture of high expectations for achievement. The effects from these varying opportunities to learn carry with the student through their future academic experiences, including when they enter into higher education. Specific to instruction in the mathematics classroom, Flores (2007) indicated that effective strategies for increasing students' opportunities to learn include helping students to develop a strong understanding of concepts instead of superficial procedures, to express a deep belief in the capabilities of the students, to enable students to use mathematics as a tool for examining important social issues, and a classroom environment that supports students to justify their solutions. Gutiérrez (2008) contended that in order to positively reframe effective ways to help underrepresented minority students, more research should be done to investigate effective teaching and learning environments for marginalized students. She argued that research should focus less on single variables that predict student success, as these do not accurately reflect the environments from which students come. She also argued that such research should be accessible to practitioners via professional development or other platforms. Because Latinx student performance in mathematics in community colleges follows similar trends from K-12 settings (Bahr, 2010; Crisp & Nora, 2010; Crisp, Reyes, & Doran, 2015), something needs to be done to increase student success. No studies have come to understand instruction in the mathematics classroom, specifically on how Latinx students perceive their class experiences. Understanding their perspectives is a direct way to begin to understand what instruction may be lacking in order to support their success.

Latinx Students in Developmental Mathematics at Community College

The work that investigates Latinx students in developmental mathematics focuses on persistence and transfer (Crisp & Nora, 2010; Ornelas & Solórzano, 2004) and performance outcomes (Bahr, 2010; Crisp, Reyes, & Doran, 2017) using quantitative methods drawing conclusions across large groups of students that identify as Latinx. This information is useful, but falls short helping educators to make changes to their practice. There are a handful of studies that investigate what happens within the classroom to understand the ways that Latinx experience instruction (Barbatis, 2010; Acevedo-Gil, Santos, Alonso, and Solórzano, 2015), but they do not investigate the experiences of students, and don't explain how to support students' mathematical learning.

Ornelas and Solórzano (2004) interviewed students, faculty, counselors, and administration at a Hispanic Serving Institution to understand why Latinx students had lower transfer rates than their White peers. They found that 91% of Latinx students they interviewed in focus groups wanted to transfer to a four-year institution. However, some counselors and administration at the college blamed low transfer rates on Latinx students and their families for having low commitment to their college education. The authors found that the most significant barrier for student transfer was related to the overwhelming pressure to balance multiple roles and responsibilities outside of college while attending to the demands of being a student. Students placed in developmental mathematics were often discouraged to persist in community college because of the large amount of coursework they must complete (Ornelas & Solórzano, 2004).

In a study that investigated the level of preparedness for mathematics and science degrees of Latinx and White community college students (Nora & Rendon, 1990), the researchers found that Latinx students were more prepared than most of their White peers. Latinx students reported higher grades in high school math and science courses compared to white female students, and were comparable to white male students. They also found significantly higher numbers of Latinx students enrolled in community colleges compared to their White peers. The researchers conjectured that because Latinx students were more likely to attend community colleges to ease the financial burden of schooling, “some of the brightest Hispanic students may be attending community colleges to initiate mathematics and science careers” (Nora & Rendon, 1990, p. 38). Focusing specifically on developmental mathematics, Bahr (2010) found that Latinx college students who enroll in developmental mathematics were substantially more underprepared than their White counterparts, indicating that students’ previous schooling experiences may not have been the same as their peers. He found that only one-fifth of Latinx students attained college-level mathematics credit compared to one-fourth of White students and one-third of Asian students. The contradictory findings of Nora and Rendon (1990) and Bahr (2010) might be explained in two different ways. First, Nora and Rendon (1990) looked at all students, not only developmental mathematics students, who were STEM intending. Second, they looked at characteristics of incoming students, not their outcomes, whereas Bahr (2010) considered the students' progress past developmental mathematics. Considering this second point, it is important to understand that Latinx students are just as prepared as they enter college, however, Bahr's (2010) findings point out that for some reason Latinx students are not progressing forward in similar ways as their peers do. That is problematic, and it is unclear where the mixed results are coming from.

Crisp, Reyes, and Doran (2017) wanted to understand what factors contribute to successful completion of developmental mathematics courses for Latinx students. They found that students who received more financial aid, who received faculty and peer support, and students who were enrolled at institutions with high Latinx enrollment were more likely to successfully complete developmental mathematics. However, they did find that the more developmental courses a Latinx student was required to take lowered the odds that a student would reach college-level mathematics. The authors suggested that more needs to be done to understand the experiences of Latinx students within the classroom as the measures they used only address specific parts of the student learning experience, outside of instruction.

Barbatis (2010) interviewed 22 underrepresented minority students who had taken developmental coursework at a community college searching for factors that contributed to successful completion. He found that students who successfully passed their developmental courses had strong family support at home and relied on having social connections at the college. Barbatis suggested that the instructional methods in developmental courses need to be more engaging and different than those students faced in high school, otherwise students felt that they were experiencing the same setting that contributed to their placement in developmental coursework. Acevedo-Gil, Santos, Alonso, and Solórzano (2015) interviewed over 30 Latinx students placed into developmental education in the Los Angeles area to understand how they experienced their courses. Students described examples of validation from their instructor, peers, and counselor that related to their social identities and supported their improvement within mathematics. These people provided students with positive experiences and confidence to continue with their academic goals. At the same time, students experienced just as many instances where their mathematics instructors demonstrated lack of approachability and relayed negative, deficit comments towards them, which caused many to question their capability to complete their mathematics coursework.

Thus, much of the work that investigates Latinx students in developmental mathematics focuses on long-term outcomes, such as persistence, transfer, and performance. This work suggests that Latinx students underperform and do not transfer at equal rates to their peers. While this information is important to understand that there inherent challenges for Latinx students enrolled in community college developmental mathematics, more work needs to investigate what students experience while they are in these courses as a way to create positive and long-term change.

What none of these studies accurately address is what happens *in* the classroom. None of these studies report on the day-to-day experience of the students as they sit in and interact with the instructor and the material nor on how they perceive that experience. Without this information, it is difficult to understand and interpret the outcomes mentioned in the studies and even harder to identify ways to engage students in classrooms so that they can possibly improve their performance outcomes, including persistence in courses, and degree completion and transfer. Part of the problem is the lack of language to describe what transpires in the classroom. I turn to that aspect next.

Conceptual Framework

This study investigates instruction in developmental mathematics and students' instructional experiences, as a way for researchers to understand students' overall experience in the classroom. For this purpose, I use the definition of instruction proposed by D. Cohen, Raudenbush, and Ball (2003), "Instruction consists of interactions among teachers and students around content, in environments" (2003, p. 122) and I propose a definition for instructional experiences.

Instruction

D. Cohen et al.'s (2003) definition of instruction shifts attention from the *teacher* to what occurs in the classroom, specifically what is said and what is done. It considers the multiple interactions that occur in any given moment in an environment where teachers and students both use and leverage resources meant to support student learning of the material (D. Cohen & Ball, 2001; Herbst & Chazan, 2012).

The instructional triangle (Figure 1) illustrates four major interactions that define instruction: student-teacher, teacher-content, student-content, and student-student. The interactions, represented by bidirectional arrows, suggest the necessity for all interactions to be foundational for shaping student learning (Ball & Forzani, 2009). Significant scholarship has been produced to understand instruction from the instructor's perspective (Lampert, 2001, 2010) and of the role and type of mathematical content that intervenes (Doyle & Carter, 1984; Stein & Smith, 1998). While the instructor and mathematical content are important elements, this study aims to understand instruction from the students' perspective.

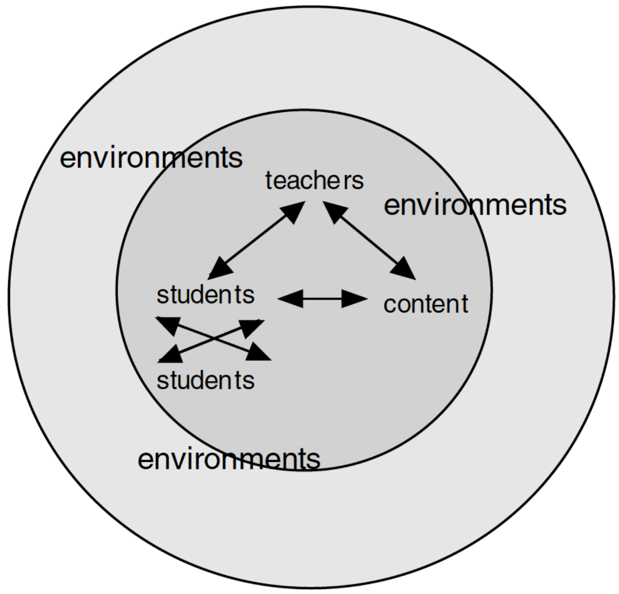


Figure 1. The Instructional Triangle From D. Cohen, Raudenbush, And Ball (2003)

Instruction is bounded by the classroom and influenced by outside factors (as seen in Figure 1). D. Cohen et al. (2003) defined environments as external influences, which include previous instructors, parents, or policies within the department. Environments can also include the work obligations of a part-time instructor or the college requirements for its students. Yet other environments, such as the personal financial obligations a student may face or the commute a student must make to arrive to school in the morning, constrain the schooling experience of students. Such environments directly affect the instruction itself; “If these things do in some sense exist outside instruction, they also appear within it” (D. Cohen et al., 2003, p. 127). Environments are imported and used by instructors and students, and influence instructional interactions (D. Cohen & Ball, 2001). Cohen and Ball (2001) argue that instructors and students unknowingly respond to environments during instruction, subtly shaping the instructional opportunities in the classroom.

These environments, therefore, directly affect mathematical instruction. Researchers argue that it is important to understand how various environments affect mathematics instruction within the classroom (D. Cohen et al., 2003; Chazan, Herbst, & Clark, 2016). However, little research has been done to understand how such environments shape mathematical instruction within classrooms at community colleges (Mesa, 2017).

There are many examples of the environments that affect students who take developmental mathematics at the community college level. Some states, (e.g., California, Ohio) have recommended and enforced statewide agreements between community colleges and four-year institutions that stipulate the requirements a student must meet in order to be transfer-ready (Zamani, 2001); in other states (e.g., Michigan), the receiving institution draws the agreements (Dowd et al., 2006; Michigan Association of Collegiate Registrars and Admissions Officers, n. d). These state policies can affect the types of coursework a student is expected to complete in order to transfer, adding to the anxiety a student may bring to the classroom when the student is expected to take multiple mathematics courses in order to transfer on a timely schedule. Colleges may have established mandates at the level of each disciplinary department for how students are placed into developmental mathematics, the number of courses a student is expected to take once placed, and restrictions on the number of opportunities a student has to repeat a course (Larnell, 2016; Melguizo, Kosiewiez, Prather, & Bos, 2014). These institutional policies may increase time to degree completion, increasing cost or forcing students to drop out (Melguizo, Hagedorn, & Cypers, 2008). Disciplinary departments sometimes have courses coordinated by full-time faculty, requiring instructors of courses to use specific materials or curriculum. Such departmental policies can affect instruction because faculty who teach in a coordinated course may be required to teach specific content or may feel overwhelmed by departmental expectations (e.g., grading within a particular time frame, attending professional development, etc.). Part-time instructors are usually employed at multiple institutions that have varying requirements for the instructors, affecting the instructors' work obligations, which can affect the time an instructor can dedicate to specific courses or limit their campus availability.

At the individual level, students and part-time instructors bring with them other environmental constraints. Students bring to the classroom expectations built from what their families and friends think about pursuing their educational career. These expectations could influence instruction because students may feel an overwhelming burden born out of their families' imposed messages about success. Most part-time instructors are not assigned a designated office space and so they cannot hold office hours and do not have a place to store course materials such as student work, lessons, or other resources. Not having a working space at the institution impacts the types of interactions they can build with their students outside the classroom. Without an office students may not be able to privately describe concerns they may have with the course, which have been shown to be important for student success in developmental mathematics (Chang, 2005; Crisp, Reyes, & Doran, 2017). Not having spaces to strengthen rapport between students and instructors may get in the way of developing a positive learning environment (Wood & Harris, 2015).

Instructional Experiences

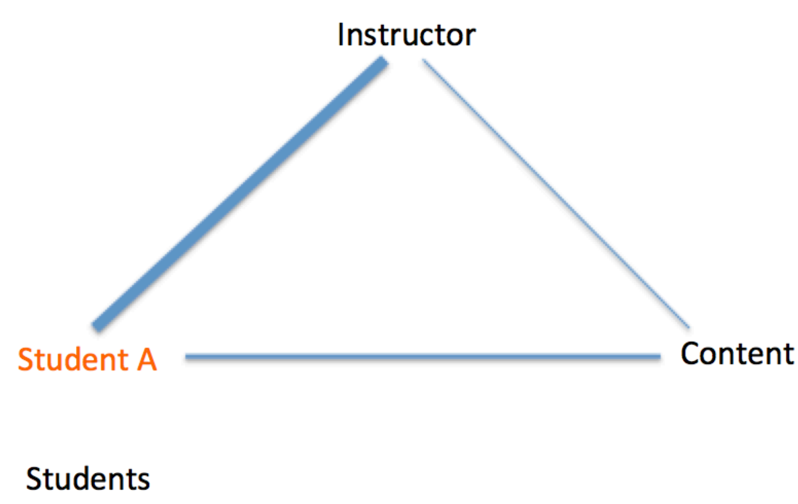
The term "experience" is used widely in education literature. It is quite difficult to write about experience because of the many ways in which the term is used (Boud, R. Cohen, & Walker, 1993). The term can be used as both a verb and a noun. "As a verb, it suggests either a particular instance or a process of observing, undergoing, or encountering. As a noun, it is all that is known, the knowledge or practical wisdom gained from observing, undergoing or encountering" (p. 6). As a verb, a student could experience a group activity in a way that motivates him or her to engage in the mathematics. As a noun, it refers to that what the students bring, a set of prior experiences that influence their behaviors. It is also understood as number of years instructors may have taught.

Researchers in education often use "experience" both as a verb and a noun to group together similar types of interactions (e.g., educational experience, personal experience, teaching experience, campus experience) without defining what contributes to the *experience* or how people identify and qualify it. What is inherent in general use of the term experience in educational research is both the notion of *experiencing* and *what is experienced*. Boud and colleagues (1993) contend that these two notions cannot exist without the other. In quantitative research, the term experience is used as solely as a noun. For example, Crisp and Nora (2010) identify academic experiences as attending an HSI, time with a faculty member or academic advisor, GPA, and enrollment in developmental coursework while Crisp, Reyes, and Doran (2015) identify receiving financial aid and being enrolled in college full-time as experiences. As a noun, these studies identify single items as being an entire experience. In these studies, these experiences affect the outcomes of students as they are enrolled in developmental mathematics. Boud et al. (1993) point out that while many studies attempt to isolate experiences into single events or objects, that experiences build upon one another and are multi-faceted and multi-layered that it is almost impossible to separate one experience from another.

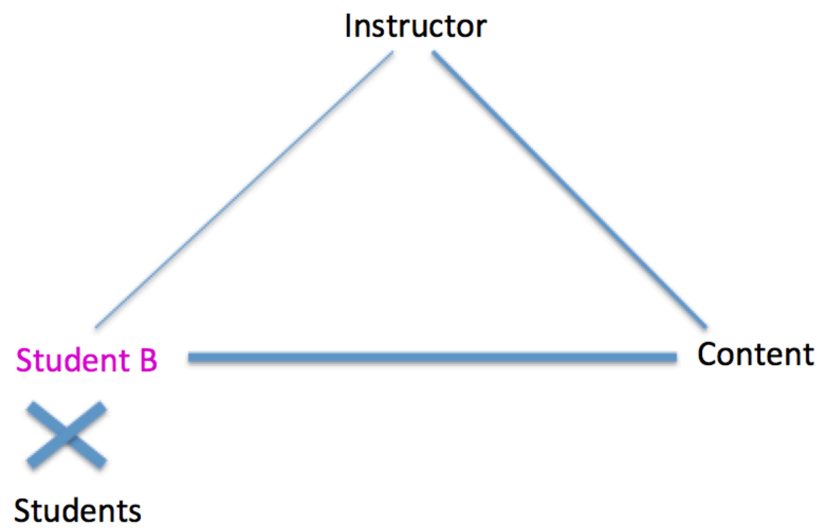
Dewey (1938) described two abstract principles that can help explain the nature of experience: continuity and interaction. Continuity, also known as the experiential continuum, acknowledges that all experiences are connected and build upon one another. In other words, all experiences are carried forward and therefore influence any future experience a student may have. Through continuity, these experiences can be conceived as resources in the classroom, and can influence and shape the way that students see mathematics. Interaction related to specific instances of an experience. Dewey recognized that an experience did not occur within a vacuum, implying that there were outside sources, such as people, curriculum, or resources in other words, the environments, in which experiences took place, which gave rise to an experience. Interaction refers to the idea that while there are indeed outside sources (e.g., environment), the way a student internalizes these objective sources is what ultimately determines what kind of experience the student has. That is, two students engaged in the same lesson may claim to have different experiences because of how they internalized the external contributors towards the lesson (Chazan, Herbst, & Clark, 2016). By considering both continuity and interaction, Dewey argued researchers can then understand the needs of individual students.

Polkinghorne (1989) provided another philosophical explanation of experience, through the lens of phenomenology. He argued that "experience occurs at the meeting of person and the world" and that "the form and continuity of experience are products of an intrinsic relationship between [them]" (p. 42). Like Dewey, Polkinghorne argued that the identification of an experience occurs through the consciousness of the person, that experience is a reality of the openness the person has with the world around them. Again, two people may have a different experience of the same interaction based on their individual perceptions. Polkinghorne believed that an essential characteristic of experience is that it is always an experience of *something*. That is, one cannot describe an experience without a point of reference.

I conceptualize students' experience during instruction, by defining students' *instructional experiences* as the student internalization of the interactions between students, the content, and the instructor. Students experience instruction differently based the types and number of interactions they have with their instructor, the content, and their peers as well as the way that they come to perceive these interactions. These experiences are also shaped by various environmental factors. The differences in interactions and the differences in environment that each student brings can result in markedly different course experiences for students by the end of a semester-long course. Students internalize their instructional experiences in unique ways. I visualize this within the instructional triangle as shown in Figure 2. Each edge of the instructional triangle is associated with different instructional experiences, which may demonstrate a different emphasis of the interactions. Figure 2a is meant to represent how a particular student, say Student A, perceives the interactions in any given day. For a specific class session, Student A's perceptions centered on multiple interactions he had with the instructor, with a few or no references to the other possible interactions with the triangle (e.g., no line represents no reference to interactions with class mates; the thickness of the lines represents the different emphasis with which Student A talked about those interactions). A different student, Student B, could perceive instruction differently that *same* day.



(a)



(b)

Figure 2. Examples of students' instructional experiences. Student A's perceptions focus on multiple interactions with the instructor and fewer towards the content, without describing interactions with their peers. Student B's perceptions focus on interactions with their peers as well as the content, with fewer perceptions about interactions with the instructor or the instructor's interaction with the content.

Following the work of Boud and colleagues (1993), Dewey (1938), and Polkinghorne (1989), I conceptualize an instructional experience as having three specific features. First, experiences build upon one another, influencing future experiences. In this study, the way that students see themselves as doers of mathematics and their previous mathematics experiences will shape the instructional experiences within their mathematics class. Second, an instructional experience results from the interaction of the student and external sources. More specifically, instructional experiences are shaped and affected by the environments in which they exist, and how specific resources are leveraged. And third, students determine the result of what is experienced, relating to themselves as doers of mathematics as well as the way they make use of available resources. These instructional experiences individually contribute to the continuity of experience that a student has within one mathematics course, while as a whole, contribute to students' future mathematics learning.

Research Questions

This study aims to understand what instruction looks like within an intermediate algebra course at a community college and how Latinx students perceive the instructional experiences in the classroom. As described above, I assume that the environment, the available resources and how they are used, and students' mathematics identities may influence instructional experiences and simultaneously that instruction may influence students' mathematics identities. Thus, I posed the following questions to guide this study:

1. How is instruction enacted in a developmental mathematics classroom taught by an adjunct faculty at a Hispanic-serving institution?
    a. What are the interactions between the students and between student and instructor?
    b. What are the interactions between the instructor and content?
    c. What are the interactions between the student and content?
2. How do Latinx learners perceive their instructional experiences in this developmental mathematics classroom at this Hispanic-serving institution with an adjunct faculty?

Students placed in developmental mathematics face different challenges than their peers—they must revisit content they have previously learned often fostering feelings of inadequacy and they are required to take more courses, leading to extended time to degree completion and more money spent on their education. Therefore, it's extremely important to understand what instruction looks like in the classroom in order to foster a positive learning environment and contribute to higher levels of success for students taking these courses. Research Question 1 aims to gain an understanding of the types of instructional experiences that are present in a developmental mathematics class. Because a higher number of Latinx students are placed in developmental mathematics (Bahr, 2010), Research Question 2 aims to understand the ways that Latinx students perceive the instructional experiences that they have in the course. Finally, because instruction exists within specific contexts, I explain why instruction may be enacted in the way that it is.

Chapter 3

Methods

The purpose of this study is to understand how instruction is manifested in a community college developmental mathematics course taught by an adjunct faculty member and to understand how students in that course narrate their instructional experiences. In this way we will expand existing models of success in developmental education based on measurable predictors (e.g., GPA, test scores, race) by considering what happens *inside* the black box of the classroom and even further, understand how students make sense of their instructional experiences. Documenting student performance via measures at the beginning and the end of a course only captures a small portion of the issue at hand. It is even more important to gain an understanding of what happens throughout the semester. This qualitative case study uses an ethnographic approach to data collection and analysis to understand what instruction looks like and the types of experiences students have and how they perceive these experiences in the classroom. This chapter describes the research design, sample, and analytical methods for the proposed study.

Design

Qualitative research methods allow the researcher to observe "the inner experience of participants, to determine how meanings are formed through and in culture, and to discover rather than test variables" (Corbin & Strauss, 2008, p. 12). Ethnography is a useful methodological tool to study the experiences of a person as it positions the researcher to "participate, overtly or covertly, in people's daily lives for an extended period of time, watching what happens, listening to what is said, asking questions… to throw light on the issues with which he or she is concerned” (Hammersley & Atkinson, 2007, p. 2). Researchers using qualitative methods acknowledge that the world is complex and therefore it is challenging to understand such complex phenomena via alternate methods. I argue that classroom experiences are an important avenue to understanding the ways in which such experiences affect student learning, mathematical understanding, and success. I incorporated a case study design in order to look at an instance or a phenomenon that is of scientific interest and that is bounded (George & Bennett, 2005; Ragin & Becker, 1992), specifically, the classroom instructional experiences of Latinx students. Because I aimed to understand student experiences in the classroom, it was important to understand how the setting influences the interactions within the classroom. Through ethnographic methods, I was able to observe how instruction existed within its natural context, and to covertly become and observer of this space.

In order to begin to understand an experience, there is always a visceral evaluation of the experience: positive, negative, or neutral. I believe that there is a general process that one goes through to evaluate an experience. First, the experience affects *how* you feel (e.g., smart, embarrassed). In order to understand how you feel, it is important to understand *why* you feel this way. Finally, something must have contributed to how you felt; therefore it is essential to understand *what* contributed to these feelings. Through this process, students may refer to various sources that contribute to the experience. Students may describe their experiences relating to their identities within the classroom (Boaler, 2002; Carlone, 2012; Cobb, Gresalfi & Hodge, 2009; Martin, 2000). For example, students may contend that they understand the mathematics because they believe that they are “doers” of mathematics. Alternatively students’ experiences could relate to the specific resources available to them, which in turn can limit the opportunities students have while learning (Adler, 2000; Cohen & Ball, 2001; Grubb, 2008). Students' experiences in the classroom can also be shaped by their views of the relevance of mathematics in their lives and their personal definitions of success (Wenger, 1998). For example, students may believe that the mathematics that they are learning does not directly relate to their current or future needs and show little interest and negative attitudes towards the material and the course.

Sampling

The selection of participants for this study started with the identification of a college that had specific characteristics. First, I wanted a college that was located in California, a state that has one of the largest proportions of college age Latinx students. In order to ensure that the college was cognizant and recognized the importance of diversity, I particularly looked for a *large* college with an HSI designation. The size of the college would provide me with the possibility of having a large number of mathematics courses to choose from, and the HSI designation would ensure that the college would be mindful of the need to support Latinx students at the college. I was also interested in a college located in an urban area, because, relative to a rural college for example, the urban college would support a variety of student goals, including vocational training and transfer to state and flagship universities. I was also interested in a college that had defined programs and agreements with other institutions that help streamline students' transitions to the local universities, because these reduce the time to degree completion for students starting in developmental math. Of the various colleges that fitted this description, I chose Clear Water College, because in addition to fitting all the features described above, the college was open to be part of the study. In Chapter 4 I provide more details about the college.

Once the college was chosen, the next step was to select a developmental course to observe. I wanted to find a course that was higher in the sequence of developmental math courses because this would offer multiple entry points to the course. MATH 5 is the highest developmental mathematics course. Students may place directly into MATH 5 upon initial placement testing or students may have taken a lower level developmental mathematics course in previous semesters, therefore providing variance in student exposure to developmental mathematics courses at this college. This is important to the study because the class may have various types of students (e.g., first-year college students, students who have already taken a course at CWC), increasing the diversity in how students may perceive their experiences in the classroom. Because observing instruction is central to the study, I wanted a course that met face-to-face. Clear Water College offered multiple delivery options for MATH 5. Students could select from traditional face-to-face instruction, accelerated face-to-face sections, online courses, or hybrid courses, which blended traditional and online instruction. According to faculty teaching at the college, classes in the earlier hours of the day have higher student enrollment and better attendance rates than classes that meet in the afternoons and evening. Therefore, I wanted a course that offered multiple sections in the morning hours. I also wanted to select a course that had a high number of sections that were taught by part-time faculty. At Clear Water College, part-time faculty taught at least half of the sections of MATH 5. More information about MATH 5 is given in Chapter 4.

I wanted a section that was taught by a part-time faculty member for three reasons. First, part-time faculty are more likely to teach developmental mathematics courses than full-time faculty (Blair, Kirkman, & Maxwell, 2013), therefore I assumed that a part-time faculty may have more experience teaching this course. This was important for my study because with more experience teaching developmental mathematics courses, the instructor may know better how to teach the students who take this course. Second, part-time instructors tend to teach at multiple colleges, and therefore may be exposed to more diverse student representation and curriculum. This higher level of exposure to other departments and student bodies was good for my study, as the instructor may be more aware of and react to student needs differently than an instructor who teaches only at Clear Water College. Finally, professional obligations of a part-time instructor may influence the way that students experience instruction in the classroom (Chazan, Herbst, & Clark, 2016; Lande & Mesa, 2016). Therefore, in order to understand the environment and resources that influence instructional opportunities, it is important to capture the reality at most community colleges: most students take developmental mathematics courses with part-time faculty.

In order to select the course section to observe, I emailed all faculty scheduled to teach a face-to-face section of MATH 5 four weeks prior to the start of the term. Four instructors responded to the email. Three of the instructors were full-time faculty and one, Beatrice, was part-time. More description about Beatrice is found in Chapter 4.

In order to select the students that would be the focus of the study, I attended the first day of class to do the recruitment. The instructor agreed to step out of the classroom as I spoke to the entire class about the study, and why I would be sitting in the classroom throughout the course, video- and audio-recording those sessions. After informing the students about the study, I passed out a consent form that would allow me to conduct the observations. I explained that I was looking for a group of students who would be completing information throughout the semester by writing about their classroom experiences. For students who said they were interested in participating as informants, I provided a survey requesting background information (see

Appendix A) that I used to make the final selection of students. Of the 40 students enrolled in the course, 29 submitted a survey. Because of my interest on the experiences of Latinx students, I narrowed the survey responses to those who indicated their race/ethnicity as being Latino/Latina, Mexican, Hispanic, or "mixed" or if they indicated that their mother or father's nationality was from a Central or South American country. A total of 14 of the 29 respondents met these criteria, but two were under-age, and therefore not included in the final set. I emailed, texted, or called 12 students to participate in the study based on their preferred form of contact. By the end of the first week of the course, nine students committed to participating in the study. In Chapter 4 I provide information about each of these nine focal students.

Data Sources

I used six data sources for analysis in this study: classroom observations, fieldnotes, student observation surveys, student recruitment questionnaire, interviews (with focal students and course instructor), and classroom artifacts (see *Table 1*). To increase credibility of the findings, I selected these multiple sources of data such that I could triangulate findings (Merriam, 2009). By using observations, student observation surveys, and interviews to support findings, I sought to gain a better understanding of the experiences of the students during instruction (Maxwell, 2012). I will describe each of these items in the following sections.

Table 1: Sources of Data

Type	How many?	When?	Format	Purpose
Classroom Observations	12 meetings (18 hours)	One week each month during Fall 2016 semester	Video-taped; audio-taped	To observe and document focal student behavior/experiences; to observe mathematical content
Field Notes	12 meetings	Recorded during each class meeting	Written	To document researcher observations; to document instruction in the classroom
Student Demographic Survey	1	First day of class	Written	To select students for interviews
Student Observation Surveys	12 responses per student	After each classroom observation	Written	To document student experiences from observed meeting days
Interviews				
Instructor	3 times (~5 hours)	Before, middle, and after semester	Audio-recorded	To understand: goals for course; teaching experience; teaching philosophy; thoughts on course progression; thoughts on students
Students (9)	3 times per student (3 hours per student; 27 hours total)	Before, middle, and after semester	Audio-recorded	To understand: past mathematical experiences; current experiences in classroom; reflections on the course
Classroom Artifacts	All Quizzes and Tests with instructor feedback (5 quizzes, 3 Exams, 1 Final Exam)	Throughout the semester	Written	To know the types of material students engage with in the course; to see instructor feedback and evaluation

Classroom Observations and Fieldnotes

I attended 12 class meetings throughout the 16-week semester, which corresponded to about 25% of the class meetings. I observed the class for an entire week approximately every four weeks. Weeklong observations occurred during Week 3, Week 8, Week 12 and Week 15 of the semester. During the observations, I sat in the back of the class in a chair placed in the middle, against the wall (see Figure 4). I recorded fieldnotes of what I saw during the class session on my computer. Because I observed so much class time, students became familiar with me sitting in the back, and I became familiar with most students in the class. I acted strictly as an observer, not interacting with students while they were in the classroom, though frequently, as I was setting up equipment or waiting outside at the start of class, I would strike up casual conversations with the students. I used student names during fieldnotes when possible to correlate to the names of peers that the focal students would reference in their observation survey responses for each day of observation. However, the focus of my fieldnotes was to note what I saw the focal students doing during the class session. For example, if a focal student asked a question during class, I noted what was said. If I saw various interactions between the focal students and their peers or the instructor, I made notes about the way the interaction took place. When the instructor gave an explanation or made a mathematical error, I tried my best to capture the essence of the moment.

Each observation was both video-recorded and audio-recorded. The video camera was placed in the back left corner of the room, in front of one of the two doors, to capture as much of the classroom as possible, ensuring a clear view of the projections displayed by Beatrice. The audio recorder was placed at the front of the room closer to Beatrice to ensure that her voice could be heard if the camera should have failed to capture her voice from the back of the room.

Classroom observations were important to this study in order to capture evidence of interactions as seen through the instructional triangle as well as to support students' mathematical experiences. Because a major component of this study is to understand students' mathematical experiences, it was important to capture the classroom instruction in order to triangulate these experiences.

Student Recruitment Questionnaire and Student Observation Surveys

On the first day of class, the focal students filled out the student recruitment questionnaire providing background information (e.g., race, ethnicity, age, and gender) past mathematical performance, current obligations (e.g., work obligations, caregiving), educational goals, and their relationship with mathematics. Because developmental mathematics courses have high attrition rates (Attewell, Lavin, Domina, & Levey, 2006), I sought to recruit as many students as possible, knowing that there could be a likelihood of fewer students continuing in the course.

At the end of each classroom observation, I emailed the focal students a survey link to complete information about their experience in class that day (see Appendix B for sample survey). In total, students were asked to complete 12 surveys. These entries required students to provide a short response describing their experiences during that specific class session. Students were asked to rate the class session, describing why they gave the rating, as well as describe the topic of the class. Students were also asked, for example, to describe moments in class that went well, did not go well, or were challenging. Students were expected to select all of the ways that they participated in the class session (e.g., asked the instructor for help, provided a response in the lecture when the instructor asked the large group, helped a classmate). Students were asked whether they thought the mathematics they learned during that session was useful for their future. Students were also asked if they felt part of the classroom mathematics community that day, and why they felt so. Students were asked to list all of the people that they interacted with during that class session. If a student did not attend an observed class session, they were still required to fill out the survey, describing the circumstances contributing to the absence and their plans for catching up on the missed material, including the people they may contact about the missed class.

The student observation surveys were used to inform the second and third student interviews. Because the student survey responses were short in length, I used time during the interviews to provide a richer understanding to the way that students were experiencing the classroom. For example, I asked students to elaborate on their responses to moments that went well in class, moments that did not go well in class, and moments that were challenging. I also repeated their responses for how they viewed themselves as fitting in to the classroom community and asked for them to expand on the way they came to understand what it meant to be a valued member of the classroom.

Interviews

I interviewed both the focal students and the instructor three times throughout the semester.

Student Interviews

The interviews for each student elaborated on the experiences that students had in the classroom and how aspects of their life outside of the classroom were affecting their experiences in the class. The interviews helped to create a narrative, "a story of a sequence of events that has significance" for the students (Coffey & Atkinson, 1996, p. 55). The student interviews provided a space for the Latinx students to share their stories; "storytelling has been used to provide a venue for the marginalized to voice their knowledge and lived experiences" (Rodriguez, 2010, p. 493). Solórzano and Yosso (2002) argue that stories can build a sense of community among marginalized populations, giving voices to those who may be overshadowed by the dominant stories within education. Because schooling privileges some students and not others, understanding a student's perspectives of mathematics instruction can aid in understanding how those students who are under-supported. These stories will contribute to my understanding of Latinx students' experiences in the mathematics course as specific factors within the course may have varying affects on the students (Heyl, 2001).

Not all Latinxs are the same, therefore Gutiérrez (2002) reminds us that "work on the diverse perspectives of Latinxs in mathematics is critical to developing support structures that honor students' identities and adequately inform [instruction]" (p. 1050). As such, this study does not attempt to make claims about the Latinx population in general; rather it aims to understand individual students' classroom experiences. By understanding Latinx students' experiences individually, this study contributes to identifying cases of students that self-identify as Latinx while also seeking patterns that emerge from these experiences in this particular classroom to seek explanations that tie them to their course outcomes. This can help break down the general understandings of Latinx students.

I interviewed each student three times over the course of the study. Interview 1 intended to establish a good relationship with the student, allowing me to get to know each of them as individuals. In this interview I inquired about students' past academic preparation, attitudes towards mathematics, and educational goals and values. I interviewed the students during the first and second week of the course. The second interview took place after the first midterm, around eight weeks into the course. I asked students to describe how the class and the way that

Beatrice taught, to elaborate on observation survey responses, to describe their participation, to talk about the ways they interacted with others in the classroom as well as other aspects of the course including the online homework and their sense of their performance. Prior to this interview, I looked at the six sets of observation surveys and selected one example of a moment that went well and a moment that did not go well such that the students could talk in more detail about these moments. Interview three occurred after the students took the final exam and had a sense of their overall performance.[2] The students were asked to talk about their overall experience in the course and to discuss future plans given their thoughts on their performance. Prior to this interview, I again read through the six sets of observation surveys and wrote specific questions for each student based on their responses. All interviews were scheduled for one hour, but some students stayed longer to continue to share their story.

Instructor Interviews

The interviews with the instructor helped me better understand the instruction that transpired in the classroom. For example, as part of pedagogical repertoire, an instructor might encourage student presentations of their work. But student presentations may create a negative experience in the classroom if a student is anxious about speaking in front of their peers. By interviewing the instructor I was able to discern why it was important to the instructor to send students to the board and drew conclusions from such views in relationship to students' perceptions of their experiences. In order to be fully attentive of what was happening during instruction, I considered other instructor characteristics that may have influenced the classroom instruction such as the way that Beatrice ran her course (including topics to be covered, a tentative schedule, requirements imposed by the department), the types of courses she has taught, years of teaching experience, her general weekly schedule, her past educational experiences, as

[2] The interview took place before final grades were released.

well as what it is like to be a part-time faculty at various institutions. This information was useful to understand why Beatrice made certain changes throughout the course. Years of experience an instructor has taught and also the types of courses taught could influence the instructor's pedagogical knowledge for teaching, which could influence the kinds of things he or she does in the classroom with the students and the content. For example, a new instructor may not know how to interpret student misconceptions or may not know multiple ways to explain content or how to utilize alternative methods for instruction. Encountering situations in which the instructor has little knowledge of how to act may create situations that can be problematic for the students, thus creating a potentially negative experience for them. The instructor's weekly schedule may impact the amount of time that the instructor is at the college, impacting the relationships that could be developed with the students, and as such can result in different experiences for the students. Past educational experiences as a student often influence the way that an instructor teaches (Mewborn & Tyminksi, 2006). Finally, the pressures as a part-time faculty can be very stressful and affect the quality of the job as an instructor (Ellison, 2002).

I interviewed the instructor three times during the semester. The first interview took place before the start of the semester. It addressed the topics above and helped me get to know Beatrice, including her expectations for the course. The second interview took place during the middle of the semester, after she completed grading the students' first exam. I asked Beatrice to describe how she felt the semester was progressing, to describe the top three students in the class and the bottom three students in the class, to discuss changes that she planned to make, as well as to elaborate on a few notes I had made throughout the first eight weeks of the course. Asking the instructor to describe the top and bottom three students in the class will help triangulate any experiences that the students may allude to in their diary entries or interviews. If none of the focal students are included in this list, this information is still important to understand the reasons the instructor selects top and bottom students in the class. Because the instructor plays an important role in instruction, it is beneficial to understand their perspectives of who is "good" and who is "not good" within the classroom. The final interview took place after the completion of the semester and after student grades were calculated. I asked Beatrice some questions from the second interview and also asked her to describe what it meant for a student to do well or not do well in her course, to elaborate on the way she assigned grades, and to discuss students who had dropped the course and the reasons she felt they might have had for leaving the course.

Classroom Artifacts

The final data source for the study was classroom artifacts. I collected worksheets, quizzes, and exams throughout the term[3]. There were a total of five quizzes throughout the semester, three midterm exams and one final exam. The students took the first two quizzes individually. The students were asked to partner with someone to take the last three quizzes. The exams were taken individually; after the first exam, the instructor allowed students to bring in a one-page cheat sheet. The final exam was cumulative and students were also allowed to bring in a two-page cheat sheet. These artifacts helped me to understand the trajectory of the mathematical content as well as the way in which students were expected to work in the class, and to gauge the mathematical understanding that the students had of the course material.

[3] Homework in the course was assigned through ALEKS. Because this program is different for each student and students did this work at home, it was not possible for me to collect information about the assignments. However, students do talk about using the ALEKS system, which I recorded during interviews.

Table 2: Three Phases Of Data Collection

Phase #	Item Collected
Phase 1 – Week 1	Student Recruitment Questionnaire First Focal Student Interview First Instructor Interview Collection of Course Documents (e.g., syllabus, calendar, book)
Phase 2 – Week 8	Six completed classroom observations and fieldnotes Six sets of Focal Student Observation Surveys Second Focal Student Interview Second Instructor Interview Collection of Course Documents Quizzes and Exams with Instructor Feedback
Phase 3 – Week 16	Six completed classroom observations and fieldnotes Six sets of Focal Student Observation Surveys Third Focal Student Interview Third Instructor Interview Collection of Course Documents Quizzes and Exams with Instructor Feedback Student Cheat Sheets Student Exam Corrections

Data Analysis

Fieldnotes, diary entries, student and instructor interviews and classroom artifacts were analyzed for this study. Throughout the data collection, there was ongoing analysis of these items as they were collected, in order to guide and inform subsequent classroom observations and student interviews. All interviews were transcribed for analysis.

Classroom Observations

The observations used for analysis for the dissertation were selected based on four criteria. First, I narrowed the 12 observations to those that contained face-to-face instruction only. Second, I selected the observations where the instruction presented new material to the students (i.e., observations where a majority of time was spent reviewing for exams were excluded). Third, I selected the observations that presented the most variation in instructional modes (e.g., lecture, individual student work, student presentations). Finally, I searched for the observations that had the least amount of interruptions that took time away from the face-to-face instruction (e.g., departmental evaluations, quizzes or tests, working on ALEKS). Observations 2, 4, 5, 8, 10, and 11 fit these criteria. I selected Observations 2, 5, 8, and 10 because they showed the most variation in instruction and had the most students present; Observations 2 and 5 contained student presentations and Observations 8 and 10 contained more time spent on individual student work. *Table 3* shows the length of each observation, how many students were present during each observation, and the content that was taught during the observation. Each observation covered content from different chapters.

Table 3: Description of Observations Used for Analysis

Observation	Length (min)	# of Students	Content
Observation 2	95	38	• Solving one-variable linear inequalities • Absolute values • Solving absolute value equations and inequalities
Observation 5	92	29	• Factoring polynomials
Observation 8	97	24	• Multiplying radicals • Solving radical equations • Complex Numbers • Adding and Subtracting Complex numbers
Observation 10	89	23	• Composition of functions • Inverse Functions • Graphing exponential and logarithmic functions • Rewriting logarithmic and exponential functions

I analyzed the classroom observations in two stages. First, I noticed that the course was taught through a series of topics mainly presented through problems. That is, Beatrice taught the class by demonstrating how to complete problems posed by each section of the notes (e.g., solving absolute value equations, graphing exponential functions) and usually defined concepts by showing how to find solutions to the problems posed. For this reason, I analyzed the observations by changes in topic or problem, and called these segments, episodes. For each episode, I recorded its duration, the content or problem addressed, and who presented the topic or problem. For example, if during a lecture, Beatrice spent time defining an absolute value and then showed three examples for how to solve an absolute value I identified four episodes: one for the presentation of the definition of absolute value and one for each problem presented.

Second, using the instructional triangle as the lens to analyze instruction allowed me to further categorized episodes by what I call mode of instruction in which they occurred: lecture, individual student work, student presentations, and business. The percentage of class time spent engaged in each of the four modes of instruction can be seen in Figure 3. The largest percentage of time was spent in lecture for all four observations. Students were given time to practice working on problems similar to those that Beatrice demonstrated in the lecture, which is defined as time devoted to individual student work. Students were invited to work with others during the individual student work time, yet were not obligated to. Periodically, the instructor would ask students to present their work from this individual student work time at the board. Business refers to instances when the teacher reminded students about deadlines, course expectations, or discussed other important aspects of the class.

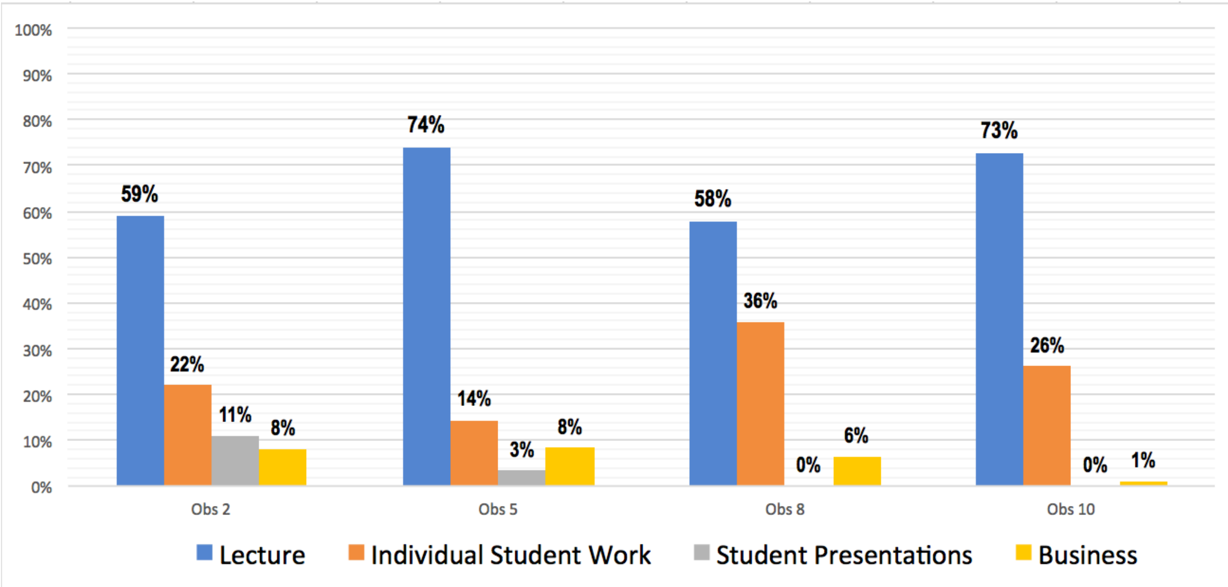


Figure 3. Modes Of Instruction By Total Percent Of Class Time

On average, Beatrice lectured two-thirds of class time (67%). Students, on average, worked individually on problems assigned by the instructor for 23 minutes. The time assigned to individual work increased by the end of the semester. Students were given opportunities to present their work during the first half of the semester, but these presentations stopped by week nine of the semester. Every observation included some discussion of class business, depending on the proximity of important dates (e.g., homework due dates, exams).

Episodes that contained mathematical work were only addressed during the instructional modes of lecture, individual student work, and student presentations. Episodes in which Beatrice presented the work to students were assigned to the lecture mode. Episodes in which students were asked to practice a set of problems were assigned to individual student work. Because students could work through assigned problems as they wished, one episode that was assigned to individual student work could contain multiple problems. Finally, if a student presented a problem to the class, I assigned the episode to student presentations. Episodes that did not contain mathematical work (e.g., important announcements, taking role, or reminders) were labeled as business.

Table 4 shows the number of episodes by mode of instruction in the selected observations. Most episodes occurred during lecture, which indicates that Beatrice presented a majority of the mathematics across all observations. Observation 5 has the highest number of episodes whereas Observation 8 has the lowest number of episodes. The higher the number of episodes indicates that more topics were discussed or more problems were worked on during that observation, decreasing the amount of time spent on any one episode. The lower the number of episodes meant that more time was spent on the episodes, rather than having a higher quantity of episodes. I recorded these episodes in a spreadsheet by observation. I used these episodes to describe various interactions during classroom instruction.

Table 4: Episodes Assigned by Mode of Instruction

Mode of Instruction	Observation 2	Observation 5	Observation 8	Observation 10	Total
Lecture	16	25	17	21	79
Individual Student Work	3	2	3	7	15
Student Presentations	3	1	0	0	4
Business	4	3	2	1	10
Total	26	31	22	29	108

Student Observation Surveys and Interviews

I thematically analyzed the student observation surveys and student interview transcripts through three levels of coding using an inductive approach: open coding, constant comparative analysis, and cross case analysis. During data collection, I performed ongoing analysis of the observation surveys and student interviews through open coding to find emergent themes (Merriam, 2009) that arose for each student, ensuring that these themes were followed up on during subsequent interviews. Some of these themes related to the levels of student interaction in the class, the amount of time students were given to practice problems during class, and the value of the mathematics that students were learning as it applied to their lives.

After open coding, I analyzed the observation surveys and student interviews in three phases. In the first phase of analysis, I used constant comparative analysis (Corbin & Strauss, 2008), developing six main themes. I found themes referring to (1) the overall quiet nature of the classroom community, (2) mathematical content as being central to moments that did and did not go well in the class, (3) the importance of the mathematics students were learning, (4) the way that the students viewed mathematics, (5) how students described their like or dislike of the various modes of instruction, including the use of ALEKS, and (6) how students described Beatrice as being a caring instructor.

In the second phase I performed a cross case analysis using structured, focused comparison. Cross-case analysis facilitates the comparison of commonalities and difference in the events, activities, and processes that are the units of analyses in case studies (Stake, 2006). Structured, focused comparison asks the same questions of each case (or student), which created a systematic comparison of the students (George & Bennett, 2005). The comparison was between students in the same course, and therefore it was important to highlight the ways that students talked about the same mathematical topic, event, or interaction within their instructional experiences. To start, I analyzed the observation surveys for the four observations in this dissertation, and then within, comparing the responses that students provided for the following items: (1) describe a moment in class that went really well, (2) describe a moment in class that did not go well, (3) describe a moment in class that was challenging, (4) select all of the different ways you participated in class today, (5) describe all of the people you interacted with in class today, (6) do you feel like a valued member of the MATH 5 mathematics classroom community today? and (7) Do you think the math you learned in today's class is useful for your future?

I used most of the responses during Interview 1 to describe the backgrounds of each student. I then compared students' responses to specific questions asked within each interview. From Interview 1 I compared student responses to Question 19 (see Appendix C). From Interview 2 I compared student responses to Questions 2, 2a, 5, 6, 10, 15, and 16 (see Appendix D). Finally, I compared student responses from Interview 3 for Questions 5, 6, 7, 10, 11, and 16 (See Appendix E). These questions related to the way that the students talked about the mathematics, to better describe moments that went well/did not go well during the classroom observations, the way that Beatrice taught, the classroom community, how they described interactions with others, and how they see the value of mathematics in their futures.

In order to answer Research Question 1 (How is instruction enacted in a developmental mathematics classroom taught by an adjunct faculty at a Hispanic-serving institution?), I looked across the instructional episodes to find examples of the various instructional interactions: student-instructor, student-student, instructor-content, and student-content. Using the modes of instruction as a guide, I pulled evidence from the episodes that highlight the themes that emerged across the four observations. Within the student-instructor interactions, the interactions were different depending on the instructional mode. For example, students who presented at the board had the most direct interaction with Beatrice. Within the student-student interactions, I observed that students were only able to interact during individual student work time, and most often students in the class chose not to work with others. Within the instructor-content interactions, I found themes related to the presentation of the mathematics as well as errors and imprecisions in the mathematics presented. For example, Beatrice presented the mathematics as a series of steps, without making conceptual connections to the work that the students did. Finally, within the student-content interactions, students applied the same step-by-step patterns of thinking to the problems that they worked on.

To answer Research Question 2 (How do Latinx learners perceive their instructional experiences in this developmental mathematics classroom at this Hispanic-serving institution with an adjunct faculty?), I reviewed the responses that students provided within their observation surveys and interviews. Themes that arose related to the way that students described participating in the instruction, while also describing ways that the instruction did or did not meet their needs.

Researcher's Stance

The main subjectivity I bring to this study is that of my identity as a white, female teacher of developmental mathematics. I also bring substantial experiential knowledge in this setting. Over the course of ten years, I have taught three different types of developmental mathematics courses to students like the ones who were central to this study. I was also a part-time instructor during these ten years, teaching at two institutions and for various summer-bridge and educational opportunity programs. Thus, I have been exposed to a wide range of departmental values and expectations implied for developmental mathematics courses.

As a white woman I have had different opportunities from those of the participants in this study, because our schooling institutions favor white, male-oriented, English speaking, heterosexual, and middle class perspectives (Yosso, 2005). I believe that it is imperative to acknowledge the injustices that occur when we favor these perspectives. "Whiteness," in particular, is the result of years of cultural practices in the United States that has favored the white male, and is everywhere in American culture (Lipsitz, 1995). Lipsitz further argues that "failure to acknowledge our society's possessive investment in whiteness prevents us from facing the present openly and honestly" (p. 384). This "whiteness" has constantly driven and shaped the schooling systems (Decuir & Dixson, 2004; Lewis, 2001), affecting aspects of schooling such as environment, resources, and students' identities as learners. For this reason, as a researcher in this work, it is important to make clear that I agree that this is true.

The community in which I was raised brought me into a culture that I feel is unique. I was raised in a working-class home in Los Angeles, California. The neighborhood that I grew up in and also the schools that I attended were extremely diverse racially, economically, and culturally. Because of my upbringing, I have developed a sensitivity to those who face hardships, challenges, and struggle and consider myself an advocate for all students. Due to the high volume of Spanish speakers in my local community, I learned to speak Spanish fluently. Although I speak Spanish fluently, I did not face the same discrimination that others may have faced because I am White. As a White woman researching Latinx students in developmental mathematics, my lens colors my analysis. I am a U.S. citizen, which makes it difficult for me to understand the anxieties of an undocumented student, although I am empathetic for their plight. While my father only completed school until sixth grade, my mother completed her bachelor's degree. Therefore, I am not a first-generation college student, which also limits my understanding of what it is like to navigate college without direct support from parents or other family members. There are other aspects of my subjectivity that were useful. As a daughter of an immigrant I can relate to the challenges I can relate to the challenges of a parent who experienced education in a different way. However, at the same time, I recognize that my father may have faced lesser hardship as an immigrant from a European, predominantly English-speaking country. Throughout my time as a student in higher education, I have needed to work multiple jobs to support myself and thus I am very familiar to the challenges of choosing between school and work life. Regarding the mathematics, I have never taken a developmental mathematics course and started college in second semester Calculus at a four-year institution. My experience with developmental mathematics is purely from the instructional perspective as the instructor of the course.

The factors that contributed to my path in education affect my perspectives in this research. Yet, I accepted the responsibility of being as objective as possible. Thus, it is important that as the principal researcher in this study, I disclose such prior experience so that readers may understand how my prior assumptions and experience may influence the approach and presentation of this study (Creswell & Miller, 2000). Because of my experiences (former teacher, white non-Latina woman), students in this study may have been guarded in describing fully the way that they experienced MATH 5. In order to manage this problem, I constantly member checked with the participants throughout the study in order to reach a good understanding of the meaning of their experiences and of any interpretations that I arrived at. I built rapport and strengthened relationships not only with the focal students in the classroom, but with most of the students in the class, to nurture a trusting relationship. I believe that having collected data for an entire semester, I was able to build and strengthen trusting relationships with the participants. By the end of the semester, all of the focal students commented that they were glad they decided to be a part of the study. Many of the students pointed out that they had never had an instructor show such interest or care in their experiences.

As a researcher in this study, I have the mathematical knowledge of the content in the course that I observed. Moreover, I am aware of the struggles that students may demonstrate with such topics including common mathematical misconceptions. This experiential knowledge helped me as I drew connections across the ways that students discussed the content, the challenges that they faced during instruction, and the importance that they attributed to the mathematics that they learned. My experiences with the content also helped me as I analyzed the instructor-content relationship throughout the observations, identifying errors, and differentiating between procedural and conceptual explanations of the material. My mathematical knowledge of the content also helped me to evaluate the level of rigor of the types of problems that Beatrice and the students completed during instruction, and the support that was necessary to complete such problems. As a previous part-time instructor, I also empathized with Beatrice throughout the study. I understood the challenges that come from being a part-time instructor, especially those of a newer instructor. As a math instructor, I recognize that we have good days and bad days, that grading can be overwhelming, and that keeping up a positive attitude can be extremely challenging when your schedule is completely consumed by the responsibilities that come with teaching at three different colleges.

Limitations

There are three limitations of the study. The first limitation is that I worked with a group of students different than myself, and thus my subjectivity had the potential to make my understanding of the students' experiences more difficult. To manage the potential of bias imposed by my subjectivity, I wrote memos (Maxwell, 2012) so that I kept at the forefront the topics that students discussed in their observation surveys and interviews. In particular, whenever I found myself making an assumption about the student's response, I wrote down questions to include in the subsequent interview or to use in a follow-up e-mail to ensure that I had clarity of the experience that the student relayed.

The second limitation is that the participants volunteered to be part of this study. Volunteer students may have had a higher sense of self-reflection or motivation than non-volunteers. Thus, I may have perspectives from a special set of students in this class and they, by no means, can represent the full spectrum of all students in the course. For example, eleven students (out of 40) dropped out of the course and 13 students passed it. Of the nine focal students in the study, one student dropped the course and 5 students passed the course. The proportions in my sample do not align with the overall course trends. I accepted all students who were interested in participating because it was important to gain access to the students who were willing to share their perspectives on classroom instruction. Given the dearth of information about experiences, having students willing to talk would provide valuable data that could then be expanded with a more comprehensive sample. To mitigate the impact of self-selection, I was intentional in selecting as focal students those who would provide a wide range of experiences so they could contribute to the richness of perspectives, as I argue that students' mathematics identities influences instruction. The perspectives from the nine students were diverse and did provide a view into the ways that students perceived their classroom instruction.

The third limitation relates to the various choices regarding data collection. I chose to be a non-participant observer. Thus I was unable to gain access to students' thinking about and to their individual work on problems during class. Even with the audio recorder in the room, it was very difficult to pick up any student conversations because whenever they did occur, they were quiet and intimate. During most student interactions, students compared papers and made corrections after working individually on problems, and did not speak up much even when working in pairs. To overcome this limitation, I specially attended to student thinking made explicit during student presentations. In addition, I looked at their quizzes and exams that showed work to infer some of their thinking.

Chapter 4

Environments Influencing the Study

This dissertation uses the MATH 5 course taught by Beatrice at Clear Water College to fully describe how instruction evolved and how it was experienced by a group of Latinx students in developmental math. In this chapter, I provide some characteristics of Clear Water College, and of the MATH 5 section that served as the context for the data collection for this dissertation. I provide information about the classroom where instruction took place, which, as we will see throughout acted as an enabler and barrier for interactions. I also provide information about Beatrice, the adjunct instructor who taught the course, followed by information about the focal students from whom I obtained data throughout the semester about their instructional experiences in Beatrice's MATH 5. In addition, a handful of students in Beatrice's MATH 5 were constantly mentioned by the focal students, and to facilitate the presentation of the findings, I've named them. I describe them as well. All of these characteristics shaped in more than one way how instruction was enacted in MATH 5 and how it was experienced by the focal students..

Clear Water College

The study takes place at Clear Water College[4] (CWC), an urban community college in California. The institution has over 30,000 students, and has been designated as a Hispanic Serving Institution; about half of the student population identifying as Latinx. The mathematics department consists of 30% full-time faculty and 70% part-time faculty and it offers courses ranging from basic arithmetic up to Calculus III and introduction to differential equations. About

90% of first time Latinx students at this institution enroll in developmental mathematics[5] but only about 30% of students who start in a developmental mathematics course at CWC successfully complete a general mathematics course. This means that around 70% of students who start in developmental mathematics do no persist to degree completion or transfer.

Students have only three attempts to take a course. If after the third attempt a student has not finished the course, he/she would need to enroll at a different community college to complete the requirement. The chair of the math department at CWC pointed out that this rule is not as bad as it could be. First, he pointed out that most students that attend CWC attend other colleges in the area. The state of California has about 100 community colleges, and in the particular region where CWC is located, there are about 15 other community colleges a student could choose within a 20-mile radius. Therefore, he believed that most students did not feel threatened by the three-attempt limit on the course. Second, other community colleges may have different requirements for developmental mathematics, so students can "shop around" to see which colleges has fewer requirements to complete the math course sequence. For example, a student could take the placement test at another community college and pass and with this continue his or her program. This would immediately trump the requirement at CWC that the student should take MATH 5 if the student transferred their transcripts from that community college to CWC. The chair said that "shopping around" was quite frequent for students at CWC.

MATH 5

MATH 5 is an Intermediate Algebra course at CWC. MATH 5 is the final course in a sequence of four developmental mathematics courses at CWC. When students arrive at the

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[4] All names of institution, courses, students and instructors are pseudonyms. Some information has been omitted to avoid possible identification that might be detrimental for the participants.
[5] This percentage is similar to the overall number of students who enroll in developmental mathematics at this college.

college they take a placement exam; the score on the test determines the mathematics course students must enroll in. Students could be placed in one of these four courses or students can place directly into a college-level mathematics course. The three courses below MATH 5 are non-credit bearing, and students receive a pass/fail for the course. While MATH 5 is considered a developmental math course, the students do receive credit for taking the course, and the letter grade affects their GPA. However, the course does not count towards their general education mathematics requirement and is not transfer eligible, which requires that students complete another college-level math course. MATH 5 includes topics such as solving linear, quadratic, rational, radical, exponential, and logarithmic equations; graphing linear, exponential, and logarithmic functions; factoring; and solving inequalities. The course can be taken in one semester or in a stretched-out format over two semesters. This organization of courses for developmental mathematics at CWC implies that if a student is placed in the lowest level developmental mathematics course, they could potentially need to take two to three years to reach college level mathematics, if they successfully pass all the courses on their first attempt. Upon successful completion of MATH 5, most students advance to take either introductory statistics or college algebra.

The Classroom

Beatrice's section of MATH 5 met five hours a week[6] for 16 weeks. Beatrice's section benefited from special departmental incentives that were given to two other sections in the department. Her students received free access to the ALEKS homework system; they had funding two catered meals that were meant to enhance the classroom, and twice a week they had an in-class tutor, a more knowledgeable Latinx peer who was in his final year at the college and planned to transfer to complete an engineering degree.

This section had an initial enrollment of 40 students, which was over the maximum number of 36 students. By the end of the course there were only 29 students enrolled. The classroom was split into two sides (see Figure 4). Each side held four rows of tables. Each row was made by combining two long tables and comfortably seated four students. At times there were five chairs in a given row, left behind by a previous class. There were a total of four table rows, which would seat 32 students comfortably. In the center of the rows there was aisle space so that students and the instructor could access their seats and that the instructor could walk to the back of the room. To make up for extra seating, there were eight or nine chairs lined up against the back wall of the classroom. These seats were often filled when a student entered the classroom late. These seats did not provide a writing surface for students, and many times students sitting in the back row did not have anyone sitting beside them.

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[6] Providing more information about the class section would compromise anonymity.

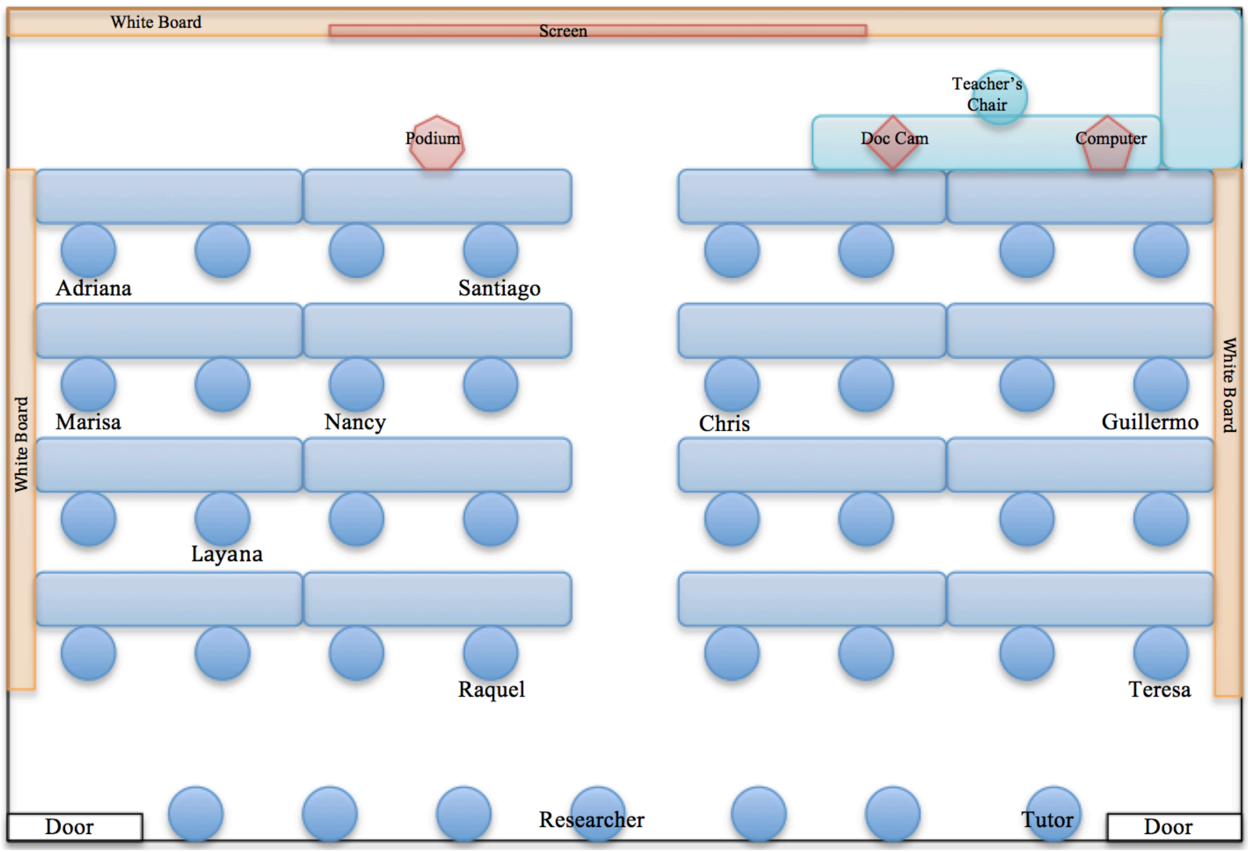

Figure 4. *Classroom Set-up. Nine focal students were seated throughout four rows of tables. A row of chairs lined the back wall. White boards surrounded the classroom on three sides. The instructor sat in the front of the room mainly using the document camera to project the notes. She also used the computer and podium on occasion. The tutor sat in the back in a chair next to the door.*

At the front of the class was desk space for the instructor. There were two rows of desks, similar to that of the students at the front of the class in front of the white board, as well as an additional desk against the wall. There was also a podium at the front of the classroom. At the instructor's desk, there was a desktop computer and a document camera. The whiteboard space was quite large, spanning from one wall to the other, and covering about two-thirds of the wall. There were also two whiteboards on the two remaining classroom walls.

The table set up for students constrained movement in the classroom. First, it was easier to access those students who sat closer to the aisle. That meant it was more difficult to access those students who sat closer to the wall. When the classroom had a large number of students, this became particularly challenging. Similarly, because the table rows were pushed up against the sides of the classroom, it made it so that the white boards along the side of the classroom unusable for those who were not sitting against the wall. The table groups also caused for students to face one direction—the front. While the chairs were detached from the tables, students did not turn their chairs to face other directions. This then constrained who the students were able to work with when they were given the option to work with peers. Most students chose to interact with the peers within their table row instead of working with students in the row in front or the row behind. The students in the class tended to sit in the same seats for the entire semester, which implied that if they did in fact choose to work with a peer, they tended to work with the same student.

Instructor

Beatrice was the only part-time instructor at CWC who indicated an interest in participating in the study. She earned a Bachelor's degree in aerospace engineering from a prestigious university. She originally wanted to major in mathematics, but her father convinced her that engineering would be a more lucrative choice. In graduate school, she decided that she wanted to focus on what her passion was, and completed a master's degree in applied mathematics in 2015. As a graduate student, Beatrice was given the opportunity to teach introductory math courses at the university for one year as a graduate teaching assistant. Upon graduation, Beatrice entered the teaching community as a part-time instructor at various colleges. This is her second semester teaching at CWC.

Beatrice was a young black woman. She was acutely aware of how she was positioned in the schooling system as a college student. She recalled many racialized and gendered experiences as one of only four black women in her entire engineering school cohort as an undergraduate student. Others constantly reminded her that she was the only black aerospace engineering student in the university. When she enrolled in her undergraduate program, she was automatically placed in a support program, which she believed happened purely because she was black and not based off her merit or capabilities. She faced multiple racialized encounters with faculty. A teaching associate once attempted to kick her out of office hours telling her, “These [office hours] are for aerospace students only”. Upon reflecting why he may have said this, “there are only two reasons that I can think of that [he] would say that. One, black. One, female. And there’s one other female in here, so that can’t be it” (Interview 1). Beatrice provided many other examples during her undergraduate program of isolation, struggle, and determination. While her experiences in graduate school were much better, she still faced racialized and gendered encounters with some male peers. However, she found support and collegiality with her professors.

Beatrice had quite a busy schedule during the Fall 2016 semester. She had recently separated from her husband, and because she needed to stay busy and to become financially stable and independent she chose to teach four courses (18 credits) at three different community colleges in the area, a larger load than what is customary (a regular teaching load is 15 units at one college). The distance between these colleges was large; she could be driving for up to three hours a day between campuses. She taught Intermediate Algebra, Trigonometry, and Calculus 2. Each campus had different expectations of her as a part-time faculty. For example, she had to attend professional developments within the department at each college and at one particular college (not CWC) return exams within a 72-hour time frame and be observed multiple times throughout the semester with intense evaluations. This resulted in her paying more immediate attention on the courses she taught at that campus. The types of courses she taught brought with them specific demands from the students. Students in the Calculus courses were more demanding and “rude” than the students she had in her trigonometry and algebra courses, which meant that she spent more time grading and preparing for her calculus classes. She also did not have a “home” at any of these campuses, meaning that she did not have one space where she could safely leave her books or materials. At CWC she shared an adjunct office space that contained 5 or 6 desks for the 70 adjunct faculty. She was not expected to hold office hours at CWC, so she did not. When students wanted to meet with her, they usually stayed after class to ask quick questions. Otherwise, she directed students to email her or to attend the math tutoring center on campus with questions about the content.

Because Beatrice was an adjunct faculty, she did not have the option of selecting her schedule. As an adjunct, the colleges offered her courses that they needed coverage for, so her options were to either accept or reject their offerings. This meant that she did not have control over the types of courses she taught or the times they were taught at. Beatrice considers herself a night owl and feels she would teach at her best if she were given evening classes. During the semester of the study, she taught all early morning classes, starting at 8 am. “I think that it does kind of catch me off guard sometimes because especially when [I’m] not fully awake, [I] don’t eat before [I] go or something, then I’m a little foggy” (Interview 1). Beatrice acknowledged that this was problematic because students often were tired and sleepy in the morning as well, which made it even more important for her to push through her grogginess.

Beatrice described her experiences teaching the students at CWC. While this is only her second semester teaching at CWC, she already had a sense of the types of students. Beatrice found that the students at CWC are more rude than those at the other colleges.

> Some students, particularly in my algebra classes are—they’re disrespectful in the way that, you know, you’ll make a mistake, or you’ll kind of bore them a bit, and they just do

> little high school things…I've noticed a lot more problems actually with the CWC students, versus the [ones at the other colleges]…I don't know if it's just 'cause they were more mature, or what. But I definitely noticed some behavioral issues with some of the students here. Talking in the middle of class, not staying focused, being openly on the phone, eating after I've said 'Don't eat.' Those sorts of things.
>
> Beatrice – Interview 1

Students at CWC tend to come from lower socioeconomic backgrounds, urban neighborhoods, and bring with them a broad range of previous experiences. The other college that Beatrice worked at is located in a more affluent area, the student population is less diverse and much smaller, and there are more resources than CWC. While she acknowledged that she understood students may be going through some serious life circumstances, she did not tolerate disrespectful behavior. Beatrice described a good student as one that is approachable, feels comfortable to correct her in class if she makes mistakes, and puts in effort outside of class time. She described two types of bad students, "there are students that do badly because they're not trying, and there are the students who do badly because they're just--for some reason it's not their subject" (Interview 1). The first type does not do anything. The second type may have struggles outside of class, may try to improve by getting tutoring, but for some reason still fail the course. She sees these students as different, but both are still doing badly.

Beatrice did acknowledge that she understood that students taking her classes at the community colleges have a lot going on in their lives. She referenced many interactions she has had with students in her one year of experience teaching at community colleges. She specifically recalled stories of her students from the class she taught at CWC from the previous semester. One of her students was attending classes at three different colleges in order to meet the requirements to transfer. This student also worked the night shift full-time to pay her bills. This student began to act out in the class, by drawing on the walls and not engaging in the lesson. She referred to another student who started to do poorly in her class only to find that the student was working three different jobs. In fact, these instances inspired her to give an anonymous survey to her students after their second exam to know what life circumstances may be getting in the way of their learning. “Turns out, a ton of people had multiple jobs. Some people had babies. Some people had family issues. And some of their issues are like, really serious” (Interview 1). Beatrice understood that there were extenuating circumstances outside of school that influenced students’ lives, motivations, focus, and persistence. Even after coming to understand the pressures students faced outside of the class, she felt, however, that perhaps students were acting immaturely about these issues. “They’re kind of acting out in class, but it’s probably still because some of them are pretty young. They’re not at the mature, adult level of just being able to talk about some of the stuff. Or at least behave even though things are going on in their lives” (Interview 1). In this sense, Beatrice seemed to think that students should be able to compartmentalize their out of class concerns when they are in the classroom.

Beatrice described her teaching style as lecture with scattered moments of having students work on problems. She admitted that she was still fresh to teaching, “so I’m kind of just overly worried about everything. Particularly, how am I doing? How are my students going to you know—How’s it gonna look, in terms of me, if my students do good or bad? Particularly my teaching style. It’s constantly improving, constantly changing” (Interview 1). She admitted that previously she would tell students how to do problems without any student interaction. She got feedback from students indicating that they are falling asleep because they were bored and unengaged. At this point in her career, instead, she gave a lot of examples with some moments of students working on tasks. This way her lecture was broken up into smaller chunks rather than one long lecture. She realized that it is not helpful for the students if they get overloaded with examples during lectures and it was also not helpful for her because she had to prepare a lot outside of class. At the start of the study, she was still trying to find a balance of this.

Focal Students

Table 5 shows information about the nine focal students of the study, organized alphabetically by student name. The students self-identified their gender; there were six females and three males. All students were enrolled at CWC as full-time students, and at the start of the term, none of the students were caregivers for any children or other family members. I define first-generation college student as a college student with no immediate family members (parents, siblings, aunts, uncles, cousins) holding a college degree. Six students identified as first-generation and three students were not[7]. For six of the students, this was their first time as a college student. Three students had previously taken classes at CWC within the last two years. All focal students were born in the United States. Adriana, Guillermo, Layana, Nancy, Teresa, and Santiago's parents were not born in the United States; they are first-generation citizens of the United States. Chris, Marisa, and Raquel's parents were born in the United States. Guillermo is the only student who aimed to finish his Associate's degree by earning a technical degree as an X-ray tech. All other focal students have the goal to transfer and complete a bachelor's degree.

[7] First-generation college students in this study are identified as those whose parents or guardians have not graduated with some kind of postsecondary degree (e.g., associate's, bachelor's). Some of these focal students have siblings who have attended college, but most have not completed a degree.

Table 5: Demographic Information of Focal Students

Student Name	Age	Gender	First Generation	First Year	Mother's Race or Ethnicity (Country of Birth)	Father's Race or Ethnicity (Country of Birth)	Hours worked per week	Educational Goals
Adriana	19	Female	Yes	Yes	Latino (Guatemala)	Latino (Guatemala)	21-30	Transfer to four-year university
Chris	21	Male	No	No	White (United States)	Mixed - Asian & Latino (United States)	21-30	Transfer to four-year university
Guillermo	18	Male	Yes	Yes	Latino (Mexico)	Latino (Mexico)	31-40	Two-Year degree
Layana	20	Female	No	No	Latino (Mexico)	Latino (Guatemala)	21-30	Transfer to a four-year university
Marisa	18	Female	No	Yes	Latino (United States)	White (United States)	11-20	Transfer to a four-year university
Nancy	18	Female	Yes	Yes	Latino (Mexico)	Latino (Mexico)	0	Transfer to a four-year university
Raquel	18	Female	Yes	No	Latino (United States)	Latino (United States)	11-20	Transfer to a four-year university
Teresa	18	Female	Yes	Yes	Latino (El Salvador)	Latino (Mexico)	11-20	Transfer to a four-year university
Santiago	18	Male	Yes	Yes	Latino (Mexico)	Latino (Mexico)	21-30	Transfer to a four-year university

The focal students in this study represent a range of students that attend CWC. Some students have commute times of up to 2 hours a day on public transportation, while other students have a car and drive 10 minutes to campus. The students' high school experiences were very different: some students had parents who helped get them into the best schools, some students went to multiple high schools, while others went to schools where they were under-resourced. Students describe their relationship with mathematics along three lines: they love mathematics, they hate mathematics, or they have a love/hate relationship with mathematics. The biographies of these students are presented next. For each student I describe their personal lives, their previous schooling experiences, and their relationship with mathematics.

Adriana

Adriana was a 19-year-old Guatemalan-American woman. Adriana was a first-year, first-generation college student. She lived with her mother and 13-year-old sister, sharing the apartment with two other men to supplement cost of rent. Her mom was born in Guatemala, and had Adriana after she moved to the United States as an adult. Her mom was not documented, and worked at a clothing factory where she was paid pennies for each article of clothing she made. Because her mom did not speak fluent English, Adriana often helped to translate important documents for her mother. Adriana commuted to CWC by taking public transportation, leaving by 6:30 am every morning to make it to class on time. Her neighborhood experienced frequent gang activity, but Adriana had become accustomed to learning to the violence that she experienced there, keeping her head down to keep her and her family safe.

Adriana attended three different high schools graduating with her diploma in five years. While she did not always enjoy the ways that she was treated while in high school (discussed more in Chapter 7), she was resilient and made the choices to ensure her graduation. She had goals to transfer and attend a prestigious university. Her career goals included being a mathematics teacher, a dental hygienist, or a registered nurse. While Adriana had originally planned to focus solely on school and did not plan to work, she picked up a new job during week 8 of the semester, working at a 24-hour Del Taco.

Adriana said she has a good relationship with math. She described being a visual learner, and preferred learning mathematics by watching her instructors present problems so that she can mimic and repeat the process for solving. Adriana had failed Algebra 1 in high school and took the course a second time. She recalled that her second instructor praised her abilities in mathematics, telling her that she was a really good math student and that he was surprised she had ever failed the course previously.

Chris

Chris was a 21-year-old man with Pilipino, White, and Mexican heritage. Both of his parents were born in the United States. His mother was White and his father was one-quarter Mexican and three-quarters Pilipino. His dad had a Bachelor’s, a teaching credential, and a master’s degree and was a physical education teacher at his high school. His mom went to a community college and worked at an insurance office. Education was important, and his mom was always checking on his grades and assignments throughout high school. His parents expected him to complete a college degree, but also helped to support him, as he became an adult. He lived at home with his parents while working around 30 hours a week at Panera. His three other siblings lived outside of the house. His earnings supported his personal bills, such as cell phone, gas, and car insurance. Having a car helped him to streamline his school schedule, work schedule, and time he devoted to church. He was aware of the how expenses could add up and tried to be frugal with his spending. For example, he did not purchase a parking pass, and instead chose to find street parking. He tried not to purchase the textbooks for courses, and instead used the set of textbooks available at the library.

Chris' Christian faith was extremely important to him. Prior to beginning his studies at CWC, Chris went through a two-year ministry program to strengthen his faith and to give back to others. This was Chris' third semester at CWC. Chris enjoyed heavy metal music and was majoring in History. When he started at CWC he placed into Elementary Algebra, a course just below MATH 5. He had plans to finish his associate's degree, and was forming plans to move to Norway with his girlfriend to finish his four-year degree. He chose Norway because he said they had a deep history of Black Metal music that mixed with the churches within the country. He also wanted to go to Norway to finish his degree because he had heard that higher education was free for youth there. He wanted to be a teacher, like his dad, and enjoyed going to school.

Chris did not feel that mathematics was overall a difficult subject but did admit that there were specific concepts, such as trigonometric functions, that were more challenging to understand. He felt that the mathematics that he learned in school did not apply to his needs in life, "Unfortunately I don't go around and see like algebra problems in my life so I'm not going around and looking for what x equals or y" (Interview 1). He appreciated learning concepts that were applicable, such as basic operations so that he could perform quicker as a cashier or how to read charts and graphs so that as a history teacher, he could help his students. Chris felt that it was important for him to be hands-on while in a math class and that he did not learn by watching others do the math.

Guillermo

Guillermo was an 18-year-old man, the son of Mexican immigrants. Guillermo was a first-year, first-generation college student. Guillermo lived with his parents and siblings. He moved around a lot as a child and felt that his parents were never really able to secure stable living for him and his siblings. Guillermo had a younger brother and sister who were attending Maple High School. Guillermo's parents struggled financially and he felt that this was the reason why they were never able to live in just one place. His dad worked at a can-recycling center and his mom worked two days a month cleaning a house. He felt that his dad was not financially smart and spent his paycheck as quickly as he received it, which often left the family with little money. His mother was afraid to search for more work because of her immigration status. she completed middle school but had to drop out because her family could not afford her education. Guillermo's dad finished elementary school and, while he could have continued through high school, he instead started working. Guillermo's mother constantly pushed him and his siblings to excel in school, "You have to do good, *mijo*. Because you have the opportunity, and I didn't" (Interview 1). Guillermo and his family were very religious and felt that the Christian faith provided them with the correct morals to abide by in life. Guillermo went to church every week, contributing as a youth leader and musician. At the time of the study Guillermo worked two jobs, around 30-40 hours per week, working for a local city's park system and also providing soccer training elementary school students in an afterschool program. Guillermo's goals included finishing his degree at CWC, buy a house, and bring his parents and siblings to live with him so he could provide housing stability for the family, something he did not have while growing up..

Guillermo went to two different high schools; he attended Spruce High School for 9th and 10th grade and graduated from Maple High School. Guillermo described himself as a very serious person, and did not like when teachers or other students messed around. He described moments in school when his teachers would act "silly" or his peers would misbehave, and he would be frustrated by those instances. Because of that, he felt that he didn't cooperate always with what was expected of him as a student. He described himself as a lone student, and pointed out that the expectation to be independent was what separated high school from college. He did not have any plans to socialize in college, focusing instead on graduating. Guillermo had a church mentor that inspired him to pursue a technical degree in medical imaging (e.g., radiology, MRI scans). Originally Guillermo wanted to pursue the police academy, but changed his mind after learning the difference in pay. His mentor was paid around $26 an hour and owned his own house. As a police officer, Guillermo estimated that he would make $18 an hour and would be putting his life on the line every day he went to work. He changed his mind just before graduation and his mentor guided him to know what courses to take in order to finish as quickly as possible and begin his career in the field. Guillermo recited all of the courses he needed to finish the program, and had already taken summer classes to advance forward. At the time of the study he was enrolled in four classes: mathematics, psychology, communications, and English totaling 14 units.

Guillermo felt that math was possibly his favorite subject. He felt that he was good at working on difficult problems. He took math during the first three years of high school: Algebra 1, Geometry/Trigonometry, and Algebra 2. He was upset because he was placed in Algebra 1 after changing districts between 8th and 9th grade, when he had just finished Algebra 1 in his previous district, earning an A in the course. He really enjoyed taking Geometry/Trigonometry because he felt it challenged him. He described how in 8th grade, he participated regularly, answering all of the questions to the point when the teacher had to ask him to stop so that others had opportunities. He changed his participation as he went into high school, and by 11th grade, he was silent and quiet in class, yet still helped those who sat near him; “I was pretty much the brain in that class” (Interview 1). He said that he did not mind helping other students, but that he liked to keep to himself because he did not trust much in others. He said that there is not one way he learns best; he said he can adjust to any way that his instructors choose teach. Guillermo preferred to work on problems individually for a while before asking for help from the instructor. He was a very independent learner.

Layana

Layana was a 20-year-old woman of Guatemalan and Mexican descent. She lived with her parents and younger brother, about 15 minutes away from CWC. She had two older brothers, one was in the military and the other had dropped out of high school and was struggling to find his place in the world. Her father had just recently completed his bachelor's degree, using his G.I. bill from the army. Her mother was also currently attending CWC, with the plan to complete her A.A. by the end of the fall semester. Layana had even taken some classes with her mom, and they were often thought of as sisters instead of mother and daughter. Both of her parents immigrated to the United States, and had very different experiences. Her mom came from Mexico with organized papers, flying into the country. Her father had a dangerous journey from Guatemala, crossing the border as a 13-year-old, caring for his two younger siblings. Layana worked for the YMCA and helped elementary school kids with their homework every day after school. Layana was recently engaged to her Guatemalan boyfriend, and described an ideal future with him as being married with children, but only after they had both completed school and had stable careers.

Layana was in her 3rd year at CWC. Her parents had made sure she had attended the best schools in the local district, and helped her as she transitioned to CWC. Because both of her parents had attended CWC, they were able to give her advice about what courses to take and what professors to avoid. Layana was placed in the second level developmental mathematics course and also into developmental English. That meant she needed to complete three developmental mathematics courses before she could take college level mathematics. She passed the first math course, but had to take the second course two times, and this semester was also the second time she was taking MATH 5. She had spent five semesters taking developmental math, which extended her time at the college beyond her goal of two years. Layana wanted to complete a degree in family counseling so that she could help others as the counselors at her high school helped her so much. She planned to transfer by the end of the academic year and ultimately wanted to get a Ph.D. in psychology.

Layana said that she did not have a very good relationship with math. It was a very challenging subject and she felt that it was the one she spent the most time on. She was not interested in the subject, and did not understand how what she learned in the recent courses would be used in her future work and life. Layana felt that math and English courses were always the subjects that students hated because they were so boring and were courses that students could not avoid. Layana felt that in order to understand the content she needed to practice a lot with the problems. She also needed a teacher that was very clear and provided clear explanations. Layana felt that she should be self-sufficient and deal with the challenges that came her way.

Marisa

Marisa was an 18-year-old woman with Mexican and White heritage. She lived with her dad and brother. Her parents had divorced when she was in 4th grade. She stayed with her mom a few nights a month, as she had done since the divorce. Her dad had custody of her and her brother because her mom did not have a steady employment record, and could not afford to support them. Both of her parents went to local high schools (Maple HS and Bay HS), and they both also attended CWC. Her dad finished his Bachelor's degree, and worked as an inspector for a major oil company. Her mother was of Mexican and Native American descent, but did not speak Spanish, and her father was White. Marisa was proud of her Mexican heritage, but recognized that she did not "look Latina." She had only been recognized as Latina one time in her life, describing that most people thought she was White. She did not speak Spanish, but felt that she could understand a few words. She identified more with her father's family because she saw them more often. Marisa worked part-time as a waitress at a Peruvian restaurant, and used her income to pay for her gas and to be able to go out with friends.

Marisa had high goals when she applied for college during high school. She was accepted to a large institution out of state, but realized that she could not afford the tuition, so settled on attending community college and focused on transferring later. She knew she wanted to move out of state and enroll in a program for occupational health or in psychology. Marisa was an athlete, playing water polo and was on the swim team during high school. This would often mean she would be away at meets on the weekends and would also have sometimes up to 5 hours of practice a day. She said that she knew that sports could have easily pulled her away from her school obligations, and because of that she put even more attention into schoolwork so that she was not left behind. Marisa took three AP courses in high school: Government, Literature, and Environmental Science.

Marisa admitted that she has always struggled with mathematics, but wanted to come into her first college math class with an open mind. She did not take mathematics beyond her sophomore year of high school. She took Geometry her freshman year and Algebra 2 her sophomore year. She felt that she did not take more math courses because the teachers that she had did not provide the right kind of support she needed. She recalled the last year she took math; she had many parent-teacher conferences with her teacher, which made her lose interest in continuing to take any more math courses. Marisa indicated that she learned best when she had an instructor that gave clear directions and worked through the math topics at a slow pace. She also felt that having an instructor who would spend time one-on-one with the students was beneficial.

Nancy

Nancy was an 18-year-old woman with Mexican heritage. She was first-year, first-generation college student. She lived about 10 minutes away from CWC with her parents and her 10-year-old sister. She has an older half-sister, 27, and a nephew, but they live out of the house with her dad's ex-wife. Her parents were both born in Mexico, but moved to Clear Water when they were infants. Nancy said they do not remember their lives in Mexico, and consider themselves to be born and raised in Clear Water. Both of her parents and both sets of grandparents spoke both English and Spanish fluently. However, Nancy only spoke and understood English, as this was the predominant language spoken among her family. Both of Nancy's parents graduated from local high schools, and both attended CWC at one point, but neither completed a college degree. Nancy's older sister also attended CWC, but finished cosmetology school at another community college in the area. Her parents met working at the same grocery store chain, where they both continue working, each managing a different store within the city. Her dad worked night shifts (1 am to 11 am) often coming home and sleeping for the rest of the afternoon, and her mom worked day shifts (6 am to 7 pm). However, her parents did not work weekends, and she felt that she was able to spend more than enough time with her parents during the week. Nancy described finding a routine to help her parents care for her little sister. She picked up her sister from school, worked with her on her homework, took her to dance practice, and then they corrected her homework when they got home. Nancy did not work while in high school, as her parents provided everything to her. Her main focus was playing softball; as long as she kept her grades up while playing, her parents would support her. Her regular schedule was dominated by the sport, and she was often at practice or at tournaments. She planned to continue to play softball for CWC (however, the season did not start until the spring semester), and recognized that her school schedule and practice schedule would keep her busy.

Nancy went to the same high school that her dad and older sister had graduated from. She even had some teachers who taught her dad. Nancy's favorite subject was English, and she felt that she really understood that subject well. She took three years of math in high school: Algebra 1 her freshman year, Geometry her junior year, and Algebra 2 her senior year. Her school had messed up her scheduling and she did not take math her sophomore year, which she felt affected her performance and motivation with mathematics when she returned took it junior year. Nancy was in honors and AP courses in high school: honors English, honors History, and AP psychology. She recognized that once any student was placed in the higher-level classes, they were automatically put in all higher level classes; "so they would put me in the higher level math and I'm like 'but I'm not a higher math level'" (Interview 1). This frustrated her more because she would watch her peers excel in math and she would struggle in silence without while not asking for help, because she did not want to be "that person" (Interview 1). Upon enrolling at CWC, Nancy was placed in both developmental English and developmental math as a first-year student at CWC.

Nancy hated mathematics. She felt that mathematics had never been easy for her and that even after taking so many courses, she never really fully understood anything. She felt that she had enjoyed it until she got to Geometry, her least favorite subject. She did not appreciate the working with shapes and figures, areas, volumes, and felt that the amount of formulas she was expected to memorize made mathematics challenging. She recalled also that in her Geometry class her teacher utilized a flipped classroom model, which did not work for Nancy. She wanted to see more traditional teaching, having a set of notes and having time for the teacher to correct her work. Nancy recalled that she felt that she needed more time than most students to understand mathematics, and that because of how fast lectures normally went in her classes, she was never able to really take time to think of questions she may have had.

Raquel

Raquel was an 18-year-old woman of Mexican-American descent. She was a first-generation college student and this was her second year in college. She lived with her mom, sister, and her 10-year-old niece. She had two older siblings who were 12 and 16 years older than her; the age difference gave her the opportunity to have a very close relationship with her mom growing up. Raquel's mom immigrated to the United States when she was 18-years-old, after finishing high school. Raquel saw her as both a mother and a father; Raquel's parents were never together and her dad recently spent eight years in jail before being deported back to Mexico. Raquel's mom had worked for a cleaning supply company but had been on disability for over a year due to being overworked at the company. They overworked their employees and she badly injured the muscles in her arm. Raquel needed to help her mom at home by lifting things for her, ensuring she did not injure her arm further. Raquel recently started working part-time at Jack-in-the-Box. She had a car, which helped her to get between work and school. Raquel also was in a serious relationship in which she invested a lot of time, and had convinced him to start college the next fall.

Education was an important topic in Raquel's household. She enjoyed her high school experience and felt that she had a lot of caring teachers. She took four years of math in high school, ending with Statistics. She was young for her grade, and started college when she was 17. She had started at a different community college the previous fall, and this was her second semester at CWC. She had to change colleges because the other college was so impacted that she was only able to enroll in one course the first semester she started. She always packed her schedule with 16 or 20 units so that she could transfer faster. Raquel was placed in the course just below MATH 5. In the previous semester she took an accelerated combined version of both the lower class and MATH 5; the first 8 weeks were for the first course, and the second 8 weeks were for MATH 5. She passed the first course, but missed the passing grade for MATH 5 by 3%, which meant she had to repeat the course. She aimed to transfer to a local university to complete a degree in interior design or architecture, inspired by the home remodeling shows she used to watch with her mom.

Raquel described having a love-hate relationship with mathematics. Her favorite subject was science, and she disliked reading. Math used to be her favorite subject throughout middle school. However, once she started high school she felt that the subject became too abstract and she felt less motivated as she had been previously. Her only motivation to pass the courses that she is required to take is so that she can complete her degree for architecture. She believed that she would need to know a lot of math in order to be a good designer, so she was trying to keep a positive mindset. She felt that with math she put in a lot of hard work and wanted her instructors to check in with her from time to time. She handled her frustrations with math by putting in more time and practicing more. She felt that she could handle anything, as long as she had the patience and perseverance to get through it.

Teresa

Teresa was an 18-year-old woman with Mexican and Salvadorian descent. She was a first-generation and first-year college student. She lived with her parents and brother about 35 miles from CWC. She commuted 2 hours one way to get to the campus, and her dad was able to drop her off for her Saturday classes. Her brother had enrolled at a university two years prior but had to drop out because he did not receive financial aid support, instead enrolling in another local community college. Her dad finished middle school in Mexico while her mom finished high school in El Salvador. She looked to her brother for advice when she enrolled at CWC and he helped her with her course selection. Her mom worked at a factory that packaged food while her dad worked as a painter for theme park rides, racking up many overtime hours; Teresa credited her dad's overtime work to why her and her brother probably did not qualify for financial aid. Teresa had a job at the start of the semester but her manager was not flexible with her class schedule and made her choose between the job or school. She picked school. She felt uncomfortable that her parents were her primary financial support, and wanted to start working again to rely less on them.

Teresa went to an urban high school that was composed of four "buildings" which each emphasized a different career trajectory. Teresa chose the public service building as an 8th grader, but did not really know the difference between the programs. Teresa described that once you were placed in the program, you did not have many opportunities to take courses that were offered in the other programs. So for example, if Teresa wanted to take AP Calculus, she would not have had the option to as it was not offered in her building. Teresa took three years of math in high school: Algebra 1, Geometry, and Algebra 2. School for Teresa was important because she knew without a college degree she wouldn't have a career, and instead would probably bounce around with low-paying jobs. Teresa intended to start at a university but she did not receive any financial aid from the state, which was the reason she enrolled in a community college. She was enrolled full-time taking four classes with the goal to ultimately enroll in the nursing program.

Teresa believed that she was “horrible” at math. She felt like she was a strong student in English and other courses that involved more writing and expression. She described failing Algebra 1 in her freshman year and also Algebra 2 in her sophomore year. She had to take summer school twice to repeat the courses. She believed that you were either good or bad at math. She described that her parents and brother were all good at math and her family often did not understand why she struggled in her classes. “I get frustrated when I can't get the concept right. So it's just like I give up easily” (Interview 1). The first time she felt good about her math skills was when she took Geometry during her junior year of high school and attributed that to the way her teacher presented the content. She was worried about starting the course at CWC because she had a one-year break since the last math course she had taken.

Teresa was the only focal student who had dropped MATH 5. While her family valued education highly, they valued solidarity to their family obligations more. Teresa’s uncle, who was undocumented, was detained in early November during the semester of study and ultimately deported, leaving behind his wife and two small children. Her aunt did not have a job, so they lost their apartment. Her aunt and cousins moved into her parents’ garage. Teresa’s parents expected that she would care for her cousins while her aunt tried to sort out her situation. Teresa tried to attend her classes, but had to make the difficult decision to drop most of them. She realized that she was not doing very well in MATH 5, and Beatrice had even sent her an email suggesting that she drop the class because her grade was too low to possibly bring it up to a passing grade. Teresa did not communicate with Beatrice about her personal situation nor did she ask for support for how to possibly fix the problem. However, she did speak with the instructor for her Reading course, and they were able to come up with a compromise for how Teresa could successfully pass the course remotely.

Santiago

Santiago was an 18-year-old man of Mexican heritage. He was a first-generation, first-year college student. He lived with his mom, his step-dad, and his sister in a house. His dad died when he was about 10 years old and he felt upset that he did not have a role model while he was going through those years of his life. His mom re-married a few years earlier, but he kept his distance from his step-dad, not wanting to get to close to him. Both of his parents were born in Mexico and completed middle school. His mom sewed clothes for a factory and received pennies per item she sewed. His step-dad was in construction, picking up jobs as he could. Santiago started working at a movie theater while in high school to provide things for himself that his parents couldn't. He found a store that would allow him to make payment plans on various items, such as a big screen TV, a laptop computer, an Xbox, and also Internet for the household. He felt proud that he was able to provide these things for himself. His job and CWC were not close to his home, and he often spent around three hours on public transportation between them. He normally worked late hours and would get home from work around 2 am, so he was worried whether or not he would be able to wake up to catch the early bus for his 8 am classes.

Santiago described himself as a "lazy" student. He wanted to get through classes by doing the least that he had to, but definitely wanted to pass his courses. He described how his "relax" time was important to him and that he preferred to be able to spend time the way he wanted to, and not be dictated by school. He took Geometry, Algebra 2, and Trigonometry in high school. He failed the second semester of Algebra 2 his freshman year, and thought he would not have to re-take it. At the start of his final semester, his counselor informed him that he would not graduate if it did not complete that semester of math, so his last semester of high school he enrolled in Algebra 2. He was frustrated and embarrassed because he was a senior in a class full of freshmen and sophomores. He described himself as being a mouthy student, which could be productive or not. For example, he was not afraid to speak up and volunteer responses, but he also described himself as the student that would say annoying things just to provoke others; he would always have a comment for everything and most often his teachers couldn't wait for him to leave his class. During high school he would make money off of doing his peers' work because he knew how to complete the work quickly. He described one time during his junior year when he charged his peers $20 each to complete a computer project. He made $120 for that project, and even went back to the teacher after graduation to let him know about his "business". He respected that teacher and the course because his teacher felt that he had real potential to get into computer software work. Santiago was not sure what he wanted to major in, but wanted to focus on engineering, aviation, or film-making. He said he enjoyed learning and wanted to get every degree that possibly existed.

Santiago had a love-hate relationship with mathematics. While he liked math when he was younger, he felt that it got more and more complex as he continued through school. The problems were longer, he understood its purpose less and less, and he felt that he was expected to do much more. He felt that he was a fast learner. He described his math classes in high school as being very social, and that he always interacted with his peers. He enjoyed working with others and felt it was the best way for him to learn mathematics.

Other Students in the Classroom

Because the focal students interacted with multiple people in the classroom, through the dissertation I reference other students that were mentioned by the participants in surveys or interviews. Larry, Rebecca, and Vanessa participated regularly during the lecture. Larry was a non-traditional, White student who had served in the military and was using his G.I. bill to attend college. Rebecca, a non-traditional student, was a White woman in her late twenties; she received the highest grade in the course. Vanessa was a first-year Latina woman and worked regularly with Nancy. Kio was a Japanese student who recently moved to the United States for college. She sat next to Adriana and they interacted with one another regularly throughout the semester. Aracely was a Latina woman who worked with Raquel throughout the course and at one point worked with Teresa. She dropped the course by Week 11, which left Raquel without a partner to work with.

Chapter 5

Personal Interactions: "Everyone is just so quiet"

Interactions with others, such as the instructor and peers, are important aspects of learning (Herbst & Chazan, 2012; Vygotsky, 1978; Wenger, 1998). The student-instructor section of the instructional triangle describes the interactions between students and the instructor during instruction whereas the student-student interactions refer to those that happen among students. The student-instructor and student-student interactions manifested in MATH 5 in various ways depending on the mode of instruction, but, as we will see in this chapter, for the most part, the student-instructor interactions were initiated and led by the instructor whereas student-student interactions were minimal. Student interactions with Beatrice consisted of her evaluating and correcting student work and leading the mathematical discussion. Student-instructor interactions increased dramatically by the second half of the semester, whereas student presentations diminished. Even during individual work or presentations when students were given more opportunity to lead discussion, Beatrice led those interactions. Most noticeable is that students felt that Beatrice showed genuine care for their learning and success. Student-student interactions were scarce and when they occurred students were extremely quiet. Students worked with the same peers throughout the course, essentially with the students who sat next to them. Students indicated that they felt that other students were closed off to interactions.

In this chapter I first describe the student-instructor interactions that I observed during each mode of instruction followed by the ways that students made sense of these types of interactions and the ways that they said those interactions supported or were barriers to their learning. I next describe the student-student interactions that occurred during each mode of instruction, followed by the ways that students made sense of these interactions and how they said those interactions supported or were barriers to their learning.

Student-Instructor Interactions

Student-instructor interactions occurred during three modes of instruction, lecture, individual student work, and during student presentations. I describe the interactions by mode of instruction because the type of interactions that occurred during these modes of instruction were different. The student-instructor interactions within the lecture were consistent throughout the semester. However, there was a change in student-instructor interaction during the individual student work time and student presentations after Week 9. The interactions during individual student work time increased, while the opportunities for student presentations decreased. Because the teacher is a valuable resource (Adler, 2000), it is important to note what opportunities students had to interact with Beatrice as well as what those interactions looked like (e.g., instructor-led, student-led). Similarly, students had more opportunity to apply their knowledge and reason independently during the modes of independent student work and student presentations. However, I found that Beatrice led most interactions across all instructional experiences, generally acting as the person who validated and corrected student work, validating and correcting their thinking. In this section, I will first talk about the interactions during lecture, and then talk about the changes that occurred during individual student work time and student presentations.

Lecture

When lecturing, Beatrice sat at the document camera at the front of the room, working through problems from a note packet that she prepared prior to the start of the semester (discussed in more detail in Chapter 6). The majority of the time Beatrice demonstrated problems, with limited interactions with students. When Beatrice demonstrated how to solve various problem types from the note packet, she often used the Initiation-Response-Evaluation pattern of interaction (I-R-E, Mehan, 1979). In this pattern, the instructor initiates discussion with a question, a student or group of students responds, and the instructor evaluates the response. For example, during observation 10, students were being shown how to rewrite $\log_3 81 = 4$ in exponential form. The following exchange took place during the lecture:

> Beatrice: So what comes first when I write exponential form?
>
> Student 1: The base.
>
> Beatrice: The base. And what is the base in this case?
>
> Student 1: Three.
>
> Beatrice: Yes, the base is three.

Beatrice and Student 1 – Observation 10

In this example, Beatrice initiates the conversation by asking students what would be the "first" step when thinking of rewriting as an exponential equation. A male student responds by saying "The base." Beatrice affirms his answer by repeating it, "The base." She follows up with another initiating question, "And what is the base in this case?" The student responds by stating the number three. The teacher validates his response again by affirming, "Yes, the base is three." She continues and finishes the problem, using the responses that the student provided.

During lecture, students were invited to engage primarily through I-R-E interactions. When Beatrice solicited student responses during lecture, Beatrice gave very little wait time (one to three seconds) for students to respond. She often selected the first correct student response and continued with the problem. If there was only one student response and it was incorrect, she normally corrected the response without rationale as to why the incorrect response was not right. With her limited wait time, there were also moments when Beatrice would respond to her own posed questions. Most times when students would respond, it would be quietly at their desk, while some students mouthed a response without vocalizing. Raquel, Teresa, and Layana sat towards the back rows of the class, and I frequently heard or saw them whispering or mouthing responses to Beatrice's questions or moving their pencil in the air which could indicate a mathematical operation. For example, during one of the observations, the instructor asked students what the first step would be when expanding $(\sqrt[3]{9}+\sqrt[3]{2})(\sqrt[3]{3}+\sqrt[3]{4})$. Layana made two swooping motions in the air with her pencil to indicate that there would be a distribution of some sort. While this type of participation was not vocal and was not in direct interaction with Beatrice, it indicated that Layana was in fact engaged in the lecture.

A few students, Chris, Larry, and Vanessa, tended to dominate the responses during lecture. They regularly and quickly responded to Beatrice's questions. During the observations, Beatrice would take the first correct answer generated by one of these students and continue with the problem. The response was given usually so quickly that there was no time for other students to consider Beatrice's questions, formulate an answer, and contribute it to the larger discussion. In addition, because Chris and Larry were two of the top three students in the class, their responses were usually correct. These behaviors combined did not leave opportunities for the rest of the students to engage in a productive struggle with the content.

Because of the way Beatrice structured her lectures, there were limited opportunities for students to engage with her that reflected their struggles, misconceptions, or sense-making. Beatrice attempted to cover two to three sections a class, moving at an average pace for a college course. As described in Chapter 4, the course required a lot of content, and in order to cover all of the content, she needed to teach multiple sections each class. She was sick for a few weeks during the first month of the semester, losing her voice at one point, so it was difficult to hear her during the lectures. When she could not speak much, Beatrice often lectured more, working through many problems without the help of students, which meant that the pacing of the problems was faster as students watched her work through the problem, without commentary. During lecture, all of the students faced the front of the room, copying what Beatrice wrote in the note packet. Most of the students did not respond to the questions Beatrice asked during the lecture and appeared busy by looking back and forth between the projection and their notes, presumably to ensure that they had everything that Beatrice had written. Beatrice rarely discussed incorrect student responses, taking only the correct responses given and moving on. Voicing of student thinking was limited to short sentences that contained some type of numerical answer; students were not seen explaining the reasoning supporting their answers.

The lecture structure that has been so far described attempted to bring students into the content that was being presented; at the same time, students engaged mostly through I-R-E patterns of interaction that did not make student thinking public. At the same time, a handful of students offered more than fill-in-the blank responses by actively addressing errors or seeking clarifications of the presentation of the material. In general the students appeared quiet, but they used gestures in responding to Beatrice's invitations to participate, which, while not discourse based, show an interest in being part of those interactions.

Individual Student Work

Individual student work, resulting from Beatrice asking students to work on a problem at their desks, provided more opportunities for interactions between students and Beatrice. I identified two markedly different structures for the individual work between the first half and the second half of the term. During the first half of the semester, Beatrice repeatedly told the students that if they needed help while working on the tasks they should raise their hand to call her over. Students would work quietly, with only a few pairs of students whispering quietly to one another. Beatrice sat at the document camera while students worked and only moved out to the tables when students raised their hand and infrequently she would move up and down the central aisle to reach some of those students. During the second half of the semester, Beatrice stopped sitting and the computer and walked by the students' desks, even reaching every single student. I describe the only two interactions that were observed in the first half of the semester, one in Observation 2 and the other in Observation 5. These interactions are brief, and difficult to make out, and address either content or calendar business. I next describe the interactions in the second half of the semester that included over 20 interactions in each, as Beatrice wanted to touch base with each student in both Observation 8 and Observation 10. These interactions varied by the students, with some lasting very few seconds and others lasting up to three minutes, and they centered on checking their work and some personal exchanges.

During Observation 2, there were no interactions between the students and Beatrice during the time students were working on problems. Towards the end of one of the instances where students practiced problems, Rebecca discretely struck up a conversation with Beatrice, as Rebecca sat right in front of her. Rebecca asked her a question related to due dates for the homework. Beatrice told Rebecca that she would need to update the calendar because they were completely off schedule. Beatrice laughed saying that it would be impossible for students to meet the deadline for the Chapter 2 homework because they had not covered much of that content yet. In Observation 5, Marisa raised her hand to ask Beatrice a question during the individual work time. The total time spent on individual student work during Observations 2 and 5 were 22 minutes and 14 minutes, respectively. The interaction with Rebecca lasted 1 minute 30 seconds, and the interaction with Marisa lasted 22 seconds. Even when students reached out to Beatrice, the interactions were short.

During the second half of the semester, the quantity and type of interactions between students and the instructor increased. The first noticeable change had to do with where Beatrice stood while students worked on problems. Rather than sitting at the document camera as she did in the first half of the semester, she walked around the room, after assigning the students a problem to work on and waiting between 30 seconds to a minute for students to start working. She usually started in the front left with where Adriana sat, or in the back left corner where a Latinx man sat. During this time, she would carry around with her a post-it note pad and a pencil so that she could write notes or demonstrate steps in a procedure to students without writing on their notes directly. While she walked around, she peered at students' work and occasionally asked, "How's it going?" when passing by. Most often, students silently turned their papers to her, she read through their work, and made corrections or clarified the concept at hand. Very few times students asked her a specific question about the problem. Sometimes after looking at their work, Beatrice would provide a comment: "That's good, now just see if it can simplify" or "Make sure you check your answer" (Observation 8). During observation 8 and 10, Beatrice made a point to interact with almost all students in the classroom by specifically walking through the rows.

In spite of Beatrice's efforts to increase her movement throughout the classroom and to engage with students during individual student work time, the students did not talk much to her. In fact, Beatrice did most of the talking. Sometimes students would sit with their pencils down and wait for her to walk by. When Beatrice did come by, students would inform her that they did not know how to start, and Beatrice would then write the first steps of the problem out on their notes and leave the student to continue their work. This practice of walking around the classroom became routine during the second half of the semester.

Because the increase of student-instructor interactions from the first half to the second half of the semester was so remarkable (in Observation 8, the instructor interacted with around 20 of the 24 students in the class by walking around and going into the rows of desks), I asked what triggered these changes. She reiterated the need for her to reinforce the expectation that students work on the problems when she asks them to, but also her concern with her students' performance on Exam 1:

> Beatrice: It's why I walk around the room more often and stuff than I used to. Because I found with all of my classes, actually, no matter what level, if you tell 'em, "Alright, guys. Do this practice problem," and you stand at the front, normally they're just looking at you, like acting like they're jotting something down and just waiting for you [the instructor] to write it out. So the more I've been walking around each one of my classes, I find those students who are like, "Oh no. She's coming!" And then they start writing the problem down really quickly and actually have a question. "Oh, well I didn't know about this part. What do I do next?"
>
> Researcher: When did you start to kind of transition to walking around the room more? What triggered that?
>
> Beatrice: Hmm. For this class, [*pauses*] probably somewhere right around Exam 1… So after Exam 1, I started really pushing them […] I definitely started walking around after Exam 1, because Exam 1 was just ouch, in terms of [results].

Beatrice – Interview 2

The average un-weighted percent score on exam 1 was 35% (33% for the focal students). While she did imply that walking around and checking on students is always necessary to get students engaged with the mathematics, she admitted that she only really started to do this after she saw the results of Exam 1, which were revealed during Week 9. This change in Beatrice's behavior while students worked on practice problems provided more opportunities for students to ask specific questions about their work, by interacting with Beatrice on a one-on-one level, even if this change happened for less than half of the semester.

Student Presentations

The frequency of student presentations diminished as the semester progressed (see Figure 3). Student presentations always occurred directly after individual student work time. During class presentations, a student went to the board, wrote their work for the given problem, looked to the instructor for validation, and then returned to their seats. Most times, students stood directly in front of their work, so it was difficult to see what they were writing. The interactions with classmates were non-existent. In general, these interactions benefited mainly the presenter. I describe the strategy that Beatrice used to send students to the board, from Observation 5, as there were no more presentations after.

During Observation 5, the instructor again asked for students to volunteer to present their work at the board. Marisa raised her hand, but Beatrice told her she wanted to have someone else come up. Because no other student volunteered to present their work, the instructor played a "Duck, Duck, Goose" game to choose the student to present. When she did this, some students immediately started to whisper to their peers sitting next to them and looked at their work. Nancy turned to look at Vanessa's paper while Santiago turned around to observe their conversation. Raquel and Layana also turned to look at the papers of their classmates who sat next to them. Other students looked anxious. During the game, Beatrice walked around the room, pointing to students calling "Duck" until she selected the student she wanted to present at the board, saying, "Goose!" Beatrice selected a male student who sat in the back of the class to present his work, but the student told her he had not finished factoring the trinomial. Beatrice told him to come to the board anyway and that she would help him through the problem.

In each of these presentations the students spoke directly to Beatrice and looked to her for validation of their work. The students did not turn out to face the classroom and did not speak to their peers. The presentations turned into a more intimate interaction with Beatrice because the presenting students were getting more direct acknowledgement and critique of their work (more of this will be discussed in Chapter 7). Common within each of these presentations was that the audience received reaffirmation of a correct solution with a little back and forth between the presenter and the instructor about their thinking and no interaction between the presenter and the class. This emphasizes the intimate nature of the exchanges between the student and instructor for each presentation, though the presenter's thinking was not always explicitly made clear, but rather was corrected or if already correct, the presenter's work was accepted without further discussion.

The students sitting in the audience of the presentations had limited interactions with both the presenter and the instructor. Whenever there were questions posed by the students in the audience, they were directed to Beatrice, and not to the presenting student. Often, Beatrice rephrased or emphasized the way a presenter described a particular operation. During two of the presentations, Beatrice asked the class a question while the student, presented. In one instance, Rebecca had made an error in her solution, and Beatrice asked the class if anyone caught it. Santiago and Vanessa both raised their hands. Beatrice called on Vanessa, who was unable to describe the error. Instead of asking for other thoughts from the class, Beatrice pointed out the error in Rebecca's work. During the student presentation in Observation 5, Beatrice asked the class to help find the factors of 54. In both of these cases, students responded to Beatrice, not to the presenter. Other than those two opportunities for engagement with the presentation, students in the audience were on their phones, whispering to one another, or staring forward while their peer presented his/her work. It was difficult to see the board work as presenters wrote on the board; many times students would not turn to look at the board until the presenter walked back to their desk. Because the students had already worked on and/or completed the four problems demonstrated in the presentations, not many students copied presented work on the board. Therefore, the student presentations did not engage the audience members at the same level as it did the presenter at the board.

Student Perspectives on Student-Instructor Interactions

The focal students described interactions with Beatrice in the observation surveys and during the interviews. In this section, I start by talking about the perspectives that students had in regard to their interactions with Beatrice during the lecture, individual student work time, and student presentations followed by discussing how the focal students described Beatrice's caring attitude towards them: the focal students felt that Beatrice showed a genuine care for their learning and success, a theme that emerged strongly as the semester progressed, from student observation surveys and during student Interviews 2 and 3.

As I described earlier, the modes of instruction shaped the opportunities and ways that students were able to interact with Beatrice. In order to organize their perspectives on their interactions with Beatrice, I structured their responses according to the modes of instruction. The focal students described their interactions with Beatrice during lecture to be contained to responding to her prompts, asking questions, correcting her work, or not interacting at all. Students described the most opportunity for interacting with Beatrice when they were given individual student work time. The students who presented said they had direct interaction with Beatrice during this time. Finally, a theme arose in ways not seen specifically in any one particular mode of instruction. Students described the sense of care and concern that Beatrice demonstrated to them through various ways: by making comments during the lecture, by what she would say to them one-on-one, by extending deadlines, or by showing her personality in the class.

Lecture

In the student observation surveys, all students marked that they participated during lecture by copying what the teacher demonstrated and also by writing down what the instructor said out loud while demonstrating the problems. Beyond this, five focal students said that they regularly participated during class by providing responses to Beatrice's questions. Three of those students also admitted to catching and correcting mistakes that Beatrice made during the lecture. The remaining four focal students marked that they did not participate during the lecture. Finally, during student interviews, four students said that there was too much lecture during the class, and this inhibited their ability to learn by putting into action the mathematics that they were learning.

Five of the focal students indicated that they interacted with Beatrice during the lecture. Chris, Santiago, Marisa, Layana, and Adriana relayed in their surveys that on more than one occasion during the four observations days, they actively provided a response to the lecture when the instructor asked the large group. The students participated during the lecture in various ways. Adriana and Santiago sat in the front of the class and felt that by sitting there, they could interact with Beatrice during the lecture. Adriana said that she provided quiet responses to the questions the teacher would ask, and knew that the teacher could hear her because every now and then Beatrice would look her way and make eye contact with her after she provided a response. Santiago said that because he sat in the front of the class, Beatrice could hear him when he gave responses to questions she asked during the lecture. When Santiago was not tired from his work shift the night before, he tended to be the class jokester, and often made funny side comments during the lecture, directed at Beatrice. Every now and then, Beatrice would laugh with Santiago about one of his comments. For example, during Observation 5, after a student presentation, the document camera would not turn back on, and Beatrice got a little flustered. Santiago made a few jokes and while Beatrice tried to get it to work, he said perhaps the class should be released early. Beatrice laughed and the two exchanged a few words. Adriana and Santiago felt that by sitting closer to the front, they were able to interact with Beatrice more during the lectures.

Chris, Marisa, and Layana marked that they interacted with Beatrice during the lecture by asking questions. The students asked two types of questions: clarifying questions about presentation of work and conceptual questions about the mathematics. Marisa's and Layana's questions were about Beatrice's expectations regarding presenting work. For example, in Observation 8, Marisa raised her hand during the lecture and asked Beatrice, "Sorry. If on the test, if it looks like that *i* is underneath the radical are we going to get marked down for it? Like should we just do something to separate them? Or will you accept it?" Chris described having a specific philosophy around the purpose of asking questions: if you do not know something, then you should ask questions. He realized that in order to learn, he needed to ask questions. He felt that his role in the class was to be the one who asked questions in order to help others in the class who were uncomfortable to do so. Chris interacted with Beatrice more than any other student during lecture, asking the most conceptual questions. During Observation 10, Beatrice had finished describing logarithmic functions as inverses to exponential functions. She had described to students to always pick *y*-values when plotting logarithmic functions, and *x*-values when plotting exponential functions. Chris asked for the rationale behind why she knew when to pick specific values, "How come we're picking *x*-values instead of *y*-values?", later stating in his observation survey that he was uncertain why she approached both functions differently. In all, the majority of questions asked were not deeper mathematical questions about the content and instead clarified steps in procedures or the presentation of the work. This may relate to the fact that the lectures moved at a quick pace, causing students to focus more on ensuring that they copied all of the work down with little time to digest what they were observing.

Another form of interaction between students and the instructor was based around the errors she made. Chris, Layana, Santiago, and Raquel described catching the instructor’s mistakes during the lecture. Chris would often raise his hand and ask Beatrice questions that drew attention to the mistake, such as “How did you get that answer, again?” whereas Santiago and Layana would generally point out the error in the value (e.g., “Wait, isn’t that 75?” Santiago, Observation 5). Raquel said that she would not immediately correct Beatrice if she saw her make a mistake because she was afraid that perhaps she had not followed the work correctly herself. Beatrice always considered the questions that students posed regarding errors she may have made, and reviewed her work at the board to verify where the error took place. The students felt good about themselves when they were able to catch Beatrice making mistakes.

Nancy, Raquel, Teresa, and Guillermo indicated in their surveys that they copied what Beatrice presented without regularly participating. Nancy described only one moment in which she partially described that inverse functions mirror each other when graphed (she did not say about the line $y = x$, and Beatrice did not correct that), but otherwise did not participate during the lecture. Guillermo, who self-described as a very quiet and shy person, preferred not to speak during class. Raquel and Teresa sat in the back of the classroom and acknowledged that they did not contribute to the lectures. Teresa described that sitting in the back excluded her from participating because Beatrice only looked to the first row or two when she spoke to the classroom. Although these three students indicated that they did not interact with Beatrice during the lecture, I observed all three students silently mouthing responses to Beatrice's questions. Raquel also commented on the errors the teacher would make or would move her pencil in the air to provide a response to some of Beatrice's questions. It appears that these students considered interactions with Beatrice during lecture to be audible vocal contributions, such that Beatrice acknowledged their responses. However, the students found other ways to interact with her questions, even though Beatrice may not have seen their engagement.

Thus, in describing their perceptions of their interactions with Beatrice during lecture students showed an interest in complying with the expectations that Beatrice set out for them: by responding when asked (e.g., filling the blank) or correcting errors as they saw fit, but also by not participating (because the limited wait time set the expectation that no answer was expected). These perceptions were also shaped by where students sat in the classroom. Students who were closer to Beatrice felt they had more access to her and this resulted in more interactions, whereas students sitting in the back recognized that it was harder for them to interact Beatrice.

Individual Student Work

Six students described their perceptions of their interactions with Beatrice during individual work time. The students either liked or didn't like their one-to-one interactions with her. Adriana and Marisa liked the amount of opportunities they had to interact with Beatrice, yet used their time differently when interacting with Beatrice. Guillermo on the other hand did not like how often Beatrice spent one-on-one time with students because it took time away from learning new material during the lecture. Nancy, Teresa, and Raquel did not like interacting with Beatrice during individual work time during the regular class and preferred the one-on-one time in the computer lab. This was because they had more time to develop their questions during the computer lab given that the entire class session was spent working on problems.

Adriana and Marisa said that Beatrice provided enough one-on-one time for their learning needs. However, the ways that both students interacted with Beatrice during these interactions were very different. While Marisa regularly initiated interactions with Beatrice and asked her pointed mathematical questions, Adriana relied on Beatrice to initiate interactions with her and used the time to have Beatrice check her work. Adriana described her interactions with Beatrice during individual work as narrowed to one purpose: to validate her work. Adriana did not talk to Beatrice much when she stopped by during individual student work time, and only ever asked Beatrice to verify whether she was doing the problem correctly. Marisa on the other hand raised her hand frequently to ask Beatrice for help when she had challenges on the problems they were given. Marisa would usually have a question in mind about what she was struggling with, knowing that Beatrice would stop by her desk at some point in the class. She appreciated that Beatrice would review her problem and correct her errors or validate that she had completed the problem correctly. Marisa felt her interactions with Beatrice were opportunities to demonstrate that she was genuinely trying to do well in the class and was happy to have more time one-on-one with Beatrice during the second half of the term.

Guillermo did not like having so much interaction with Beatrice. He saw college as different than high school. In high school, he appreciated the one-on-one time with the instructor only when he really needed it. In college, he did not feel it was appropriate for anyone to ask for individual time from the instructor one-on-one. In considering why he did not ask Beatrice for help he said:

> As I see the professor going one-by-one, I don't really want to waste the time. Imagine if she's taking a little longer with me, [then] 5 minutes with another student. We're not gonna really go on with the section. So if she explains it like, to the whole class…in one certain time. Like, in 5 minutes, she explains it to the whole class, then I think that's a lot better 'cause then we could start moving onto something else.

Guillermo – Interview 2

Time was valuable to Guillermo. He was a no nonsense type of student, and wanted to spend class time efficiently. In his opinion, taking time to work one-on-one with the instructor was not an effective use of the class' time, and took away from everyone's opportunity to learn new content. He felt the students could practice problems outside of class. Given this, he limited his interactions with Beatrice. Similar to Adriana, whenever Beatrice came by, he showed her his problem, took her feedback, and let her move onto the next student. He did not want to extent her time with him by asking specific questions that he could learn later.

Nancy, Teresa, and Raquel preferred to interact with Beatrice during the classes that they spent in the computer lab. Nancy and Raquel felt that the level of instructor interaction during the regular class meetings was too limited because they spent more time in lecture than practicing problems. Raquel felt that the few classes that they spent in the computer lab working on ALEKS provided more opportunities for students to interact with Beatrice. During these days, Beatrice lectured less and spent a majority of the time helping students when they needed it. Nancy described that during the computer lab, she could ask Beatrice for help on specific math content that she was struggling with, unlike in the regular classroom, where all the students were assigned the same problems. Teresa also interacted more with Beatrice in the lab by sitting as close as she could to Beatrice in the front of the room. She could then easily call on her to help walk her through the ALEKS problem she was having difficulties with. Nancy and Teresa felt more comfortable interacting with Beatrice in this setting, and because fewer students were present they were able to spend more time with Beatrice.

During the first half of the semester, the interaction with Beatrice only occurred if the students initiated it, drawing attention to the student who asked for help. This is the reason Adriana did not call on Beatrice, as she feared showing that she needed help, even though it was important for her to get validation of her work. I also believe that Teresa and Nancy feared showing that they needed help during the regular class session, which is why they preferred to interact with Beatrice while in the computer lab. During the time spent in the computer lab, all of the students were occupied with their work on ALEKS, and each student was working on a different problem, whereas in the regular class, students were all assigned the same problem, which meant that asking for help would alert their peers that they were struggling with that specific topic. I believe this structure helped encourage Teresa and Nancy to ask Beatrice for help during the time spent in the computer lab without calling too much attention to them. Because Marisa felt comfortable with Beatrice and in fact wanted Beatrice to see her efforts, she did not have a problem calling on Beatrice during the regular class time. All four students appreciated when Beatrice began to walk around the room during the second half of the semester as it meant they did not need to call on her, and could expect to have time with her while working on the problems.

Guillermo was unique in his perspective of why he did not want to interact with Beatrice while he practiced applying the concepts he learned from the lecture. His mental image of college mathematics included fast paced presentations and an expectation that students figure things out on their own; he made it very clear that college was different than high school. He was the only student who considered that by taking time to interact with the instructor it took time away from the larger picture, and time spent learning more content.

Taken together, the perceptions of students' interactions with Beatrice during individual time show a more nuanced set of experiences and feelings towards that participation than what was gleaned through their discussion of the interactions during lecture. Some students boldly initiated the interactions, others were afraid of appearing incompetent to both Beatrice and their peers, others wanted validation from Beatrice for their work, others wanted to be seen by Beatrice as competent, yet others cringed at the idea of taking valuable time that could be devoted to the lecture that would support everyone in the classroom. Beatrice's change to walking around the classroom mediated some of the feelings that students indicated. For example, students who said they were intimidated to initiate an interaction, were now relieved of the responsibility because Beatrice showed up. In the end, from the students' perspectives, a favorable outcome of Beatrice's increased engagement was that they felt more validation about their competence in doing the mathematics required in the class.

Student Presentations

While there were not many comments on interactions with Beatrice during student presentations, I identified two different themes in the comments: anxiety that she may select a student to present and that the presentations were only beneficial to the presenter. Layana, Raquel, and Teresa described feelings of anxiety when Beatrice used the "Duck, Duck, Goose" method of selecting presenters. Chris and Marisa, who often volunteered to present their work, described the presentations as being beneficial for the presenter due to the attention their work received from Beatrice.

Layana, Raquel, and Teresa felt anxiety when Beatrice selected students for the student presentations. Layana said it was awkward when Beatrice picked students using the "Duck, Duck, Goose" game, believing that when students did not raise their hand to present their work at the board, it was because no student knew what they were doing on the problem, and were lost. Therefore, she felt that many students were uncomfortable because they could be chosen without having done the problem. Raquel agreed that the "Duck, Duck, Goose" game generated high anxiety among many students. However, if she was selected and did not have the correct work on her paper, she would go and present because she knew that Beatrice would provide support up at the board. She recalled a moment when she made a mistake in her work on a day when she presented a problem to the class, early in the semester. Beatrice corrected her mistake in front of everyone, and Raquel felt embarrassed, “but at the same time, there was probably more people that were just like me. So… it didn't really matter, but it helped me as well” (Interview 2). When Beatrice would run around the room calling “Duck, Duck, Goose”, Teresa described turning to her peers to quickly compare her answer with others around her. She was afraid of being selected and having the wrong answer. While she did not ever want to present her work, she was especially concerned about being selected to present if her work was incorrect.

Chris felt that each presentation at the board mainly benefitted the presenter because Beatrice provided direct input and feedback for the presenter’s work. Once he noticed this, he decided not to take all of the opportunities that were available to present at the board, and instead began to volunteer less and less in order to let other students have the benefit of receiving Beatrice’s feedback. Marisa said she volunteered to present in order to have an opportunity to show Beatrice her work. Because there were fewer opportunities to work individually on problems, Marisa came to understand student presentations as opportunities to get feedback and to show Beatrice that she could successfully complete the practice problems. In fact, Marisa had volunteered too often and Beatrice had told her she would prefer others to present. “I felt good when our professor told me I didn't have to do the problem on the board. It let me know she had confidence that I was going to do the problem correctly” (Marisa, Observation Survey 5).

Students’ perspectives on student presentations revealed that the way in which Beatrice selected students to present might have heightened some students’ anxiety regarding their own mathematical competence. Students felt that Beatrice’s choice did not honor that students may not want to be publicly exposed as not knowing the material. While some students did not feel that anxiety it seems that the strategy was in general, not appreciated. Students also keenly noticed that in this setting the only ones who benefitted from the interactions during presentations were the presenters; it was like a one-on-one interaction of which the rest of the students of the class did not have much access to; they were observers. At the same time, some students indicated that they did not want to present, unless they could be reassured that their work was correct, which reaffirms that they wanted to receive Beatrice's validation about the quality of their work.

"It Seems Like She Does Care"

Not specific to any one mode of instruction, the focal students brought up that they felt that Beatrice's actions showed that she really cared about her MATH 5 students and their success. The students mentioned comments Beatrice made that demonstrated that she wanted them to succeed. Adriana, Santiago, Layana, Marisa, and Guillermo believed that Beatrice really cared for all of the students. Adriana reflected that "[Beatrice] said it herself, 'Oh, I want you guys all to succeed and to pass my class.'" (Interview 3), telling the students regularly that she wanted to see them succeed. She felt that Beatrice put these words into action by allowing extensions on homework and by lowering the necessary number of topics on ALEKS. One particular day in class, another student who often sat next to Teresa in the back of the class caused a scene by talking back to Beatrice. Adriana reflected on this moment and could sense that Beatrice was upset by the student's lack of respect and could see how much Beatrice cared for all of the students in the class because of how upset she appeared with Johnny. Adriana felt that if Beatrice did not care for her students, she would not have even reacted to the student in the back. In multiple surveys, Santiago mentioned that he felt that Beatrice constantly made him feel that she wanted everyone in the course to improve. He felt that Beatrice was very caring and enthusiastic and that "she [sought] improvement of ourselves [*sic*], not just because it's her job" (Survey, Observation 8). In particular he noticed that she supported them by checking in on students as they worked. Reflecting upon her teaching, he said that, "She worries about like, everybody… so if you were to come up to her individual[ly], she would help you with that" (Interview 2). Santiago said this was the sign of a good teacher. Both Adriana and Santiago pointed out that Beatrice always tried to say little jokes here and there to keep students alert and engaged, although they never laughed at her jokes. They both agreed that they enjoyed this aspect of Beatrice's interactions that showed her personality and that she was human too.

Layana said that she had not yet had an instructor at CWC who showed as much care as Beatrice did. She recalled her most recent instructor who she had the previous semester for MATH 5. When she spoke with this instructor about her struggles or grades, the instructor would place the blame on her. For example, the instructor told Layana that she was working too much, and that she should reorganize her schedule such that school is the focus. However, Beatrice always encouraged Layana. "You can genuinely see she cares about the students" (Layana, Interview 3). Marisa reflected on the negative experiences she had with her high school teachers:

> It was really frustrating. It didn't help that I didn't feel like I could go to my [previous] instructor for help because they would just look down upon me. So it's really nice to have someone who actually thinks that I can do the work and more so like, I feel like [Beatrice] believes in me…I feel like she does.
>
> Marisa – Interview 2

Marisa felt comfortable enough to call Beatrice over to ask questions and did not feel ashamed to do it as she previously did in high school.

Guillermo reflected on his decision to drop two of his courses during the semester, and described how this math class was one of the courses he kept in his schedule because of

Beatrice's concern for her students. He needed to drop two courses because he had picked up more hours at both of his part-time jobs and did not have the time to focus on four classes. When the decision came to which classes he would drop, it came down to how caring the instructor was. Guillermo decided to drop his Communications course because he felt the instructor did not understand Guillermo's needs and did not provide him the right level of support. For example, there was a time when he needed to leave early and the instructor, without looking up at Guillermo, told to him that he did not care if he was there in class or not. Guillermo said that this bothered him, as he wanted to know that the instructor showed concern and care, while still understanding his needs. "Like, at least look at me, in the face." (Interview 2). In contrast, Guillermo said that Beatrice demonstrated professionalism by providing focus and attention on the math content at the same time that she demonstrated that she believed the students could pass the course; Beatrice's actions made him feel super confident when he went into the final exam (Observation Survey 12).

Raquel was not as positive regarding Beatrice's care as her peers. Raquel said that perhaps this was because she did not talk as much with Beatrice. Instead, Raquel thought that Beatrice could show that she really cared for the students by not making so many mistakes during her lectures.

> I feel like if I were to talk to her more, it would [*pauses*] motivate me more. It would like, show me that she actually cares and that she wants like, to make sure we all pass… I think she kind of sugarcoats her teaching methods. [*laughs*]… Like, like she says she wants all, us all to, to pass, but it's like, if you really wanted all of us to pass, you would like, improve your methods and stop messing up. 'Cause you're just confusing us.
>
> Raquel – Interview 2

Raquel recognized that Beatrice cared, but that she wished that this care would come through in her teaching.

The focal students recognized the interactions with Beatrice, making sense of how those interactions benefitted their experience. For many, Beatrice’s role was to demonstrate how to solve various problem types and also to validate and correct their mistakes. For a few, the interactions with Beatrice were not as significant to their success. What had become more apparent was that certain students demonstrated various needs with their interactions with Beatrice. For example, Marisa wanted the most interaction with Beatrice because it was an opportunity to prove her course efforts to her. Others, like Nancy and Teresa, interpreted their interactions with Beatrice as a demonstration that they needed help, which portrayed them as weak. Though he could have, Chris did not always take advantage of all opportunities to interact with Beatrice, realizing that every time he did so, he took an opportunity away from a peer that was in more need than him.

In all, most of the students felt that Beatrice was caring and wanted to support all of them as best she could, independently of whether or not students felt interactions with Beatrice fulfilled all of their needs or were important for their learning.

Student-Student Interactions

Students interacted with one another when the instructor assigned problems to work on at their desks. Student interaction during the lecture was minimal: students may have whispered once or twice to one another, or one student may have asked the person sitting next to them if they could copy something they may have missed in the notes from a previous page. For the most part, the interactions during lecture were in the form of individual students responding to Beatrice’s prompts, with no large group discussions about mathematical topics. Individual student work time was the only time during class when Beatrice invited students to work with their peers; however, she did not structure or require any students to work with each other. Most of the individual student work time was spent with students working alone on problems, with very limited interactions with their peers. Overall, individual student work time was spent in silence, and any interactions were carried out in whispers or silently comparing work. Students did not reason mathematically or discuss their work.

Because so little student-student interaction occurred, I highlight a few instances where students interacted beyond a whispered exchange. The three examples I describe here demonstrated three things. First, when the silence in the classroom was broken, students that normally were silent would begin to talk to their neighbors. This indicated to me that the students were timid to make sound, unless there was other commotion in the room. The second example demonstrates a moment when Teresa, a student who normally did not reach out to others, asked another student multiple questions on a problem. Finally, I draw attention to Raquel who called on the tutor, when others in the class would normally not engage him.

In Observation 2, all students worked in silence at their desks. In the last three minutes of the individual student work time, Beatrice started talking in a normal tone to Rebecca, who sat directly in front of her. The rest of the class started to murmur to one another, instead of whispering. The students started moving around a little more, turning to others and asking others what their solution was. This instance demonstrated to me that the students in the class might have been too afraid to break the silence. Once there was some sort of sound (initiated by Rebecca and Beatrice's conversation) other students felt more comfortable interacting with their peers, and more variations of interactions unfolded (e.g., asking the tutor for help, Marisa turning around to a table behind her to interact).

In Observation 8, Teresa initiated interaction with another student, Aracely. This stood out to me because I did not see her speak so much with another student in any other observations. Teresa leaned over to Aracely to clarify the problem that they were assigned. Once she initiated this first interaction, Teresa engaged Aracely again by asking, “Why?” and pointed to Aracely’s work, which then led to Teresa asking her a few more questions. This instance stood out to me because it seemed that Teresa never wanted to be the person to ask for help. Perhaps once she saw Aracely’s receptiveness to her questions, she felt more comfortable to continue a conversation. Unfortunately, I did not see Teresa sitting next to Aracely again in the rest of the observations, so this type of interaction did not occur again. Towards the end of Observation 8, Chris had finished a problem before class ended (Solve: $\sqrt{x} + 1 = \sqrt{x + 1}$) so he packed up and started to walk out of the room. A student in the back grabbed his arm as he passed and said, “Hey I know *you* can help me!” and asked Chris to explain the problem to him. Chris gave him some hints, pointing out that he needed to keep in mind parentheses when he squared the binomial on the left side, and then walked out. Chris did not like working with other students and specifically sat at the end of a row to avoid that kind of contact. The student who stopped Chris on his way out seemed to believe that Chris was capable and would be able to help him with his problem.

Another instance that stood out to me was relates to Raquel who was the only focal student to call on the in-class tutor for help. The tutor was assigned to Beatrice’s section as a resource to leverage greater student success; not all class sections were given one. Very few students called on him for help, and when they did, most often they asked him to look at their work to verify it. On one particular occasion, Raquel called on the tutor, but instead of asking about the problem they were working on, she asked him to help clarify content she had learned in the previous class session. She asked him how to find the domain and range of a function. She asked, “What does this mean?” pointing to the domain, written in interval notation, of an example they had worked on in the prior class. Raquel interacted with the tutor in a different way than other students, asking him to help clarify her understanding on various topics.

The limited interactions among students may have been due to a few reasons. First, the classroom seemed to be a quiet place; the level of noise was similar during the lectures and student presentations. Students seemed to be disinclined to disrupt the classroom norm that most work was done in silence. Second, the class met at 8 am, and many students appeared drowsy. Third, the instructional modes were not structured to foster a supportive and interactive classroom community. While Beatrice encouraged students to interact, there was no formal structuring (e.g., group work, paired work) or invitation to get students to feel comfortable to introduce themselves and work with each other. While it is not just the instructor's responsibility to get students to know one another, students respond better to work with their peers when they are asked to. Students might have become accustomed to sitting in the chair that they selected from the first day, which made it harder to interact or seek other students in the class; students seemed to prefer to be by themselves.

At the start of the semester, Beatrice introduced the tutor, pointing him out at the back of the room giving his name and saying that they could call on him as needed. The tutor was another student at the college who looked just like the other students in the class. He was approachable and eager to help. For the majority of the term, he sat in a chair along the back wall and faded away out of most of the students' view. Most students did not call on him. The students that usually interacted with him were in the back table, closest to him. Usually, once a student called him over, they asked him to check or find an error in their work. One student in particular seemed to realize that none of the other students were calling on him, so he would regularly just work with the tutor during the individual student work time. I noticed that Raquel, who also sat in the back row of tables, would call on him every now and then.

In summary, the student-student interactions in MATH 5 occurred only during individual work time and were characterized by quiet exchanges that followed short periods of individual work; the exchanges did not appear to be collaborative. Students tended to work with the same students who were sitting in close proximity to their left or their right, which resulted in some exclusion from students who wanted to interact with others. There seemed to be an understanding that the classroom had to be a quiet place.

Student Perspectives on Student-Student Interaction

After every observation, the students used the survey to name students with whom they interacted that day in class. Guillermo was the only student who consistently stated that he did not interact with any others during class. All other students described interacting with some other student at some point during the four observations. When the focal students marked that they interacted with a peer, it was always the person sitting to the left or to the right of them, and did not vary unless a new person sat next to them. Consistently, Nancy marked working with Vanessa, Raquel marked working with Aracely, Marisa marked working with Layana and the student sitting directly beside her, and Layana marked working with Marisa and Larry, who normally sat directly next to her. Teresa marked working with Aracely and another student during two different observations. Santiago listed his “elbow buddies” as the students in which he interacted with, but it seems it may have just been casual conversation at the start or end of class.

The students varied in their need for having interactions with their peers. Chris and Guillermo did not feel the need to interact with others. Teresa, Santiago, and Raquel felt that they needed much more interaction with their peers because it was the best way for them to learn. Adriana and Marisa felt that the amount of interaction was just right. Layana struggled to initiate contact with other students, but was happy when other students reached out to her, and wished there was more time to spend working with others. None of the focal students interacted with any of the students outside of the classroom.

Chris and Guillermo were completely happy not interacting with their peers during the class time. Chris did not feel that interacting with his peers helped his learning. During the class, Chris wanted to work through a problem as fast as he possibly could, and working with a peer would have only slowed him down. He did not engage at all with his peers outside of class because he always had to leave to go to work, and it was hard to find time to keep up any relationships with students in the class. Chris admitted that while he did not seek to work with others, it appeared that other students needed his help. He described the moment during Observation 8 when the student in the back pulled him aside as he was leaving the class:

> As I was walking, he just asked me how to, how to do it. So I tried to explain it to him without just giving him the answer because I know that if you just give them the answer, it's not gonna help them at all. So I tried to explain it as I did it…I didn't feel uncomfortable. Especially since it-- If it was something that I didn't know, then I would just tell them, "Hey. I, I actually don't know how to do this." But because I did, then I felt kind of obligated so to speak, to help them out.
>
> Chris – Interview 3

Chris mentioned two other times when other students came to him for help. In each instance, he described not fully giving the answer away to his peers, but instead provided some hints and suggestions in their work.

Guillermo admitted that he also did not work with others because he felt it dragged him down. He wanted to also be efficient with his time and work through problems as fast as he could, and working with his peers would inhibit his speed. He referred to Chris as being a leader in the class, and often pushed himself to be just as fast as Chris was. “Chris. He’s good…he’s smart” (Interview 3). Guillermo recently started to practice Mixed Martial Arts, and compared his experiences there to the classroom. He knew that to be the best you have to compete against the best. He admitted that in the classroom, no one is there to beat another student. However, for him, the goal was to pass, and to do it as efficiently as possible, which for him meant to work independently. This was a change for him from high school, where previously he worked with others quite regularly.

> My mentality was different back then [in high school]. My mentality was helping others and just you know, uh, getting along with somebody else. But since now, I'm all on my own, you know, I'm, this is what I see. The facts that play how I think now. You know, I'm working, uh I go to school, and then I have to think about how to get more money uh, to help my parents. So that mentality gets me just to focus on my own. Just focus on myself. So that's, this is why in college now, in these classes or any other class, my mentality is, "Just focus on you. Just do what you got to do. Go to class. You know, be quiet, pay attention, and that's it. And do good."
>
> Guillermo – Interview 3

Guillermo saw himself as a different person than he was just a few months before while in high school. He felt more of an obligation to help his parents out more now that he was 18. Work was his number one priority while school came second. Getting to know his peers during class time was a distraction and he felt he needed to fend for only himself and his learning.

Teresa and Santiago tended to work alone during the times in class when Beatrice encouraged students to feel free to work with peers. Coincidentally, Teresa and Santiago were the two students who indicated that they preferred to work with their peers and felt it was the best way for them to learn mathematics. Teresa was a very shy person; she felt intimidated to start conversations with others in the class and preferred others to start conversations. She felt more comfortable around guys rather than girls because she was raised around mostly men. She felt that when other girls sat next to her, she was intimidated to ask for help or engage in conversation. She wanted Beatrice to incorporate more structured group activities, assigning groups and students to work with one another. Teresa indicated that one thing she would change about the instruction is to provide opportunities for students to work collaboratively on problems.

> Teresa: Just be more… [*pauses*] I guess all of the peers get more together.
>
> Researcher: Mm-hmm. Does that help you?
>
> Teresa: Um, yeah because sometimes, some students have different ways of learning the technique, and then maybe their technique might work for me, but I just don't know…Yeah, more interacting with the peer, like, with your, with the classmates on like, a certain problem. Let's say um [*pauses*] she stops and has us do problems like she usually does. Instead of us working it out ourselves, just form groups real quick and then, yeah.
>
> Researcher: Right. 'Cause I know, it seems like she stops and says, "Okay, guys. Work on it." And it is kind of quiet. Do you feel like you can work with your partner when it's that moment or do you feel like you have to work by yourself?
>
> Teresa: Um, I feel like I can work with her. It's just, what we usually do is, do the problem ourselves or as far as we can get and then we just compare.

Teresa – Interview 2

Teresa wished that there were more opportunities for students to work together from the start of a problem, rather than only comparing work once they had finished working on a problem. This felt isolating and unproductive towards understanding the mathematics. She felt that if she were provided opportunities to get to know others in the class, she would have felt more comfortable participating in other ways such as providing more responses during the large lecture and even would have presented her work in front of the class.

Santiago described the classroom community as a very quiet space, where the students were timid and shy, often working individually. He wanted more interactions with his peers because he felt that working with others helped him to feel more confident in his work.

> Santiago: I'm a very social guy, so to me, it like, I don't like doing things individually. Like, if I have to, then I will, but I prefer doing it with somebody else and myself. 'Cause you know, sometimes like-- Not that I'm insecure, but I'd rather have, I'd rather be two

> people wrong than just myself. 'Cause then I feel like I'm not dumb, but like, you know like, I just, my self-esteem goes down.
>
> Researcher: Yeah. So like, if you-- So if you both got it wrong, like you feel better about it?
>
> Santiago: …Like, if I got it wrong, I be like, "Oh, snap." Like, who am I gonna-- Like, I can't say anything. Like, it's all on me, you know? Like, with somebody else, I be like, "Ah, we both got it wrong." So like, you know you both laugh about it. But, by yourself, you just like, "Aw, snap," you know? You feel like, embarrassed.

Santiago – Interview 2

When working alone, Santiago felt successful when he attempted a problem and got it correct, however, he felt very insecure when he got a problem wrong. He preferred working with peers because it helped him to realize that he may not be the only one in the room who had difficulties with the mathematics. Santiago regularly sat at the front of the room closest to the aisle. Adriana and Kio sat on the other end of his row, and they had formed a relationship early in the semester, comparing work with one another. That meant that Santiago did not have another student to interact with within his row. Behind him, Nancy and Vanessa always worked together. At one point, Santiago tried to interact with both groups, but it was very tangential and did not go beyond a few words. Given that, Santiago tended to work individually when provided opportunities to work on practice on problems. Sometimes he would lie his head down and not work on the problem at all. When asked how he would change the way the class was currently run, he wished that there was time spent in group work. While he felt that Beatrice started to reach out more to the students, he preferred to work with his peers.

> Yeah 'cause to me, like, if you were to just talk, a teacher and student, like it's not, it's not the same experience as student to student. So, a student with a student is more like, comfortable than with a student with then a, with the teacher. 'Cause the teacher, of course she's gonna know more. But the student, like you could relate on certain topics. Like, be like, "Oh, you know what? I don't understand it." "Oh, me too."
>
> And then you guys get more comfortable to work together. And just work it. 'Cause when you're by yourself, you're just like, "Oh, like, I don't get this." Like, you know, like, you

> feel like everybody else does. But then in the end, like, everybody's the same, you know? So, I feel like if you were to add a little bit more group, like, people would be able to like, understand a little bit more. And like, help each other more out than just be individual work. And then in the end of the day, or at the end of the class, you're already failing the class 'cause you didn't fail to ask, or you didn't fail to study, or you didn't fail to understand, you know?

Santiago – Interview 2

Santiago felt that group work was important for everyone in the class to feel connected. He wanted more structured opportunities to work with his peers, as it seemed most of his classmates were too shy to reach out and work with someone new when given the opportunity, and instead tended to work individually.

Nancy felt interpreted the silence in the class as something that was part of being a young person. During one observation survey, Nancy indicated that she did not feel like a valued member in the class because everyone was so quiet and others did not interact with her. She explained this phenomenon of silence in the class as follows:

> I think it's just you feed off of the feeling you have from everyone else and I think that day was just, everyone else was just quiet so it's like, "Oh well, I'm quiet today too then." So it's like, you know teenagers, we tend to feed off of each other and we tend to just do what everyone else is doing. So it's like, if one person or a group of people are quiet, or not talking, most likely like, everyone else is gonna be kind of like, to themselves…. [But if] you hear a lot of chatter and you kind of feed off of what everyone talks to. When, during practice problems you hear like, little bickering [*sic*] and then you kind of feed off of that.

Nancy – Interview 3

Nancy felt that students behaved silently or talked more based on what everyone else in the room was doing. She described that if she did not hear other students talking or whispering to one another, then she did not do it either. However, when she heard chatter in the room she did not mind reaching over to her partner Vanessa to, often whispering to her. She behaved the way she felt the room was behaving and did not want to be the person to break the silence. Because the classroom was usually very quiet, the types of interactions were always set to whispers. Nancy also tended to whisper to Vanessa whenever she interacted with her.

Raquel agreed that there was very little interaction amongst the students, and that this resulted in students not having an opportunity to know one another, which made it harder for them to seek help among peers. When asked to describe the classroom community, she responded,

> Mm, [*pauses*] that's hard to answer. 'Cause like, nobody really-- Well, I don't really talk to the other people in the class…there's not much communication. Yeah. I feel like if we're all to just like, somewhat do an activity and then get group [*sic*] randomly, or like, we choose like, 4 people. I think we will be able to get to know each other more. And then like, help each other more.
>
> Raquel – Interview 2

Raquel felt that she only really interacted with Aracely when she had the opportunity to. This was limited to whether she was able to sit next to her. Because they sat in the back row, if Raquel was late, often another student would sit in her seat. Aracely dropped the class by the 13th week, so by the end of the semester, Raquel worked alone. She felt that if Beatrice had provided projects or assignments where students had to work together, she would have been able to get to know others in the class where it would not feel strange if she reached out to other students. She described why she called on the tutor; she preferred talking to him than to call on Beatrice for help and she felt she most often called on him to check her work. While she worked regularly with Aracely, she wanted to have someone who had taken the class previously (i.e., the tutor) to affirm that she was correct instead of a peer who was also just learning the material.

Adriana and Marisa said that having the option to choose when they wanted to work with a peer worked well for them. At times both students preferred working alone, knowing that they could always reach out to the people sitting around them. Adriana mentioned working with Kio most often, but only to compare their work. Adriana felt that working with peers was important, “because like, sometimes they have a different way to solve the math. Or they have different ways of doing it than I do” (Interview 2). She felt that the level of interaction (comparing work) was perfect for her. After Adriana started to work at a new job, she found she was less engaged in the class and towards the end of the semester, she interacted less and less with Kio, and they ultimately stopped talking to one another.

Marisa felt that opportunities to work with others worked well for her because she was not afraid to reach out to others. She appeared to be extremely friendly to those around her, chatting with students in the morning as they waited for the classroom to be unlocked. She often worked with the student who sat next to her, but many times would turn around with a smile to talk with Layana, who sat in the row behind her. However, Marisa felt that the only person she really needed to interact with was the instructor. She really did not feel like she knew any of her peers and more importantly, they did not influence her grade. Because she felt no real connection to her peers, she only reached out whenever she was confused or stuck.

> We just kind of coexist. We all just sit next to each other. I guess if you need help with a problem you can turn to the person next to you. But it’s not necessarily something that a lot of people do. Like, you can see that there are little friendships that are formed throughout the classroom just by people talking to each other. But it doesn’t seem like – like, as a whole I’m really not sure of some of the people’s names in there. You could show me a face and I would have no clue who it was. Yeah. We don’t really speak to each other. We don’t really have a whole community type thing. I think it’s just more of a we go there, we sit down, we do our work, we don’t really have the desire to talk to each other almost.
>
> Marisa – Interview 2

Marisa was a confident student and had no problem reaching out to others when she wanted to interact. She noted that overall most students did not reach out to others, making the classroom feel isolating. She described the role of a student in MATH 5 to follow a specific routine: show up, sit down, and do the work. Interactions with others did not fit into this common routine.

Layana had the same experience as Marisa—students did not want to engage with their peers in the class.

> But as far as with my peers in that course, I don't feel like anyone is really valued there. I don't feel like anyone turns to anyone for help or...Not as far as help when they're stuck on a problem, but, like, help like, "Oh, let's work together on this." People in that class are just not looking for communication with others in there.
>
> Layana – Interview 2

Layana felt that students did reach out whenever they were stuck, but did not want to collaborate when trying to work on problems or potentially review and learn the material. Granted, the opportunities that Beatrice offered to students limited the ways that students could work collaboratively. Layana admitted that the times she did work with her peers in the class had really benefited her. In particular, towards the middle of the semester Larry, a person she felt was smarter than her at math, sat next to her regularly. Layana described herself as being timid and never reaching out to him; Larry would always interact with her during the time they had to practice problems, for which she was grateful. At first, she would always push her paper to him and let him read it, not saying anything. As time progressed, they would whisper quietly to one another. By the end of the class, she found herself reaching out more to Larry, initiating the interactions. She noticed that her interactions with Marisa were always initiated by Marisa, and towards the middle of the semester, she and Marisa stopped comparing work and talking to one another. Layana preferred working in pairs; she felt that if she were assigned to work in groups of three or more students, she would have felt overwhelmed and would not have engaged. She enjoyed that Beatrice allowed students to choose whether they wanted to engage with their peers. However, she wished there was more opportunity to work on practice problems, allowing more time to work with a partner or even spend more time presenting at the board and engaging with peers there. Given the large amount of note-taking, she felt students tended to work individually because they in fact did not know what to do, and did not feel comfortable to consider reaching out to work with a peer.

The students in MATH 5 valued varying levels of peer interaction. Some students were open to working with others while others wanted more opportunities to work with their peers because they saw the benefit of learning from them or getting help to navigate the mathematics. Other students did not like working with others or reluctantly interacted. Students described not knowing their peers in the class and felt an overall sense that all of the students kept to themselves. Confirming my observations, students said that they preferred to work with the students who sat directly beside them. Most of the students who wanted and valued more interactions in MATH 5 felt shy and ill-equipped to start the interactions, and said that they would have liked for Beatrice to structure those better. We learned also that some students saw peer interactions as detrimental because working with others it is not a realistic setting during assessment. These students wanted to take the time to practice on their own and demonstrate that they could complete the work with speed and accuracy.

Summary

I identified two overarching findings when considering the personal interactions within the classroom. First, the interactions with others during the course were extremely limited in that students did not have many opportunities to interact with either their peers or Beatrice due to the amount of time the class was spent in lecture. While students did seem to interact more with Beatrice than with their peers, most interactions were brief and did not support substantial mathematical discussion. The focal students described the students (including themselves) in the class as quiet and that they kept to themselves. Some students indicated that they wanted more interactions with peers, but they did not seem to know how to initiate them given how the classroom community developed to encourage individual work. Even though Beatrice began to interact with students more by the second half of the semester, these interactions were brief as she tried to ensure talking to every student during each opportunity that they had to practice problems.

Second, when students interacted with Beatrice, she dominated the discussions. During the moments that students interacted with Beatrice during all three modes of instruction, she led the conversations and the mathematical thinking. This is especially important to note during individual student work time and student presentations, when these opportunities appeared to be utilized to give students opportunities to apply what they had learned. The students tended to speak far less than Beatrice did, and the questions they asked were not related to their mathematical thinking so much as to demonstrate to Beatrice that they knew how to apply a mathematical procedure. The interactions with Beatrice tended to lead to corrections and validation of work, rather than elaboration on mathematical thinking.

Chapter 6

Teacher-Content Interactions: "I am tired" and "We just don't have time for everything"

In this chapter, I describe the way that Beatrice interacted with the content during instruction, which was primarily during the lecture. I organize the description of these interactions as seen in three distinct areas: her use of the note packet, her demonstration of solutions to problems, and her preference for certain solution methods. Beatrice used the note packet as the structure of her lecture during every class session. In creating the note packet, she made decisions about the content discussed as well as problem selection. She demonstrated solutions to problems as a series of steps, which rendered the mathematics as mainly an activity that centers on using mathematical procedures. Finally, Beatrice explicitly stated the methods she preferred to use when she worked on problems, making critical comments towards others, refocusing students' attention to those that, in her view, were more efficient and effective to reach a solution.

Note Packet

Beatrice lectured for the majority of the class sessions using the note packet as her guide. Every day she marked where she started and stopped the lesson, continuing where she left off in the previous class meeting, and working her way through as many sections as she could cover in the time period. Because lecture dominated each class observation, the note packet was a key resource for Beatrice. In this section, I describe the ordering of problems that Beatrice demonstrated during lecture and assigned to students for individual student work time (easier problems demonstrated, harder problems assigned), the way that time affected the selection of problems that Beatrice demonstrated (when pressed for time Beatrice preferred to demonstrate several simpler problems rather than one complex one), and the way she used the note packet to write down the solutions (when running out of space she used post-it notes).

Ordering of Problems

The note packet had sections of practice problems that the instructor used to select those that were demonstrated to students during lecture and those she assigned students to work on during individual student work time. The number of problems available for Beatrice to select from during the four observations varied from 16 to 58 (see Appendix F for list of problems). Beatrice generally selected one to six problems within each section to demonstrate to students and every now and then selected one or two problems for students to work on at their desks. However, the types of problems that Beatrice would demonstrate were quite different from the problems that she assigned students to practice in class. For example, during the second observation, the instructor introduced students to solving absolute value equations. The instructor selected three problems to demonstrate to students: $|y| = 8$, $|w| + 7 = 10$ and $|4x + 1| = 9$. After she explained that there would be two possible solutions for each of these problems, she gave the students the following problem to work on at their desks: $3\left|\frac{3}{2}a + 1\right| + 2 = 14$. The classroom was silent the 3 ½ minutes that the students worked on the problem. Students worked independently and no student called on the teacher for help. This problem was challenging for a few reasons. Beatrice described completing problems as a series of steps (described in more detail later in this chapter). The selected problems that Beatrice demonstrated required fewer steps than the student assigned problem, and also did not contain a coefficient on the absolute value term. For example, in the third problem, Beatrice demonstrated that students must write two equations, $4x + 1 = 9$ and $4x + 1 = -9$ (step 1). At this point, she showed the two steps students must use to solve each equation: subtract one from both sides (step 2) and divide by four (step 3). The students' problem, however, required five or six steps (depending on the method students used to isolate *a*) and for students to apply knowledge that they had not yet seen for these types of problems. First, students needed to isolate the absolute value term, which meant they needed to subtract two from both sides, $3\left|\frac{3}{2}a+1\right|=12$ and then divide by three, $\left|\frac{3}{2}a+1\right|=4$. This last step, applying the inverse property of multiplication to isolate the absolute value, had not yet been demonstrated, so students would need to have known to do this before moving on. Next, students should write two equations, $\frac{3}{2}a+1=4$ and $\frac{3}{2}a+1=-4$. At this point, students should solve both equations by isolating the variable. First, they would subtract the one. Second, they would need to use the inverse property of multiplication to isolate the *a* term. However, in this problem, the coefficient on the *a* term is a fraction. Therefore students may have used two steps to solve for *a*, by multiplying both sides of the equation by two and then dividing by three. The problem students were given required more attention, and pulled on knowledge that students saw the solution path as two parts: first to isolate the absolute value term and second to isolate the variable.

Later in the class, students were given similarly challenging tasks: $1=-4+\left|2-\frac{1}{4}w\right|$ and $\left|\frac{4w-1}{6}\right|=\left|\frac{2w}{3}+\frac{1}{4}\right|$. The first problem was identical in form as the previous problem but in the second problem, students were expected to understand how to solve an absolute value equation with two absolute values present. In this problem, all of the coefficients were rational numbers, which the students had not yet seen in this section. Different for this problem, there was only one solution, which the students had not yet seen before. When solving the equation $\frac{4w-1}{6}=\frac{2w}{3}+\frac{1}{4}$, students find that the variable terms sum to zero, leading to no solution. If one were to multiply both sides of the equation by the least common denominator, the resulting equation would be $8w - 2 = 8w + 3$, which reduces to $-2 = 3$, which is a false statement. This problem brought up a new concept, that there might not be two solutions that satisfy an absolute value equation, as the students had previously seen. Students also worked in silence during this individual work time, and did not reach out to Beatrice or their peers for assistance with the problems.

While it is not entirely unattainable to solve these types of problems, there was not much scaffolding of the problems to support students' work on their solutions. Beatrice said that when assigning problems for students to work on she sought to add variety and to provide opportunities for them to engage productively with more challenging material. She made the decisions of problems to assign on the spot by selecting problems that looked different (e.g., new variables, higher powers) from what students may have seen up to that point. In her decision making process regarding the selection of the problems she did not describe attending to mathematical content that students may have been struggling with. As we will see later, students described having challenges with the practice problems because of the sudden introduction of what to them looked like a clearly different problem (e.g., rational instead of integer coefficients). While the problems that she assigned were meant to challenge students, this purpose was not fully fulfilled, because students could not always solve them and they knew they could wait until Beatrice demonstrated it.

Time

Towards the end of the term Beatrice began to skip sections in the note packet as she progressed through the lecture because she realized that she would not be able to get to the material students needed to fulfill the course content outlined by the department for the course. Her decision making process regarding what to keep favored shorter, more procedural tasks rather than more complex or conceptually demanding ones in the topics she covered. Even when word problems were discussed, she spent more time on learning the mathematical procedures underlying the word problem rather than exploring and considering alternative paths or explorations. Indeed, in out of the 12 observed lessons, there were only two sessions that discussed word problems.

For example, in Observation 10 Beatrice skipped the topic of modeling population growth utilizing the exponential model $P(t) = P_o(1 + r)^t$. She marked her notes with the phrase “if time” and continued on with other problems. Her decision to skip this application problem in order to spend more time working on practicing the procedure of rewriting logarithmic and exponential equations (e.g., “Rewrite the equation in exponential form $\log_3 81 = 4$”, “Evaluate the expression. $\log_4 16$”) was interesting because a similar modeling problem appeared in the final exam and accounted for about 8% of the total score while problems on rewriting logarithmic and exponential equations was not.

In making these decisions, Beatrice seemed to favor practicing procedures over engaging content that would allow students to apply these procedures in real world context, which may help students in passing MATH 5. She did cover more problems in that time frame at the expense of exposing students to material that would allow them to solve some harder problems in exams.

Spacing within the Note Packet

Regularly throughout the lectures, Beatrice ran out of room while writing the solutions problems on the note packet. Frequently problems were completed within the space provided for other problems on the page, on post-it notes, or on separate pieces of paper, which made it difficult to follow the whole solution process for any given problem. For example, in

Observation 8, Beatrice demonstrated example 5, $\sqrt{3x+1} - \sqrt{2x-1} = 1$ (Figure 5). In this example, Beatrice wrote the detailed work for solving an equation with two radical terms. As Beatrice ran out of space, she used post-it notes to complete the various subtasks of the problem, writing above the problem, and checking work on another page. This way of writing the solutions was common throughout the lectures.

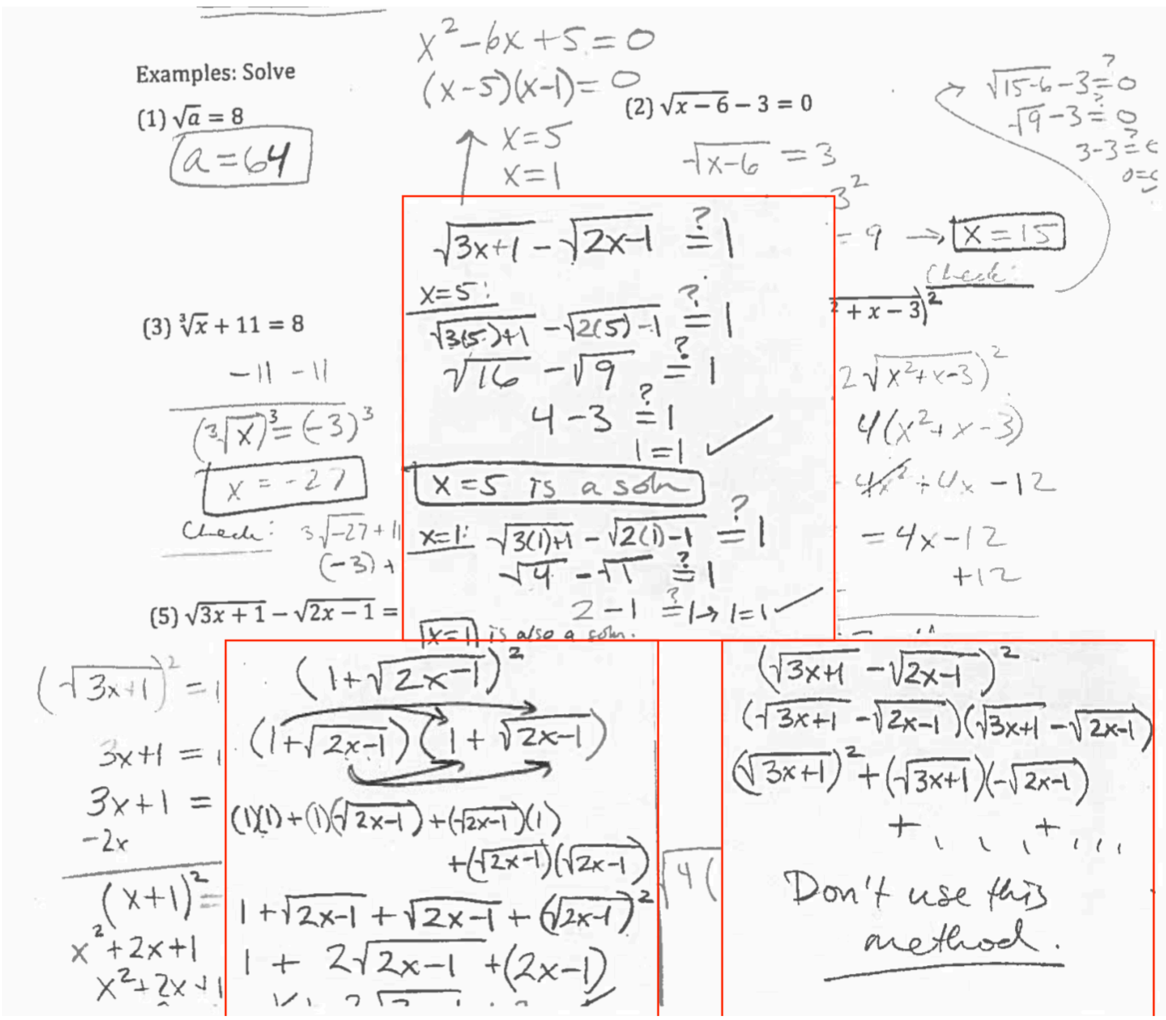

Figure 5. Example of the Solution to Example 5iIn Observation 8. The notes include the three post-it notes, marked in red, used to add extra space for Example 5.

The way in which the packet was designed maximized the problems that were available for students to practice the material, which was meant to be useful for students but reduced the space available to demonstrate the solution. This way of working on the solutions meant that students did not have an organized and clear path that easily showed the various steps needed. It is likely, that for those students using the packet, it would require significant time on their part to later make sense of the work.

Presentation of the Mathematics

Beatrice presented procedures as a series of steps to follow; during the lecture, she often used the phrase "What's my next step?" as a way to engage students in the lecture and her note packet presented mathematical work as a series of steps. Figure 6 shows three sets of steps that were central to the types of work students encountered in Observations 2, 5, and 8. The instructor referred to these lists while demonstrating problems to the students and often used the term "step" while working, leading a path for students to follow each time they were asked to work on similar problems. The way in which Beatrice applied the list of steps for the students to follow was similar for the three content areas—solving absolute value equations, factoring polynomials, and solving radical equations. I use her presentation of solving absolute value equations in Observation 2 to illustrate her emphasis on steps.

<u>Solving absolute value equations</u>

(1) Isolate the | |
(2) If $a<0$, then there is no solution
(3) Rewrite the absolute equation into two different equations, + and –
(4) Check the answer in the original absolute value equation

(a)

<u>We should understand and practice the suggestions below to master factoring.</u>

We have the following helpful hints for factoring

(1) Make sure polynomial is in standard form
- (A.) GCF
- (B.) If a trinomial then:
  - (i) trial & error
  - (ii) AC Method
  - (iii) Difference of squares & Perfect Square trinomials
- (C.) If a 4-term polynomial then (factor by grouping):
  - (i) Draw line after 2nd term
  - (ii) Factor GCF of first two terms
  - (iii) Factor GCF of last two terms
  - (iv) Factor common bubble & the "left overs" belong to their own bubble.

(b)

<u>To solve a radical equation</u>

(1) Rewrite the equation to one radical is isolated

(2) Raise each side of the equation to a power equal to the index

(3) Combine like terms

(4) If need be, repeat steps 1-3

(5) Solve the equation

(6) Check all solutions in the original equation for extraneous solutions.

(c)

Figure 6. Directions Given in Student Note Packet. (a) Set of steps for solving absolute value equations in Observation 2. (b) Set of steps to consider to "master factoring" in Observation 5. (c) Set of steps to solve radical equations in Observation 8.

During Observation 2, Beatrice introduced solving absolute value equations by following a particular process (Figure 6a). Once Beatrice defined an absolute value, she solved three one- and two-step absolute value equations, $|y| = 8$, $|w| + 7 = 10$, and $|x| = -1$. After demonstrating these three problems, she directed the students' attention to the list of steps for solving all absolute value equations (Figure 6a). She described solving all absolute value equations as a process of steps:

> So now, we have a process for solving absolute value equations. So of course, we want to isolate the absolute value term because that's the one that will have the *x* inside [*points to step 1*]. And we already know from the get-go that if the right side of the equation is a negative number, and the left side of the equation has an absolute value on it, there will be no solution [*points to step 2*]. If that's not the case, rewrite the absolute value equation into two separate equations [*points to step 3*]. One is going to be a positive. One's going to be a negative on one side. And when you're done solving, you check your value, ok?
>
> Beatrice – Observation 2 – Part 1, 26:00-26:26

Students were given four steps to follow when solving an absolute value equation. While Beatrice did include the notion of distance when first defining an absolute value, she did not bring that idea to bear when talking about the process to solve these equations.

Beatrice then proceeded to demonstrate other problems, recalling the steps the students should follow. The following exchange took place when Beatrice showed the class how to solve the problem $3\left|\frac{3}{2}a+1\right|+2=14$, which was the first problem that students were given the opportunity to solve on their own individually at their desks.

> Beatrice: Alright, so, what's the first thing I want to do?
>
> Multiple students whisper: Subtract two.
>
> Beatrice: Subtract two. Remember I want to isolate the absolute value term. [*subtracts 2 from both sides, writing* $3\left|\frac{3}{2}a+1\right|=12$]. Then what? Divide by three. [*divides both sides by 3, writing* $\left|\frac{3}{2}a+1\right|=4$] Then what?
>
> Student: Multiply both sides by two.
>
> Beatrice: Multiply? Not yet. We separate them into two. Yeah so that's the step that we have to remember. [*draws two arrows from the equation to write two new equations*] Before we do anything inside the absolute value we have to make two different equations, ok? So we have $\frac{3}{2}a+1=4$ and we have $\frac{3}{2}a+1=-4$. Alrighty. So then just solve out our equations like normal… So [*sighs*] we check them.
>
> Observation 2 – Part 1, 34:14-37:53

In this exchange, Beatrice aligns with the directions given in the notes by using phrases such as "first thing" and "Then what?" Throughout the intercourse with the students, Beatrice did not relate any of the steps to the rationale for why they were being done. Instead, she followed them in an order for completion. Beatrice indirectly indicated to students that they must first isolate the absolute value term (step 1). In this case, she did not refer to step 2 to check if the isolated absolute value is set equal to a negative number. She then pointed out to students that they would need to remember to rewrite the equation into two new equations before beginning to solve for x (step 3). Finally, she indicated that they needed to check their solutions (step 4). Throughout the lecture for solving absolute value equations, Beatrice refers to these steps in order to solve the equations.

The listing of steps in the note packet allowed Beatrice to anchor the content in ways that got the work of solving the equations done. The steps may have helped in managing time by providing a structure for the presentation of the material, with the added bonus of allowing students to replicate the work on their own by following the recipe given with the steps. The steps also can be seen as signposts: the instructor could use them to easily identify where the students were in the solution process or locate errors. By labeling the steps, the instructor could direct students to an area that might be missing. The emphasis on steps could be seen as an aid in simplifying a complex task into simpler tasks that individually may seem more manageable and therefore give students confidence that they would be able to perform the problems on their own.

Instructor's Preferred Methods

Beatrice often made comments during her lecture that revealed the method strategies that she preferred when working on problems, leading to comments that cast a negative shadow on alternative methods. This happened during three of the four focal observations. During

Observation 5, Beatrice indicated her preference for using a specific method for factoring trinomials. In Observation 8, Beatrice demonstrated two ways to solve a radical equation containing two radicals, and indicated to students that they should focus on using her preferred method and not the other, similar method ("[*writes "Don't use this method"*] Of course if you want to use that method feel free. But don't"). During Observation 10, Beatrice told students that they should only graph logarithmic equations by first rewriting the equation in its equivalent exponential form, because using the logarithmic form would provide numbers that they "don't want." In each of these instances, the alternative methods that she told students not to use were just as mathematically accurate, limiting the opportunities that students had to explore other mathematical opportunities. I will explain the instance in Observation 5, when Beatrice asked students to factor trinomials, and highlight how Beatrice's preferences for the choice of procedure to use, displaying her interactions with the content.

During Observation 5, a portion of the lesson was devoted to factoring trinomials using three methods: 1) the *AC-method*, 2) trial and error, and 3) the *box method*. She first demonstrated how to factor $10x^2 + x - 3$ using the *AC-method*, which they had learned in the previous lesson. The AC-method requires students to look at the standard form of a trinomial, $ax^2 + bx + c$, and find pairs of numbers whose product is $a \cdot c$ (in this case $10 \cdot -3 = -30$) and whose sum is *b* (in this case 1). Once a pair of numbers is found that satisfies these two requirements (in this case 6 and -5 where $6 \cdot (-5) = -30$ and $6 + (-5) = 1$), students can re-write the *bx* term as a sum using the pair of numbers as coefficients (in this case $1x = 6x - 5x$), creating four terms ($10x^2 + 6x - 5x - 3$), and finish by using the factor by grouping method. After this example, Beatrice then moved on to the new material for the day, which was to factor $2x^2 + 7x + 6$ using the trial and error method. Beatrice told the students that she did not like the trial and error method ("This second method is my least favorite. Honestly."), but spent nearly 17 minutes of class time demonstrating how to use the method. Halfway through the solution, she said: "Ugh. I hate this method. Sorry. I apologize for saying that so much, but considering it's not required, I don't think I'm actually going to test you guys on it." After completing the first trial and error example, she took time to show how the AC-method could be used to factor the trinomial instead of the trial and error. At the end of applying the two methods to the same trinomial, she rhetorically asked the students, "Which way do you prefer?" and laughed. She then moved onto another problem, $4t^2 + 5t - 6$, stating, "And we're going to see why [the trial and error method] gets even messier". At the end of demonstrating the trial and error method, she told the class that there may be some students there who prefer the trial and error method, but in the notes she wrote in large letters "USE AC" for factoring trinomials. Later in the class, she demonstrated how to factor $n^2 + 4n - 12$. Immediately she recommended using the AC-method, "just because it's easier." However, she did indicate that there was another method that some students use, which was the *box method*[8], but that she found that it was harder for her to use to factor. She attempted to show how to use the box method to factor, incorrectly demonstrating the method. Instead she showed students how to use a similar method for multiplying two binomials, $(n + 6)(n - 2)$, resulting in the original trinomial $n^2 + 4n - 12$ (which is in fact is a good way to check if you factored correctly, though not the purpose of her demonstration). While attempting to show the students very briefly how to use the box method, Beatrice stated that the box method is similar to the trial and error method and "I don't recommend it," ending her presentation of this third method part-way through. She made it very

[8] The box method is similar to the AC-method where students work backwards to find the factored pairs. From my personal experience, many students in this particular area are taught the box method in their high school curriculum.

clear that she preferred the AC-method, by constantly referring back to the method when instructions explicitly asked students to demonstrate their understanding of other procedures.

There are pros and cons to narrowing multiple solution methods to just one. First, the topic of factoring in intermediate algebra requires students to consider and utilize various methods (e.g., factoring out a greatest common factor, factor by grouping, using specialized factor formulas). Beatrice may be reducing the cognitive load, and associated stress, of remembering multiple methods strongly advising students to use her preferred method. On the other hand, this choice also limits the opportunities for students to decide on their own which method works best for them bypassing an important skill to develop an understanding of the affordances and constraints of using various methods in solving problems (Herbst, 2013).

An emphasis on a single procedure can also be predicated on the need to save time. While the trial and error method might be effective in supporting explorations, when time is a constraint, the instructor may prefer a method that she knows works efficiently. Alternatively, her confidence on a preferred procedure over her confidence in using the less known procedure (e.g., box method) could give her control of what may happen in the classroom. There would be no surprises that she would not be able to handle if she were to open conversation to alternate methods. By excluding alternative methods and avoiding exploration, students learn that the most efficient pathway is what is valued and that exploration of other pathways is only shown to demonstrate the heightened value of the “best” way.

Student Perspectives on the Teacher-Content Interaction

The focal students discussed their perspectives with the ways that Beatrice interacted with the content in MATH 5. In this section, I present student reflections regarding the note packet, the way Beatrice presented the material during the lecture and perspectives on Beatrice’s preferred methods. In addition, I describe their perspectives regarding errors that Beatrice made during her presentation of the material.

Note Packet

Because Beatrice used the note packet as the basis for each lecture, she expected that all students would have the note packet printed for each class session. Many of the students did not feel that having a physical copy of the note packet was an essential resource for their learning, and instead relied on the projection of the notes during class. Most students could not print out the note packet due to lack of resources to do so (e.g., money, access to a printer) or felt that their money was better spent on other school necessities. Nancy was the only student who regularly had copies of the note packet. Nancy said it was particularly helpful to have the note packet whenever they did any word problems because she would not be able to copy the problem down fast enough without the packet. The remaining students did not consistently print the note packet for various reasons, mainly because it was costly and unnecessary to do so. Raquel printed the notes from home until she ran out of ink, and could not afford to buy more, recounting that it was difficult anyway to print the notes because Beatrice would sometimes send the notes just before class started, and at that point Raquel was already on the city bus to school. Teresa did not have a printer at home and could not afford to pay to print the notes at the college library, so she settled on writing the notes in an old notebook. Chris felt that printing the notes wasted paper and money that he could put towards other more important educational resources.

Six students felt that Beatrice moved through the content at very fast speed, working through demonstrations of problems so fast that they struggled to copy everything that Beatrice wrote. Whenever Raquel, Adriana, and Nancy had the notes printed, they said that they were able to write less and watch Beatrice as she demonstrated the problems as a way to “keep up” with the content. Chris was vocal when he missed something in the notes, raising his hand to ask Beatrice to return to a previous page so that he could copy what he missed. Layana recognized that as the semester progressed, Beatrice moved faster through the content. Whenever it became too much for her to keep up with Beatrice, she would stop copying the notes, pull out her phone, and take pictures of the projections instead, so as not to lose the opportunity to have the full demonstration of the problem. Teresa felt that Beatrice moved too quickly through the notes, and that at times it was difficult for her to know what sections they had covered in a lecture because of how much Beatrice moved around in the note packet. In her perspective, they worked through many problems, but it was not always clear what the content was that they were learning because the camera was zoomed in on individual problems. In that sense, Teresa felt that in each class, Beatrice always demonstrated a series of problems. However, Teresa did not feel comfortable to ask Beatrice for clarification or to slow down her demonstrations of problems.

A few of these students utilized various resources (e.g., taking pictures, asking see a previous page, using the note packet) to manage the fast pace, others did not do any of these things. Raquel, Adriana, and Nancy recognized the value of utilizing the note packet as a resource to help them mediate the pace. However, Raquel and Adriana did not have the note packet for a majority of the lectures. Chris and Layana were the only two students who did something different to mediate the fast pace. Chris did not have a problem to break the classroom silence with a question or a comment, and so did not have a problem stopping Beatrice to ask her to go back to another page of notes. Layana knew that keeping up with copying the notes became overwhelming, so instead she took pictures of the projection which would still give her access to the notes, while alleviating the pressure of copying everything that Beatrice wrote. In all, the lecture was difficult for students to keep up with, which seemed to take away from their abilities to engage with the mathematics, as they were trying to simply ensure that they had copied the material that Beatrice presented.

In spite of Beatrice's assumption that the note packet could be a useful resource for students, from their perspectives, it wasn't. The focal students saw that the packet provided more practice problems, but only a few students took time to use those. For many students the packet was prohibitively expensive to print and have handy in every class. From their perspective Beatrice's use of the note packet increased the pace of the lecture. It allowed covering the needed material, but because it was done at a faster pace, students had a difficult time keeping up with the material. The students perceived a resource that was seen by the instructor as a time saver as acting against Beatrice's goal of teaching effectively.

Perspectives on Beatrice's Preferred Methods for Solving Problems

Chris and Raquel both recognized that Beatrice taught multiple methods for procedures, while at the same time telling students to focus on one method. While Chris felt that Beatrice took up unnecessary class time in Observation 5 to discuss the trial and error method, he felt that she was obligated to teach specific content, and that it was out of Beatrice's control:

> Researcher: Last week when the instructor was teaching about the trial and error method … you said that that did not go well.
>
> Chris: Yeah, because it was such a long process on how to do it 'cause it was, okay, let's see if it works this way. See if it works um, like they wrote out the problem and they plugged in just random numbers, so to say. And they just went to see if it worked out. And I just kind of ignored that because there was [sic] other methods on how to do it and I liked those methods more. And it just would've saved me some space on my paper [*laughs*] if I didn't write it. So, but um, she said that she doesn't like that method and she's obligated to teach it that way. She never recommended using that method for tests or anything. But it was, it was, I don't know. It was a little confusing for me to do it that way.
>
> Researcher: So did it bother you that she was teaching a method that she didn't like?
>
> Chris: Not really, because if she said that she's kind of obligated to teach it that way, then I would understand because um, as a teacher, you have to teach what the, what your boss

> tells you how, um what to teach. You can't always just teach the way that you like, or the things that you like.

Chris – Interview 2

Chris recognized that Beatrice was obligated to teach specific content, regardless of her personal preferences. Because he did not find the method to be useful, he chose not to copy the notes during this section, focusing instead on other methods he preferred. This revealed a lot of autonomy on Chris' part; he recognized what worked well for him in the moment, and made a decision on what aspects of the lecture were important for his use.

It was frustrating for Raquel to be taught methods of solving that were immediately rejected. When reflecting back on the day when Beatrice taught the trial and error method, she said

> Well, [*pauses*] she would give us the, the easy one first [the AC-method]. And then she'll give us like, the hard one. And it's like, like, it's, she's providing us both, but then she's like, "But just forget about this one. This one is like ..." So then I'm like, "Why did you show it to us then?" Yeah…She was like, "This is pointless, but ..." And it's like, if it's pointless, then why do you show it to us? It just takes up time and it confuses us more.

Raquel – Interview 2

Not only was it difficult for Raquel to see multiple methods, it made it difficult for her to know which method to use and when. Raquel would be especially frustrated when she copied down an entire problem illustrating a procedure, to which the teacher then labeled as one not to use, leading her to disengage in the lecture. Raquel admitted to writing down all the methods to ensure that she had access to them, but unlike Chris, was not able to discern during the lesson which procedure or method was best for her. While the two students recognized that being taught extraneous methods took away from class time and could contribute to confusion they approached this instructional conundrum differently. Chris assessed his learning needs in the moment and ignored the methods that did not work for him. Raquel, on the other hand, copied all methods, though was unmotivated during the lecture, frustrated that they were talking about content that was considered “pointless.” Most of the focal students, like Raquel, copied everything that Beatrice wrote on the board. For the 17 minutes that Beatrice discussed the trial and error method, Chris was the only student who sat back and watched, while the remaining students copied what Beatrice wrote at the board.

These different student perspectives on Beatrice’s declaration of preferred methods suggest that for students the explicit exhortations to avoid certain methods (with the intention of possibly making students’ lives easier) were perceived as detrimental or frustrating as they navigated what was expected as mathematical work in their classroom

Summary

The note packet was the main document that bounded the instructor-content interaction and greatly shaped the content that was presented and available to the students. While a packet created at the beginning of the semester may be seen as a good organizational and helpful tool, it mainly benefited the instructor, and not so much the students. The students could not use the packet in the ways that Beatrice envisioned.

The presentation of the mathematics strongly emphasized the procedural nature of mathematics, narrowing the content even more into preferred methods that were presumably more efficient and effective. It appeared that Beatrice had a fixed plan to present the content, which was not influenced by any other factors in the classroom (e.g., student thinking, or student struggles).

Chapter 7

Student-Content Interactions: “I want to make sure I can get the same steps as her” and “I’ve gotten over being stuck not knowing”

To understand the ways that students interacted with the content in this course, I analyzed the exposure students had to content during the four observations by first looking across the three main modes of instruction: lecture, individual student work, and student presentations. The interaction that students had with the mathematics was limited to the individual student work time and student presentations. It was easier, methodologically, to establish how students thought about the mathematics by focusing on their presentations at the board. In the first section, I describe how two students presented a problem to their peers. In the second section, I describe the student perspectives of the ways that they interacted with the content. In particular I outline how they viewed the content during lecture, individual student work time and student presentations.

Student-Content

A list of the problems that were assigned to students is given in Appendix G. That meant that the area in which I was able to observe and document students interacting directly with the mathematics was during the student presentations. In this section, I highlight two instances in which students in the class presented their work.

Student Presentations

Student presentations came directly after individual student work time. Students only presented during Observations 2 and 5 in the first half of the semester. Four different students presented problems at the board during these observations, three students voluntarily presented three separate problems during Observation 2 (problems that they felt were correctly done), and one student was selected to present work during Observation 5 (a problem that the student had not attempted). As discussed in Chapter 5, students did not speak much while presenting, and when they did, they spoke directly to Beatrice. The students at the board would receive validation and critique from Beatrice, with her physically going to the board and fixing the errors on the student solutions. During each of these presentations, students vocalized the process they used to solve the problems, which allowed me to hear them talk about their work and the mathematics. Beatrice did not involve other students in these presentations. In this section, I describe two student presentations that were atypical in Beatrice's MATH 5. In the first presentation, Rebecca made an error in her work, but she fixed it by herself while at the board; during her presentation, Beatrice asked for students' input. In the second presentation, Beatrice walked a student through the presentation of material for a problem that the student did not complete during the individual student work time. The first episode showcases that some students in Beatrice's MATH 5 were able to grapple with the mathematics in a productive way; the second episode illustrates that with the instructor's scaffolding, some students were able to publicly engage with mathematical thinking.

Student Presentation 1

Rebecca presented the solution to $1 = -4 + \left|2 - \frac{1}{4}w\right|$. She wrote her work at the board in silence. As she was getting towards the end of the problem she looked to Beatrice and scoffed saying, "I think I did something wrong." Beatrice told her to keep going and that when she was finished they would see what happened. Beatrice asked Rebecca to try and explain her work to see if she could catch the mistake (see Figure 7 for the work at this point in the presentation).

While she explained her work, she turned, with her back to the audience and spoke directly to Beatrice. The following exchange took place:

> Rebecca: Um, so I isolated the constants by adding four to both sides. [*refers to the original equation,* $1 = -4 + \left|2 - \frac{1}{4}w\right|$] So… or first I made this equation what it is [*points to* $5 = 2 - \frac{1}{4}w$], then I negated everything on that side [*points to the -5 in* $-5 = 2 - \frac{1}{4}w$].
>
> Beatrice: Ok.
>
> Rebecca: Ok? [*laughs*]
>
> Beatrice: So yeah, so you made two separate equations. You negated one and you left one positive.
>
> Rebecca: And then um, at that point, you kinda have your full equations so then you bring the constant to the other side [*points to the 4 in the original equation, swooping her hand to show that she moved it to the left side*]. So with this being a positive you bring it—it becomes 5 after you add four [*pointing again at* $5 = 2 - \frac{1}{4}w$]. The negative 1…is that what I did? [*points to the -5 in* $-5 = 2 - \frac{1}{4}w$ *and pauses*] No. Um and then with negative one, subtracting 4, adding 4. Oh my gosh! I think that's where I screwed up.
>
> Beatrice: What happened?
>
> Rebecca: Um, so. [*pauses and laughs*] Actually, no, ok. Sorry! The first thing I did was add four to both sides and then you get five [*points to the first line in her work*]. And then at that point I negated one side. So then I get negative five, and then positive five [*points to the two new equations she created*]. And then um, at that point, this kind of becomes parentheses. This totally becomes parentheses [*pointing to the* $2 - \frac{1}{4}w$ *in the equation* $5 = \left(2 - \frac{1}{4}w\right)$]. And then I multiplied by the lowest common denominator, being four. And then it's five equals eight minus w and negative five equals eight minus w.
>
> Observation 2 – Part 2, 29:06-30:41

Rebecca struggled at the start of her explanation to describe the order in which she applied her work. Technically the work she did to add 4 to both sides and to rewrite the two equations was correct. In her explanation, she reverses the order in which she did these two moves, saying that first she created the two equations and then added 4 to both sides. This is where her confusion was with whether she should have had two equations with a 5 or with a 1 on the left-hand side.

However, she is able to pause, review her work, and recognized that she described the order in which she applied the properties and definitions incorrectly.

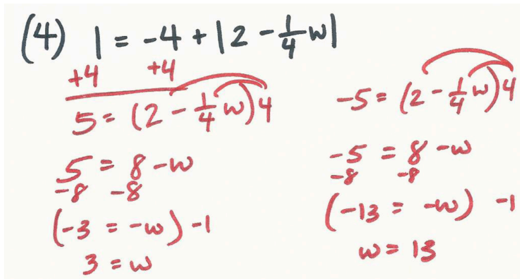

Figure 7. Rebecca's Original Work for Problem 4, Observation 2

At this point, Beatrice stopped Rebecca and acknowledged that there was an error in her work. Rebecca found the least common denominator, 4, however, she did not multiply both sides of the equations by 4, and instead only multiplied the right-hand side of each equation, resulting in $5 = 8 - w$ and $-5 = 8 - w$, when instead she should have resulted with $20 = 8 - w$ and $-20 = 8 - w$. When Rebecca finished her explanation, Beatrice turned and asked the class "Does anyone see an error?" Santiago and Vanessa both raised their hand, and Beatrice called on Vanessa. It was not often that Santiago raised his hand to participate in the class, while Vanessa's voice was regularly heard during class lecture. Vanessa did not correct the error and instead said that she did the problem in a different way and got a different answer than Vanessa, saving "the fractions until the end". Beatrice responded to Vanessa's response by saying, "Oh so you just um…oh I see what you mean," without pressing Vanessa further. At the same time Rebecca said that she realized her mistake, and that she had the work correctly written on her paper, but was doing the problem differently on the board (Rebecca had not referred to her paper after she had created the two new equations). Without asking for Rebecca to explain her error or for any another student's thoughts on the error, Beatrice jumped to the front of the room and explained that Rebecca did not multiply both sides by the least common denominator. Rebecca erased various numbers within her work while Beatrice spoke and appeared flustered as to which numbers to change. Beatrice again jumped in, took the eraser from Rebecca, and said, “So here’s what we’re gonna do” and laughed while erasing the last few lines of Rebecca’s work. Beatrice turned to the class and said,

> Another part of Algebra: When you make a mistake, it’s usually best to scratch it and start fresh. Because sometimes you’re trying to back to correct mistakes and you don’t find them. Sometimes you correct mistakes incorrectly and then you make mistake after mistake after mistake…sometimes it’s just better to *swish-swish*. Etch-a-sketch.
>
> Beatrice – Observation 2 – Part 2, 31:55-32:22

While Beatrice gave this advice to the students, Rebecca fixed her work, rewriting the two equations as $20 = 8 - w$ and $-20 = 8 - w$ and wrote the solutions as $w = -12$ and $w = 28$ on the board. Beatrice asked, “How’s that?” and a female student in the audience said “Yeah”. Beatrice thanked Rebecca saying, “That’s perfect,” and Rebecca returned to her seat. Beatrice did not remind Rebecca to check her solutions, although this was part of the steps outlined for solving absolute value equations.

This presentation was different than other student presentations in two ways. In this case, Rebecca struggled at first to identify the error she made (not multiplying both sides by the least common denominator), but was able to come find the error after reviewing the work she had written (presumably correctly) on her paper. This was different from other presentations because Beatrice always corrected the students’ work without giving the presenter the chance to do so. Moreover, Beatrice, uncharacteristic of other situations, invited the students to comment by asking if they were able to see the error that Rebecca had made but did not take up on Vanessa’s contribution. In the end Rebecca noticed her mistake and fixed it without explaining what it was. In this occasion the students publicly spoke about mathematics: Rebecca spoke more than other students; Beatrice opened up the discussion to the class, using an error as a focal point; and a student offered an alternative solution.

Student Presentation 2

During Observation 5, Beatrice selected a male student at the back of the room to present his work for factoring $2n^2 + 6n - 108$. He had not completed the problem, and Beatrice encouraged him to come to the board anyway and that she would help him. As he approached the board Beatrice said, "Practice! Because I already know how to do it. It's not helpful if I just sit here and do it in front of you right?" reminding the students that presenting at the board was meant to help them in their learning. At the board, Beatrice read out the trinomial as the presenter wrote it on the board. Instead of starting, he turned to look at Beatrice. The following exchange took place:

Beatrice: Ok first thing, what are we thinking?

Presenter: AC-method?

Beatrice: We can use AC-method. That works. Before that do you see any common factors?

Presenter: 2

Beatrice: 2! So let's pull a 2 out first. What are we left with inside the parentheses?

Presenter: [*pauses*] n-squared?

Beatrice: n-squared

Presenter writes $n^2 + 3n - 54$

Beatrice: plus 3 n minus 54. Perfect. So now we have a quadratic in here that's not factorable right *now*. There's no GCF I mean. So then we can use the AC-method on the inside. So go ahead and give that a shot.

Presenter writes a large X on the board and writes 54 in the top section of the X and 3 in the bottom section. He turns to look at Beatrice.

Beatrice: Oh, a negative. [*points at the 54 he wrote in the top section*] So what factors does 54 break into?

Student in the audience: 9 and 6

Beatrice: 9 and 6. Ah so already we know that that one works out [*gives a thumbs up*]. So go ahead and throw 9 and 6 in there. [*Presenter writes 9 and 6 in the side sections of the X*] and then how can I get 3 from 9 and 6? [*Presenter adds a negative sign in front of the 6*] Negative 6. Perfect. So then, what are we gonna do to this? [*points at the trinomial* $n^2 + 3n - 54$.]

Presenter writes $n^2 + 9n - 6n - 54$ *on the board.*

Beatrice: Perfect. Keep going.

Presenter works in silence for 36 seconds. He writes $n(n + 9) - 6(n + 9)$ *followed by* $(n - 6)(n + 9)$ *and turns to look at Beatrice*.

Beatrice: Great, so you factored that. What's the only thing that's missing? For the final answer? The 2 in parentheses. [*student writes a 2 at the beginning of the expression*] Perfect! Awesome! Thank you so much! Give him a round of applause!

Observation 5 – Part 2, 20:43-23:36

Beatrice led this presentation while the student wrote what he was told. The camera in the back could not pick up anything that the presenter said; he spoke quietly to Beatrice whenever he provided a response. In this presentation it was difficult to know whether the student was nervous to present in front of his peers and in fact knew how to factor the trinomial or if he did not know how to factor the trinomial. From his responses, he seemed to demonstrate an understanding of the AC-method, yet looked to Beatrice to receive approval to continue with each step of the problem.

As was customary, the entire class worked on the problem prior to the start of the presentation, so all students appeared to be familiar with the problem. Beatrice made the comment at the start that it was important for the students to do the problems instead of her because they were the ones who needed the practice. However, this exchange reminded me of what regularly occurred during the lecture: Beatrice asked questions about next steps and students provided one-word answers. Only in this case, the student acted as a record keeper. It may be possible that Beatrice decided to scaffold the student's work in this way to help make the student feel more comfortable to present at the board given that he had not completed the problem.

These two episodes illustrate two types of student interaction with the mathematical content. In one we see a student being proactive in both working the problem on her own and, after recognizing that she had made a mistake, fixing it in the front of the class. In the other we see a student, who was able to scribe the solution to a problem that he may or may not know how to work on his own, giving him and the rest of the students in the class the opportunity to produce a correct solution to the problem. These interactions may seem limited but illustrate that in this class there were students who were capable to deal with the mathematical work that the class supported.

Because as the semester progressed Beatrice presented most of the problems after students were given time to complete them individually at their desks (see Appendix G), it became routine for some students to just wait for Beatrice to work the problems at the board once the individual work time was over. As Beatrice brought their attention back to the projection, students would start writing in their notes. Beatrice noticed this behavior as the weeks progressed.

> I started looking around and noticing that more and more people were doing less and less. So before, it was like, "Okay, everybody's head's down. They're working." Then it was like, "Okay. People are looking underneath their desks, so they're probably looking at their phone." 'Cause who looks at their crotch all day? And then I noticed that you know, people were just kind of like staring at me, or staring off into space, or just trying to avoid eye contact.
>
> Beatrice – Interview 2

After Week 8, Beatrice stopped student presentations, because of time pressure and continued going over the solutions problems after the students “worked on them.” She said that she was intentionally trying to engage them while she presented in order to support their interactions with the content: “I always ask them throughout the problems that I'm doing, ‘Why am I doing this? What's my next step?’ I try to give like, questions to kind of get their mind going, even if they're not saying it” (Interview 2). From Beatrice’s perspective, students were given plenty of opportunities to engage with material; but this approach makes it difficult to see students’ actual engagement with mathematical work that would be visible when students are presenting their work and their thinking to peers while at the board.

Student Perspectives on the Student-Content Interaction

While I was only able to describe the way that the focal students interacted with the content during the student presentations, the students talked about their interactions with the content in many more areas than I was able to access via observation. I primarily talk about their perceptions of the interactions with the content during lecture, individual student work, and student presentations. Overall most of the students wanted more direct engagement with the content beyond the opportunities that Beatrice gave them in their MATH 5 course. They said that watching Beatrice solve problems was not necessarily the best strategy (even when that strategy was described by some as fitting their needs). Second, when students described moments that went well, did not go well, or were challenging, in almost all the cases those referred to their interactions with the content, which reveals that they were keenly aware of a main purpose of them being in the class, to become proficient with the material.

Lecture

Students felt that the lectures required a lot of copying and listening, without many opportunities for them to think deeply about the mathematics. Adriana preferred not having to think too deeply about the mathematics, and appreciated that the note packet had a lot of the content already displayed without her having to copy. “Because like, it's all there. So all you have to do is just copy what she—Well, listen and copy and try to like, memorize it. And like, writing it all down—'cause then you get confused" (Interview 2). Adriana felt that without the note packet, copying down the definitions, steps, and problems could have left room for her to copy it incorrectly or get confused about the mathematics. Having the notes ensured that she had the correct information about the content. Santiago, on the other hand, felt that having a lot of the content pre-written took away from his learning.

> I feel like I learn quicker if I were to like, write it down and then solve it. Instead of it just being there. I could like, as I write it down, I know what I'm writing and then I understand it a bit more than just, "Oh I see it," and then I don't know what it is."
>
> Santiago – Interview 2

Santiago felt engaged with the content when he was able to write down the problems and definitions, and then to work on them himself.

For some of the students, the lectures were not engaging. Layana often struggled with the amount of notes that she took and did not feel that she understood or learned any material by copying someone else.

> I feel like I would like a little more engagement, like, just not so much lecturing. Yeah, you know. Like working with your partner or going up to the board and doing it more. Just not so much lecturing and copying down what she's writing, because sometimes when that's happening I kind of feel like I'm not really putting into practice what she's saying. And then when she's like, "Okay, go ahead and work on a problem," I'm like, "What the heck do I do?" You know? But I've been copying her the entire time as she's going. But I'm not necessarily learning it. So.
>
> Layana – Interview 2

Layana wanted deeper engagement with the content, and more opportunities to do so via alternative modes of instruction. Raquel also found that Beatrice lectured too much about the material, and she preferred having more time to practice the content on her own. The previous semester, she had taken a MATH 5 class that mainly used the ALEKS learning program instead of traditional instruction. Students came to campus to work individually on the program, and there was no lecture and no interaction with her peers. Raquel believed that this section of MATH 5 did not offer nearly as many opportunities for students to engage directly with the mathematics.

Three students found a way to challenge themselves with the content they were learning during the lecture by choosing to work through other problems that were projected that Beatrice was not demonstrating. Chris, Guillermo, and Marisa attempted to work on additional problems whenever they were within view on the projection. Chris tended to work ahead of Beatrice, working on the problem she selected to present as well as others that were also displayed on the document camera. He enjoyed knowing he could practice other problems, using his time more efficiently. Guillermo enjoyed doing the extra problems when he had time to. Marisa described her reasons for working on extra problems:

> A lot of the time I'll go ahead and try and do the problems while she's explaining another one. Like, if I feel if I got the topic, I'll be like, "Alright. I can see that there's three other problems on here. So I'm going to go try and do those."… And then sometimes she'll go over them and I'll get validation, like, "Oh, yeah. I did the right thing." But sometimes it's wrong…She's not teaching at a slow pace. But sometimes she does need to go over examples a couple of times for other people, which I don't think is a bad thing at all. I think it does give me more time to like, I don't know, do things by myself and try and work it out by myself. And then get—like I said—validation for actually getting it right and knowing that I did the right thing on my own.
>
> Marisa – Interview 2

Marisa chose to spend her time during lectures working individually so that she could have more opportunities for individual practice rather than following along with Beatrice.

I see a range of perspectives on the students' interactions with the content as Beatrice presented it; all students recognized Beatrice lectured too much, but for some students, this was just fine, while for others, it was either overwhelming to the point of not letting them keep up or an opportunity to be selective about how they spent their time during the lecture.

Individual Student Work

The students enjoyed the times in class when Beatrice assigned practice problems, as this was the time when the students could put into action the procedures and methods that she presented. The most common response that students gave in the observation surveys about moments that went well related to when students were able to complete a problem correctly during the individual student work time. For example, Guillermo indicated that a moment that went well for him was during Observation 8, when he was given the warm up problem, $(\sqrt[3]{9}+\sqrt[3]{2})(\sqrt[3]{3}+\sqrt[3]{4})$, and he “knew how to do it.” Marisa felt that a moment that went well was “when I attempted problem 6 and 7 in 8.4. I got both of them by myself and I got them correct” (Observation 10). Both of these problems required Marisa to rewrite the equation in logarithmic form: $12^2 = 144$ and $9^{-2} = \frac{1}{81}$.

In many of these instances, the students referred to support or validation needed from the instructor, which made them feel positive about those moments. That is, students did not feel comfortable to continue or finish the problems they were completing without the help of Beatrice. Self-reliance is something that we generally want students to build up, such that they can feel confident in their work. In Observation 8, while Adriana, Layana, Teresa, and Nancy described the practice problems as moments that went well, they included their instructor as a contributor to these moments. Adriana and Layana felt that a moment that went well in class was working on the final practice problem that they were given. Students were given the following problem, $\sqrt{x}+1=\sqrt{x+1}$, as an exit problem. While no directions were given, it is assumed that students should solve for x. Figure 8 shows the work presented by Beatrice after students spent time working on this problem. This problem was different than others demonstrated because one side reduced to the value zero (line 3 of the work), resulting in the final solution of

$x = 0$. In Adriana's survey response for Observation 8, she described working on this problem as a moment that went well. Adriana described, "winging" the exit problem until Beatrice came by to check in on her. At this point, Adriana asked Beatrice if she was doing the problem correctly. "She said 'ya' and then she explained how I had to move the 1 so it'll be 0 on the other side and then square it to get the radical out" (Observation Survey 8, Adriana). While it is not entirely clear what Adriana is referring to, I believe she was stuck at line 3 (see Figure 8), unsure what to do, as subtracting 1 from both sides would result with the right hand side simplified to zero. It appeared in this instance that Adriana had arrived at a specific point in the problem, $2\sqrt{x} + 1 = 1$, and did not know how to continue. Anecdotally, students sometimes believe that an answer of $x = 0$ is not a valid response. Perhaps Adriana was unsure how to continue, because she would result in $2\sqrt{x} = 0$. On the other hand, perhaps Adriana instead had tried to square both sides of the equation $2\sqrt{x} + 1 = 1$, when subtracting the 1 was more efficient to solving the problem.

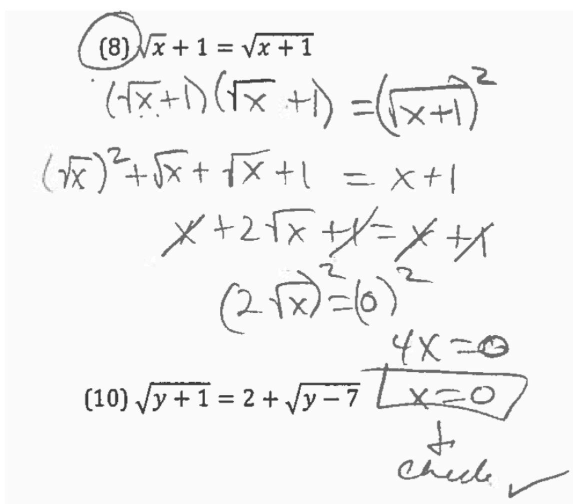

Figure 8. Demonstrated Work for Practice Problem 8 in Observation 8

Layana also had issues while working with the same problem, but felt that this was a moment that went well for her. "Once she clarified what I was stuck on, everything went smoothly. I was able to complete the problem without further assistance. It was the last problem, which I got a 0 and I thought it was wrong but it turns out it was the right answer" (Observation Survey 8). In this case, Layana thought that her solution of $x = 0$ was not a valid response. Had Layana could have checked if her solution was true by substituting it into the original equation. Beatrice always suggested that students should check their solutions at the end of the problem, yet did not always enforce this with every problem. Instead, Layana needed the guidance and validation from Beatrice, and felt more confident with her work after receiving this attention.

Nancy and Raquel referred to needing Beatrice's help in order to complete problems. For example, Nancy said that working on the practice problems were both moments that did and did not go well for her. For example, in Observation 8, Nancy felt that starting the problems on her own was troublesome for her. "They all seem the same to me. I don't know how to start it" (Observation Survey 8, Nancy). Students were asked to simplify radical expressions and solve radical equations. In order to get started on the practice problems, she needed Beatrice's help to guide her, and then she was able to complete them from that point. Nancy described, "when we were doing the practice problems it went well because once the instructor got me started I knew what to do with the problems on my own" (Observation Survey 8). In the first practice problem, $\left(\sqrt[3]{9} + \sqrt[3]{2}\right)\left(\sqrt[3]{3} + \sqrt[3]{4}\right)$, students were required to multiply two binomials. The second problem, $\left(1 + \sqrt{2x - 1}\right)^2$, required students to do a similar operation, but needed to understand that $\left(1 + \sqrt{2x - 1}\right)^2$ could be rewritten as $\left(1 + \sqrt{2x - 1}\right)\left(1 + \sqrt{2x - 1}\right)$. In the final problem, students needed to solve the equation $\sqrt{x} + 1 = \sqrt{x + 1}$. Nancy may have had challenges working on these problems for several reasons. First, the first and last problems did not include directions (see Appendix G). Maybe Nancy did not know how to get started on the problems because she did not know what the directions were for the problem. Second, the three problems appear similar yet different. All three problems contain radicals. However, each requires different attention. In the first two problems, the operation was the same: multiply two binomials. However, the two problems may have appeared slightly different to Nancy: the first problem did not contain variables whereas the second problem contained a binomial radicand. In the final problem, Nancy needed to practice what she learned from the second problem, and isolate the radicals in the equation two times. However, it is not clear what Nancy struggled with in starting the problems. What is noticeable during this observation is that her partner, Vanessa, was absent. In almost all the observations, Nancy and Vanessa whispered to each other during individual student work time, and Vanessa often let Nancy read the work she did on the problems. It seems that this is one of the first times Nancy needed to rely on Beatrice to work effectively on the problems, implying that perhaps Nancy did not understand how to start many of the problems they were given.

Beatrice selected the problems that students worked on during individual student work time. As mentioned in Chapter 5, the ordering of the problem selection may have been challenging for students. From Observation 2, Adriana, Layana, Marisa, Nancy and Teresa described working on the problems with fractions contributed to challenging moments and to moments that did not go well for them. Students were given three practice problems that contained fractions during the individual student work time: $3\left|\frac{3}{2}a+1\right|+2=14$, $1=-4+\left|2-\frac{1}{4}w\right|$, and $\left|\frac{4w-1}{6}\right|=\left|\frac{2w}{3}+\frac{1}{4}\right|$. Layana mentioned that she had issues with fractions multiple times throughout the semester and commented on how she felt when she struggled.

> Layana: I just kind of, when she was going over the fractions I was just kind of just watching. Because I just, mentally I just could not keep up with what she was doing. So I just kind of took a step back and I was like, “Okay, let me just watch.” But it wasn’t like, “Alright, this is how we do it. And when this comes up, we do that.” It was just like, here

> doing it. She was like, “Okay, got it?” and then she’d move to the next one. And I’d be like, my eyes were barely adjusting to the problem and she turned the page.
>
> Researcher: And do you feel like… in that moment, what was your decision about not raising your hand to make a comment?
>
> Layana: Um… I guess it just kind of falls back, like, I wouldn’t want to put her on the spot, maybe? Like, “You’re moving too fast.” So I don’t want it to come off like I’m criticizing how she’s teaching something.
>
> Researcher: Do you think there are other students that might have had similar problems with fractions that you had?
>
> Layana: Yeah, because she, she like joked about it. She was like, “Woo! Fractions!” Because she knows – I’m assuming – being a math professor you know that people don’t really get along with fractions. So she kind of joked about it. But you would think that you’re joking that something’s hard. Why not go slower, you know? So even the gentleman next to me was like, “What did she just do?” I was like, “I have no idea.”
>
> Interview 2

There were no problems on the quizzes or exams where students were expected to add or subtract fractions, so I do not have any evidence of student work to provide here. However, the topic of fractions was commonly referred to when students described challenging content.

All students mentioned content in one way or another when describing moments that went well, did not go well, or were challenging. They had the opportunity to talk about other challenges (e.g., being tired, feeling rejected by peers or the instructor) yet they talked about their interaction with the content. We learned that while working individually, students, for the most part, were expecting reassurance from Beatrice that their work was correct. Students also spoke extensively about the challenging nature of the problems that they were given to work individually relative to those the Beatrice had demonstrated in the lecture. From their perspective, the scaffolds provided were not sufficient and they felt they needed more assistance.

Student Presentations

While Adriana, Raquel, and Marisa indicated that they had presented during other classes in the semester, across the four observations, Chris was the only focal student observed presenting at the board. Chris, Marisa, and Raquel volunteered to present whereas Beatrice chose Adriana to go up to the board when no one volunteered. Chris and Marisa, the two students who volunteered to present the most, felt that the presentations were not beneficial to anyone other than the presenter. From the descriptions of the presentations earlier, it was clear that the students in the audience were not often incorporated into the activity. Chris felt that he did not want to take away opportunities from others by always volunteering to present. “I don't feel like [presenting] really benefits everybody. It mainly benefits the person going up on the board” (Interview 2). Marisa chose to present at the board because it contributed to her confidence that she knew the material, and acknowledged that when she presented, it was mainly for her own benefit not necessarily for the others in the class.

Adriana felt that all too often students were silent when Beatrice would ask for volunteers to present, which made her feel uncomfortable to ever volunteer herself—she didn’t want to be the only one raising her hand. Adriana described what she did when she presented, “So I just told them what was I, what did I do first. And then what did I do after that, and then yeah. How I got the answer” (Interview 2). Raquel presented early in the semester, and was one of the first students to present. When she presented her problem, Beatrice had found an error in her work and corrected it in front of the entire class. Raquel had only volunteered to present because the tutor had assured her that her response was correct. In her presentation, she was asked to find the union of two sets: B: $x > 0$ and C: $-4 < x \leq 3$. In her work, she graphed the two inequalities (see Figure 9) and wrote that her solution was $(-4, 0) \cup (0, 3]$. Beatrice corrected her solution in front of the class, indicating that the solution did not stop at 3, but continued to positive infinity. Raquel added to her solution and wrote $(-4, 0) \cup (0, 3] \cup [3, \infty)$. Beatrice further corrected her response told her she could write a simplified version of the interval by writing $(-4, 0) \cup (0, \infty)$. She explained how that experience went for her

> Researcher: So what made you decide on that day, that you wanted to go up to the board to volunteer or present?
>
> Raquel: Um, because I was working on it, and then like, I asked the tutor for help. And then, he, I told him, "This is, is this right?" [*laughs*] He's like, "Yeah, that's, that's right." And then I went up the board and I was like not right. Well it was like, half almost right. Yeah, 'cause then there was like, more to it. So I was like, kind of embarrassed, but at the same time, there was probably more people that were just like me. So it doesn't, it didn't really matter, but it helped me as well.

Raquel – Interview 2

Raquel went to the board because she felt confident given the validation from the tutor. While she felt embarrassed to be corrected in front of her peers, she recognized the value of having her work critiqued in front of her peers as not only helping her but also helping others who may have committed the same error.

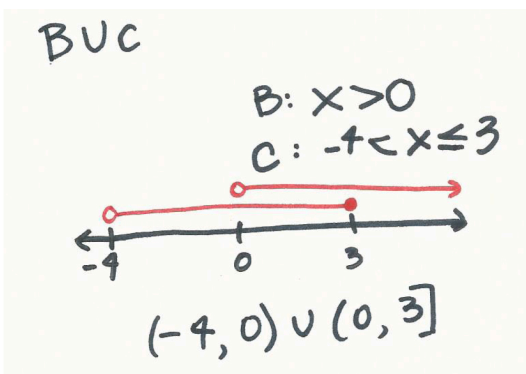

Figure 9. Raquel's Presentation of Union Of $x > 0$ *and* $-4 < x \leq 3$

However, the work that Raquel presented at the board reflected the errors that were made in that day's lesson. The correct response for $B \cup C$ is $(-4, \infty)$. In the notes, Beatrice demonstrated how to find the intersection of two sets incorrectly. First, she told students that if there were a value that was not in one set (in this example, zero in set B), then it would not be part of the union of the two sets. The union of two sets contains all elements in both sets. In this example, because set C contains zero, then the union will contain zero. In the lecture, Beatrice told students to exclude the end values, or the values that were labeled with an open circle, when writing the union. Second, in her notes, she wrote solutions to unions of sets in the same way that Raquel wrote her final response. That is, in the lecture, Beatrice told students that a solution such as $(-4, 0) \cup (0, 3] \cup [3, \infty)$ was correct. In mathematics, interval notation is a notation that represents a continuous set of numbers that satisfy a given statement. The number 3 is included in the solution, and therefore does not need to be written as a union of two sets, namely $(0, 3]$ and $[3, \infty)$. In her presentation, Raquel did not extend her solution to include numbers to positive infinity, however, the mistake of not including zero, and writing the solution as a union of three sets, followed the mathematics that Beatrice presented. Beatrice did not identify the error either and wrote on the board the way she would like to see the solution presented (Figure 10). This example illustrates that Raquel had the ability to apply the mathematics that she learned from the lesson, even though it was mathematically incorrect.

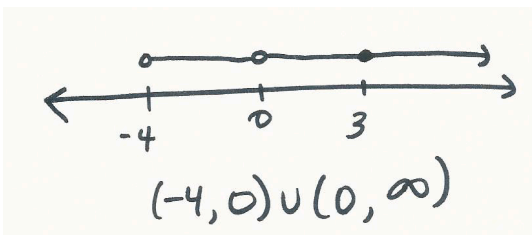

Figure 10. Beatrice's Solution for Representing the Set Resulting from the Union Of $x > 0$ *and* $-4 < x \leq 3$

Other students did not go up to the board for various reasons. The most prominent theme across most students for not presenting was because they did not feel confident with the mathematics. For example, Layana did not go to the board because many of the times when

Beatrice would incorporate presentations, Layana had not understood the problem they had been working on and did not have any work to present to the class. Layana felt that in fact most students did not raise their hand to present for similar reasons—they did not know what they were doing. "It's not like they don't want to. It's because they're just lost" (Interview 2). Layana described the content as being challenging though did not relate it back to specific content (Appendix G shows the types of problems students were asked to complete during the focal observations). She felt that when students were given opportunities to go to the board, they chose not to because they did not know what to do with the content. Recall that student presentations occurred during the first half of the semester, when Beatrice did not rotate around the room when students worked individually on practice problems. Students did not often raise their hand for help on these problems. Layana admitted that instead of asking for help, she would stop working on the problem and wait until it was presented later. For this reason, she and other focal students did not volunteer to present to the class.

The focal students noticed that individual students in the class did not eagerly volunteer to present their work at the board. In part, they said, it was because they either felt insecure about the correctness of their work or did not know how to start the problem. Students commented that during individual student work in the first half of the semester, they were not inclined to initiate interactions with Beatrice to check the correctness of their work or request assistance to start the problem. This led to them not being willing to volunteer to present their work at the board. Students noticed that the student presentations benefitted only the presenter, because Beatrice's feedback on the correctness of the solution addressed directly the student at the board and rarely involved the rest of the class. As presentations dwindled in favor of more student-instructor interactions during individual student work, the interactions with content changed to be more personal. Yet other students were aware that being at the board presenting work that contained errors could benefit other students in the class.

Chapter 8

Lived Experiences: The Stories of Adriana and Layana

In this chapter, I describe the stories of two students in MATH 5: Adriana and Layana, two students who sat a few desks away from one another yet had different experiences and results in the course. That is, even though both students took a course that could be seen as providing the same experience to them, a course that was influenced by similar environments, their instructional experiences were quite different. I argue, that an important reason lies in the differences of the individual students' environments; the differences in these two students environments had a great influence on their instructional experiences. These environments shaped and influenced the each student's community cultural wealth, "an array of knowledge, skills, abilities and contacts possessed and utilized" by underrepresented minority students to survive places that may not be structured to fully support them (Yosso, 2005, p. 77), which in turn, influenced their behavior in the classroom, their role in the process of doing mathematics, and their success in the course. In the case of Adriana, her perspective as a mathematics doer aligned with the format of instruction, and in consequence, she did not feel the need for change in her instructional experiences. Layana, on the other hand, did not feel that her learning was supported in the way that she needed, and made suggestions to the instructor, which in turn shaped her instructional experiences in different ways. Adriana and Layana were similar to other students in the study. Adriana, like Teresa, Santiago, and Nancy, came to class, did what was expected of her during class time, and overall felt that the course was what she expected of a college mathematics course. Layana, like Chris, Marisa, Guillermo, and Raquel, had spent time at the college already, and in some ways understood how to make changes such that the instruction worked in a better way for her. For each student, starting with Adriana, I will describe five areas. First I will describe the home life for each student, describing her family support and obligations she maintained outside of the classroom. Next, I describe her previous school experiences, including her previous mathematics experiences and relationships with peers and instructors. Third, I describe her relationship with mathematics followed by her educational goals and aspirations. Finally I describe in detail her instructional experiences in the MATH 5 classroom. To conclude this chapter, I compare and contrast the two students' instructional experiences, providing insight into how the students' different levels of capital may have operated within their instructional experiences.

Adriana

Adriana is a 19-year-old woman, born in the United States to Guatemalan parents. She is a first-year, first-generation college student.

Home Life

Adriana lived with her mother and 13-year-old sister in a two-bedroom apartment. They shared this apartment with two other men to help with the cost of rent. While not of blood relation, she considered one of these men as a father figure (Adriana never knew her own father) and referred to him as her stepdad. He was born in Mexico, immigrated to the United States without documents, and opened a tailor shop. Her mother left Guatemala for a better life, moving to the United States without documents, taking up jobs as a sewer at any factory that would hire her. She recently lost her job in a factory because there was a lawsuit filed to pay workers more than just a few cents per piece of clothing, so the factory shut down and made plans to move to Las Vegas where they could continue their (mal)practice of underpaying their workers. Adriana helped her mom cook, clean, and look for other work, while also looking after her sister. She helped her stepdad with his work writing checks to pay bills as well as translating emails and other important letters from English into Spanish. Neither her mom nor stepdad spoke or understood English very well. Her mom finished her first year of middle school before dropping out to work, while her stepdad did not finish elementary school in Mexico.

Finances in the household varied depending on whether or not Adriana's mom had a job. While her mom wanted her two daughters to have what they needed, there were times when they couldn't afford new things. At the start of the study, Adriana mentioned that her two pairs of pants (the only pairs she owned) finally tore, but her sister also needed a new school uniform because she grew substantially over the summer. Her mom was able to buy her sister a new uniform, but could not afford anything for Adriana. Her stepdad did not want Adriana to start school without something new and stepped in, buying her three pairs of new pants, two shirts, and a sweatshirt and offered to fix her torn pants.

Gang activity was a common occurrence in her neighborhood, and Adriana was used to the stories that she heard from her neighbors. Only two days before the start of the semester there was a shooting right in front of her building, while kids were playing out front. Neighborhood shootings regularly occurred to counter rival gang members invading other gangs' territories. Adriana was grateful that they lived on the second story because she had not yet dealt with gang members trying to break into their apartment in order to hide from the police, as had often happened with her neighbors downstairs. Adriana had become accustomed to this activity, "I mean at the beginning I [felt] unsafe but then now it's just like I'm used to it you could say" (Interview 1). She learned that if she and her family kept their heads down, they would stay out of trouble with the surrounding violence they experienced.

Adriana strived to be a good role model for her sister; she believed that her sister was a good kid and that they had a very good and open relationship. Adriana defined herself as a "good role model" by being open with her sister about the mistakes she made in high school and the challenges she faced to even graduate. Adriana knew her sister looked to her to understand what *not* to do when she entered high school. As a young teenager, Adriana faced difficult challenges and experiences, learning quickly how to make very adult decisions. She came to understand how her decisions affected her future, and used her hard life experiences as a way to rise above those around her. While Adriana had set bad examples for her sister when she was younger, she was hopeful her sister could learn from her mistakes and not repeat them.

Adriana realized she needed to start making better decisions because her sister was watching the repercussions of the choices she made, and was pleased when she realized she had a chance to make a big change by starting college. When it came time to decide what college to attend, Adriana vowed to herself that she would go to a school that was out of her neighborhood; she wanted to be far away, in a new place so that she could meet new people. She wanted a fresh start. The main factor for Adriana's college selection was its distance to where she lived. She did not look into the types of programs or supports the colleges offered, but estimated whether she would know anyone at the college. She settled on Clear Water College and even though the commute took about an hour each way, she felt it was worth it. She was pleased with her decision because she felt that CWC was filled with friendly students who were serious about their studies.

Previous School Experiences

Adriana went to three different high schools over the course of five years. She attended Hemlock for 9th and 10th grade, transferred to Willow where she repeated 10th grade and completed 11th grade, and then graduated from Birch high school. *Table 6* shows Adriana's high school timeline, including the courses that she took and important instances that she recalled. By the start of 10th grade at Hemlock, Adriana realized it was time to make a change; she had failed several classes her freshman year and had created the incorrect reputation for herself as a student who did not care about her studies. However, it was too late as the school system felt she needed to move to a different school that "supported" underperforming students, and was transferred to Willow high school, a continuation school. She wished she had never been sent to Willow. Adriana felt that Willow high school's learning program did not promote students to succeed: students were required to complete "contracts" for specific course content, yet many students were not informed fully of how to do this, causing students to repeat multiple classes and to feel stupid. "I feel that's why I got so left behind" (Interview 1). Adriana's purpose at Willow was to get ahead, yet due to the lack of administrative support and a learning program that seemed to retain students rather than help them succeed, she ended up repeating 10th grade.

Table 6: Adriana's High School Timeline by Grade

Grade	High School	Mathematics Course	Important Instances as Described by Adriana
9th (2011)	Hemlock	Algebra 1	Skipped School
10th (2012)	Hemlock	Geometry	Wanted to make a change and get back on track
10th (repeated) (2013)	Willow	Algebra 2	Transferred to Willow, required to repeat courses, placed in lower math courses, judged by faculty
11th (2014)	Willow	Algebra 2	Tried to make progress, lacked support for navigating college entrance, continued to face judgment
12th (2015)	Birch	Statistics	Found faculty support, learned how to navigate college, applied for financial aid, graduated, worked as a cashier at a fast food restaurant

Adriana spent two years at Willow high school, and experienced a lot of mistrust and judgment from faculty and administration. When Adriana transferred, she should have been placed in Algebra 2 but after taking the required placement test with confidence, she was placed into pre-algebra. Because math was her favorite subject and she had recently finished Geometry, she asked why she was being placed in such a low course. The counselor told her that every student had to complete pre-algebra to be able to move to higher-level math courses. However, Adriana noticed that the few White students who transferred into Willow were placed in higher-level courses; they were never placed in pre-algebra. When I asked her why she felt they did that, she angrily said,

> 'Cause they thought we were stupid or dumb. Even though we took the test supposedly, that would put us in the math class that we're supposed to be in. No, they bullshitted and like, they put pre-algebra for every student. Even me! And then it's just like, I already took Algebra 1, Algebra A and B. I had took [*sic*] Geometry already. I'm supposed to take at least, you know, Algebra 2. And then they wouldn't give it to me. I had to take pre-algebra. Pre-Algebra, I already did it, you know? Like, I already understand that. And then the teacher, when he noticed that I was good at it and he wouldn't like, he wouldn't say anything. He would just be like, "You have to stay. You have to stay. You have to stay in this class. You have to pass it." I'm like, "But why am I taking it if I already learned this? Like, why am I taking this class?" You know? So that's why I feel like we [Latinos], we don't get um, how do you say? We don't get noticed what we could do [*sic*]. Like, we're actually smart. We're like, not stupid also.
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> Adriana – Interview 3

According to Adriana, Latinx students were placed in the higher classes because they did not look like trouble-makers and spoke proper English. These students did not use any slang or did not have a strong accent. However, Adriana knew that these students were not in fact smarter than her; she felt that they just copied from their peers once they got into the higher-level classes. Adriana said she experienced judgment and ignorance from administration and teachers regarding her mathematical abilities; they thought she was not very capable even when she had opportunities to prove them wrong.

The entire school consisted of almost entirely Latinx students. The faculty at this school were mostly White and Adriana experienced many difficult situations with her teachers. She felt that they always assumed that she was a bad kid, doing drugs or involved in worse activities, when in reality she made a point to avoid that kind of behavior. Adriana felt that the teachers did not understand her or any of the other students, nor did they try to. She believed that the teachers held stereotypes of all students, and grouped everyone together under those stereotypes. For example, Adriana recalled instances when her teachers would accuse her of using drugs or hiding drugs for her boyfriend. Adriana did not do drugs, as this was something her mother instilled in her at a very young age. Adriana was upset that she was accused of something she never took part of. In fact, her English teacher told her that she "understood the game" and in front of the entire class accused all the Latina girls of protecting their boyfriends and hiding drugs. Adriana was unable to avoid these types of experiences, and they became regular interactions in her classes. She did not feel that her teachers were there to support her, and instead found herself defending false accusations about her behaviors.

Overall, Adriana felt that she had been ignored and mistreated at Willow high school. She felt her learning was impeded because her classmates lacked focus and that affected her ability to engage in her classes. Her classes were often rowdy; she recalled a time when her Physics teacher just stopped teaching because the students were out of control. The only math course she completed in the two years at the school was Algebra 2. As a senior, counselors were supposed to reach out to those who indicated interest in applying to college. No one ever reached out to Adriana. She felt that she was so far behind and did not have the resources she needed to continue forward.

When Adriana turned 18 in 11th grade, she was able to choose to leave Willow high school and enroll at yet another high school. At the start of her fifth year as a high school student, Adriana elected to enroll at Birch high school. Birch was an alternative continuation school that served students aged 18-24 who wanted to finish their high school diploma. Birch had a good record of supporting students. Adriana saw an immediate difference in her life. At Birch, students were there because, like her, they *wanted* to be there. She encountered teachers who were supportive and praised her accomplishments. The school offered courses such as "College and Career" readiness, which she attributed to helping her navigate college enrollment, informing her of colleges to apply to, and how to select classes. Birch provided support to help her understand how to apply for student grants and loans. While she was only there for less than a year, she was able to make up the courses she was lacking in order to graduate within five years.

Relationship with Math

Adriana completed Algebra 1, Algebra 2, Geometry, and Statistics in high school. While at her third high school, Adriana had the opportunity to make up the second semester of Algebra 1, which she had failed when she was a freshman at her first high school. The instructor gave her encouraging words, telling her that she was a really good math student and that he was surprised she had ever failed the course previously. Her favorite class was Geometry. Of all the subjects in high school, math was her favorite, "It just really gets my attention. It really does." She liked math because it was organized and there were lots of formulas to memorize, which she found exciting. She enjoyed math over history or English because when working on math problems, she felt that there always existed one right answer and that she knew when she found it that the problem was over.

Adriana felt that she was a good math student. She was a visual learner, which to her meant that if she could watch how an instructor presented a problem, she could also follow those steps to complete a problem as well. She felt confident—if her instructor asked her to work on a problem, she could probably find the correct answer. She was not afraid to go up to the board and present a problem to her peers. She said she enjoys when her instructors come to her and spend time one-on-one with her, pointing out where she has made a mistake in her work. She believed that this is the best way for her to learn. She thought that other students see her as someone they can turn to for help. However, she preferred to have practiced a problem enough before feeling confident to help others.

Educational Goals

Adriana had varied goals for her future career. At the time of the study, she had not yet decided on what she wanted to be, but hoped that being in college would help her make that decision. She enjoyed math quite a bit so she had thought about being a math teacher. She had also thought about being a registered nurse, a dental hygienist, or a make-up artist. In three years, she saw herself either working at a job where she would feel valued (unlike her previous work experience), or also possibly continuing school after transferring to a well-known university.

Adriana's mom and stepdad always spoke highly of going to college and being in school. Adriana's stepdad was the authoritative voice in the household, constantly telling Adriana and her sister that he expected high grades and did not want to hear that they were ditching classes or failing. Her mom constantly reminded Adriana that she needed to keep trying and push to succeed in school, including college. Adriana was the first person in her family to attend college. Her mom shared stories with Adriana about the opportunities that she missed by not being able to have access to education. "[My mom] wants us to be more… like not lower class. She wants us to be there you know?... able to support your family" (Interview 1). Her mom pushed her to persevere and reminded her that with a good education she could do great things.

Adriana believed that going to college was important. "Without education you won't be, I mean without it you won't do anything. I mean, you'll be what? A part-time employee? You know?" (Interview 1). She believed that mathematics was an important part of a college education, "I think [math is] important because like sometimes when you're a cashier and let's say you do a mistake and you accidentally press a hundred and it was $20 that they gave you, you have to figure it out quick" (Interview 1). She understood that mathematics was important for whatever her career choice is, but did not quite know what kind of math would be useful to her.

Adriana is motivated to complete a college degree because she recognized that she did not want to be in the same situation as her mom. She did *not* want to be paid minimum wage, "I want to do something better" (Interview 1). While at Birch high school, Adriana had worked for a fast food chain and recognized the challenges that it presented. While it was exciting to earn money and be able to buy herself clothes that she needed or to go out with friends, she realized that working for minimum wage was not getting her anywhere. Her previous manager offered her many hours and often scheduled her during hours she had requested off because of her school schedule. Her manager knew that the schedule he created affected her schooling, but insisted that she should consider working instead of putting time into school. She found that work was causing her to slack in her studies so she ultimately quit her job. Starting college, Adriana said that she would like to work while studying at CWC, but could only do so if she found a place that understood her commitment to school. However, finding a job was not a high priority for Adriana she received financial aid, which made attending college more attainable. Her financial aid paid for her classes, books, and some food while on campus. At the start of the study she did not plan to work while a student, and emphatically referred to her financial aid as supporting her to solely focus on school, “I mean they pay me to be here”. However, around halfway through the semester, Adriana decided to apply for jobs. While she indicated at the start of the term that she did not plan to work while a student, she applied for and accepted a job working a Jack-in-the-Box. She wanted to earn money so that she could buy herself some things for her birthday in November. She also wanted to buy her mom and sister Christmas presents. In particular, she felt that she could work about 40 hours a week at this job, and had the impression that the manager was sensitive to her school schedule. The location she chose to work at was about a 45-minute bus ride from her apartment. She often worked late shifts, getting out of work just before midnight.

Experiences in the MATH 5 Classroom

By the end of the semester, Adriana described the class as “unexpected.” She felt that this class was going to be extremely easy and realized within the first few weeks that it would not be. She was surprised by how fast Beatrice covered material and the level of difficulty of the new material (e.g., imaginary numbers, graphing logarithms). However, Adriana felt that the instruction and level of interaction fit her needs as a student. In this section, I will describe Adriana’s perceptions on the instruction in MATH 5, the classroom community, and interactions with others. I will also synthesize challenges that she faced as a first-generation college student as well as her performance in the class.

Adriana’s Perception of the Instruction in MATH 5

Adriana enjoyed the way that MATH 5 was taught. She described two components to the course, lecture and practice, providing a routine that Adriana could expect. Because she learned best by watching the instructor demonstrate problems, she found that there were plenty of opportunities to mimic Beatrice's work: "I follow the steps like [the teacher] does it" (Interview 1). Adriana felt that Beatrice helped her learn the math by correcting her work when she walked around during individual student work time. For example, in one class the students were given the following problem as a warm-up: $\frac{15}{x} + \frac{9x-7}{x+2} = 9$ (Observation 6). Beatrice came by and noticed that Adriana was having the same challenge as other students in the class: finding the least common denominator (LCD). The LCD for this problem was $x(x + 2)$, and it is used to help reduce the terms in the equation such that they are no longer rational. In this instance, Adriana wrote the LCD in its distributed form, $x^2 + 2x$ and got stuck when she was trying to reduce the terms in the equation, written as $\frac{15(x^2+2x)}{x} + \frac{(9x-7)(x^2+2x)}{x+2} = 9(x^2 + 2x)$. Adriana recalled the event:

> So, I know she checked today my work, I think for the warm up. The first warm up, and she's just like, "Okay, I see that everybody did this wrong." So when she went to go up there and do it, I'm like, "Oh, like I know what she, I know what I did wrong." I think I forgot the x. I for-- I forgot to factor it. So I just put $x^2 + 2x$ but I was supposed to factor it. […] Yeah, and then that's where I was like, "Oh, okay." 'Cause I thought I got it right 'cause it, it, it looked right to me. But I guess it was wrong. But I liked the way she did that. So I'm just like, "Oh, okay. Like, now I know." And like, I copy it. Like, I leave the mistake and then like, I copy the right, the right way you're supposed to do it.

Adriana – Interview 2

While Adriana did not make a mistake in her work mathematically, the purpose of the operation was to help simplify the individual terms, which she was unable to see with her un-factored LCD. In this case, Beatrice worked through the problem to show the class that the LCD was best written as $x(x + 2)$ so that they could reduce the rational expression. Adriana pointed out that she often needed Beatrice's corrections because she was unable to notice the mistakes in her work. However, Adriana pointed out that she did not have to talk through her work, and that

Beatrice would review her work and find the error, if there was one. Most instances of correction took place one-on-one in the individual student work time, which Adriana preferred. She did not feel that any part of the class needed to change. She understood her role in the classroom as taking notes and attempting the example problems when the teacher asked them to.

Moments that went well for Adriana included when Beatrice took the time to explain the mathematics, specifically when she explained the reasons behind specific steps in the problem. For example, one instance stood out to her when Beatrice gave a little more detailed explanation to why you change the inequality sign if you divide or multiply by a negative number. Adriana described her understanding of the explanation of why you reverse the inequality sign when dividing by a negative as follows:

> So like now, if I see a negative *u* greater than [*pauses*] 5 like I, I know that I have to like, get a negative out, out of *u* and then get the neg-- Divide it into a negative. The 5 into a negative one. And then the *u* becomes a positive, but then the sign switches.
>
> Adriana – Interview 2

While Adriana's understanding of why you reverse the inequality sign when you divide by a negative value is still limited (her description implied understanding the steps she must follow when solving an inequality without conceptual understanding), she was excited that Beatrice took time to explain mathematical rules, rather than simply just stating it as fact. Other moments that went well for Adriana during class is when she saw content that was familiar to her. Adriana felt that she had seen about 65% of the course content in prior classes, so when a topic came up that Adriana had experienced before, she got excited and felt it was a positive moment.

Adriana further demonstrated that she saw mathematics as a set of steps, when she indicated that her favorite part about the ALEKS homework sets was that it had built-in explanations which showed her how to solve all of the problems in a step-by-step fashion. She felt this continued to meet her learning needs. She would copy down the explanation into her notebook, and then attempted a new problem using the same step-by-step explanation as a guide. Adriana did struggle with the ALEKS homework, however, and preferred to have a textbook instead. First of all, the program required Internet connection to work and during some weeks in the start of the semester her Wi-Fi had stopped working at home and she was unable to complete the homework. Secondly, Adriana found that the types of problems that she completed on ALEKS did not align with the types of problems that she saw on the tests and exams. This misalignment made it less alluring to complete the ALEKS homework because she did not feel it aligned with what Beatrice taught during the lectures. However, because homework was a part of the overall grade, Adriana appreciated that the instructor allowed them to meet in a computer lab a few Fridays during the term to complete it, which helped to offset her internet access outside of class.

Adriana did not regularly encounter negative moments in the class. There were three instances of the 12 focal observations that stood out in her survey responses. First, she would get frustrated when Beatrice made mistakes in the lecture notes. When Beatrice would make a mistake, she would erase all of the work she just projected and start all over again. Sometimes this would happen after she had completed a full problem. Adriana felt that these were negative experiences because it seemed that she had just spent a good amount of time focusing and trying to learn a method that in the end was incorrect. She felt this wasted valuable class time. Second, some moments that did not go well related to course content that was unfamiliar to Adriana because the newer material confused her. Finally, as the semester progressed, Adriana began to lose her focus in the class; during individual student work time, she found that she stopped working on the problems and waited for Beatrice to demonstrate how to do the problem. These were negative moments because Adriana wanted to participate in her role as a student, but felt that she was tempted to skip problems, and instead would sometimes sleep or "zone out", because Beatrice would always show them later.

Classroom Community

Adriana indicated that she felt the class was silent and had limited interactions. She believed that having quiet classmates was in indication that they did not want to be in the class.

> Adriana: Like, everybody's just lazy. [*laughs*] Or like, tired, or they don't want to talk. I mean like, sometimes she [the instructor] tries to like, crack some jokes here and there. Like, the, the people are just like [*pauses*], like silent. Like, nobody laughs.
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> Researcher: Uh huh. Do you laugh at them [the jokes]?
>
> Adriana: Yeah. I mean, she's funny. She's cool. I like her. Yeah.
>
> Adriana – Interview 2

Adriana felt that the energy level was very low in the class, and thought it was kind of Beatrice to attempt to wake students up with silly jokes. However, this description of the class contradicted her previous descriptions of schooling: in her high school experiences the students were so talkative and rowdy that she her teachers were not able to teach the material. In those instances, she believed that the students did not want to learn the material either. In this class, she equated students being silent as another form of demonstrating a lack of motivation to learn. Adriana appreciated that the classroom was so muted because she was a quiet person herself. Comparing this type of student behavior to her past high school experiences, she preferred classes in which students were quiet, "'cause nobody's being rude or interrupting" (Interview 2).

Interacting with Others

Adriana enjoyed time spent working with peers. At the start of the study, she intended to interact with many people in the class. Once the semester started, Adriana referred to and regularly worked with her classmate Kio. Kio was a first-generation, Japanese woman who, just prior to the start of the study, moved to the United States to go to college. When I asked Adriana who in the course she could compare her mathematical abilities to, she selected Kio.

> Probably um, Kio, I think. Yeah, her. 'Cause we're always interacting and trying to like, see what we get on, on our [*pauses*] like, warm-ups. Like, sometimes she's right and then sometimes I'm right. Yeah, so her. And like, she explains sometimes. Like, sometimes I see that she has a answer [*sic*] right and I don't, and I told her how she did it and I get it… Once we're finished, like I'm like, "What, what did you get?" And she'll be like, "Oh" [and shows me her paper]. And then sometimes I tell her, "How do you get that?"… And then she's like, "Oh, I did this," and she just shows me her work and I go, "Okay."
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> Adriana – Interview 2

Throughout the entire semester, Adriana only interacted with Kio. Adriana sat in the same seat against the wall almost every class session, and Kio next to her. During individual student work time, I would often see muted whispers between them towards the end of solving a problem. Sometimes when the instructor came by to check on their work, she would look at both of their papers together and they would both listen to where the instructor pointed out their mistakes. Adriana believed that Beatrice did not want the students to work with partners, so for this reason, she would work independently on a problem and only compare the solution with Kio. Adriana preferred this level of interaction, and was glad that Beatrice did not have students interact more than that.

Adriana's need to have her work checked by the instructor led her to value her interactions with Beatrice, although she did not initiate them. Instead she would "wait her turn" until Beatrice visited her during the practice problems time. When that happened, Adriana said that she would ask Beatrice questions like, "Am I doing it correctly?" (Interview 3) or say nothing and turn her page so that Beatrice could read it and evaluate her work. Adriana indicated that she did not ask mathematical questions or for clarification of content but rather for Beatrice to verify whether or not she was on the correct path. As the semester progressed, Adriana interacted with Kio less and by the end of the semester, she only interacted with Beatrice whenever Beatrice initiated it. Because Adriana was a quiet person, the overall classroom was quiet, and that Beatrice did not encourage much peer-to-peer interaction, she felt that it was not necessary to continue to interact with Kio. Even though she indicated at the start of the study that she wanted to interact with multiple peers, by the end of the class she acknowledged that she preferred to work alone. As the semester wore on, Adriana found it more difficult to stay focused and awake during the lectures and during individual student work time. Checking in with Kio meant that she had to complete the problems that she was given. Because there were times when she had no work to compare, she started to disengage with Kio. This change in interaction and increased lack of focus coincided with the time when Adriana started her job. Her shifts ended late at night; because she needed to wake up early to get to class on public transportation, she got very little sleep after securing that job and it affected her classroom interactions greatly.

Challenges Of A First-Generation College Student

Through my interviews and interactions with Adriana, I learned that she experienced a lot of challenges that first-generation college students often face. While she did receive guidance in the "College and Career" course at Birch high school on how to select a college and how to enroll in courses, Adriana did not have the continued support as she navigated her first semester. Adriana faced many common first-generation issues that other college students faced. For example, Adriana waited until the instructor spoke to her about her course grades or for the instructor to come help her with the practice problems. Anecdotally, many instructors wait until the students approach them with concerns or needs, and generally do not always reach out to a student first. Some instructors feel that when a student does not approach them then the student is not interested in their learning or is not trying "hard enough". Adriana only asked Beatrice for help on a problem one time during a class in which the students were working in the computer lab. For the most part, Adriana did not communicate much with Beatrice, and therefore had not built a meaningful connection with her. Next, Adriana admitted she did not know how to access her grade, and for over half of the semester did not know where she stood in the class. In fact, she was unaware that there was a grade portal system (e.g., Blackboard) in place where she could look up grades, important announcements, or other resources. For example, she was unaware of the first exam, expecting to be constantly reminded by Beatrice about the upcoming date, and did not know how to find when future exams were taking place.

> Researcher: What did you do for the [first] test when you were getting ready to take it?
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> Adriana: I'll be honest. I didn't study. [*laughs*]
>
> Researcher: You didn't study?... What prevented you from studying?
>
> Adriana: I don't know what happened. I think I came home late. And I didn't have time. I just, I mean, I completely forgot that I was supposed to take the test. Yeah, like I don't, I don't-- I think she's, she did say it, I know, but I didn't remember. Like, I didn't remember when was it. I didn't know if it was on the, the same week or like the next week. I remember she said something about having a test, but I guess I, I just...It went through one ear, through the other. [*laughs*]
>
> Adriana – Interview 2

Beatrice emailed out updated course calendars as well as other important course documents (e.g., note packets), but Adriana was not accustomed to checking email, and admitted she did not know it was an important way of communicating, as she was not used to getting emails from instructors.

Not only did Adriana not know there was an online system that she could use to keep up to date with her grades, she also did not inquire about her grade and believed that if Beatrice was not notifying her that she was failing, then she must have been doing fine. She trusted her instructor after receiving Exam 1 when she was told, off-hand, that she was passing the course with a 70% and continued forward without making any changes to the way she approached the course. She understood that the grade was composed somehow of the homework assignments, quizzes, and exams. However, like many students often believe, she felt that focusing on homework completion would balance out the low test scores.

> Researcher: So you did see [your test and quiz scores], but you still said [you felt] you were getting a B or a C [in the class].
>
> Adriana: Yeah, because I think of ALEKS. I thought about ALEKS. Because like, I was-- At that time, I was doing, I was trying to finish all ALEKS. Like, get them all 100. Yeah, so that's why I was like, I probably am doing good 'cause she said that that was part of your grade, too.
>
> Researcher: Okay. So you were kind of thinking that like, the ALEKS percentage would really pull your test scores up or things like that.
>
> Adriana: Yeah, but I guess not. [*laughs*] That's why. 'Cause I'm like, I'm doing everything and I'm trying to like-- Like, I know I wouldn't get good grades on my tests, but then like, I thought about myself. But like, I'm doing this. Like, I'm doing ALEKS so ALEKS is kind of helping me too. So that's why I'm like, it kind of will balance it out to like, a C. That's what I was thinking. You know? But I guess not. [*laughs*] […] That's the thing. In high school, it was 50%, I think the tests. And then the little quizzes were like, 10. The homework was like, 25. So it was like, balanced out. So if you would do like, most of all your class work and you did alright, I mean you'll be like, having a C on your tests. Like, let's say on the test you did alright. Like, you didn't do that good, but it would be a C on there. So that's what I was like, "Oh, probably," but I guess the quizzes here, and the tests, were like, more worth than the other stuff that she would do.

Adriana – Interview 3

Adriana showed a lack of awareness of the overall grade distribution in the course, and felt that if she focused on one aspect, the homework, that she could get by ("I probably am doing good 'cause she said that [homework] was part of your grade, too"). Adriana assumed that because there were three main components to the grade, that homework would have a high weight, similar to how it did in high school. In reality, homework was worth 15% of the grade whereas midterms and quizzes totaled to 55% of the overall grade. Because she was working on the homework assignments and showing up for the quizzes and exams, she believed that she was doing what was expected to earn a B or a C grade. Similarly, Beatrice did not offer anything to students beyond the homework for preparation for the quizzes, so Adriana trusted that if she did the homework, she would be prepared for the exams. Due to her assumption from high school that doing the homework was enough to balance out her grades, she did not review any of her tests or quizzes and generally did not study very much for the exams, which caused for a lower overall grade in the course. Because Adriana was a first-generation college student, she only knew her previous experiences in mathematics classes to relate to her first college mathematics course. She was unaware of the difference in weight that homework had here, and that it would not "balance out" her overall grade.

Performance in MATH 5

Adriana started out strong in the course. She received higher grades than her peers on her first two quizzes and first two midterms. Although her raw scores were still below 70%, Adriana attempted all problems, and her approaches to the problems demonstrated a baseline understanding of the question, even if she did not get the question correct. In particular, she tried to answer all of the word problems, writing down information relevant to the problem, demonstrating that she was trying to connect the information she was given to provide a response.

Adriana felt that if she showed up and did what the teacher asked of her, that she would succeed in the class. On the first exam, she received a score of 30 out of 70 points. Adriana stayed after class one day to get her exam back (before the instructor passed them back to the entire class); "I [asked Beatrice] if I was passing her class and she said yeah. I have a 70, I think" (Interview 2). Adriana's course grade at that time was an un-weighted 42%. Based on her performance in the course at that point, Adriana believed she had either a high C or a low B in the course.

Once Adriana started working halfway through the semester, she found it difficult to balance working so many hours with going to school. She worked five days a week, mostly the evening shifts. On the weekend days when she was not working, she found herself helping her mom clean and cook around the house. From chapter 5 onward, Adriana stopped working on ALEKS homework. She frequently used her free time to catch up on sleep. She reflected on other moments in class that did not go well, which was related to her being sleepy and unfocused. During one of the classes, she had not eaten nor had she had any coffee and had worked late the night before. While Beatrice was lecturing, Adriana fell asleep a few times. This affected her participation during the lecture and the individual student work time. On one occasion, she woke up when the instructor had just given the students a problem to work on. She quickly tried to work on the problem, but found she did not know how to do it. When Beatrice came to her to check on her progress, Adriana told her that she was confused and did not know where to start. After Beatrice gave her a helpful start to the problem, Adriana put the problem aside and put her head down. Even during the time when Beatrice showed the class how to do the problem, Adriana had fallen asleep again. Clearly the time that Adriana committed to working was affecting her participation and engagement in the classroom instruction.

Adriana noticed that work became a huge barrier to her. It affected her motivation to work on her coursework outside of class, contributed to her sleepiness, and affected her attendance and overall performance. She missed important class sessions, missing a quiz day and the final exam review. Because Adriana worked mostly nights, she would get very little sleep and it was difficult to get up to get out the door on time for school. Adriana missed one class day because she overslept, and missed two other days because she was unmotivated to leave the house. She missed the final quiz, of which Beatrice gave full points for completion, regardless of correct answers. On the review day before the final exam, Adriana skipped coming to class so that she could study at home, specifically asking for that day off of work so she could study. However, her boss, who, according to Adriana, did not care that she was a student, scheduled her anyway, holding her accountable to come in. Adriana ended up working the night shift and did not study for the final exam as she had planned. By the end of the semester, Adriana dropped her culinary arts course, and failed both her English and Math classes. She realized that taking the job was not worth it. “I feel like I messed up a lot just by getting the job. I should've like, not gotten it” (Interview 3). She felt that because she was given grants to come to school, she should have just focused on school, and quit her job. Even though she failed her courses, she planned to repeat both English and Math again, but also to take a counseling course and Spanish. She thought about going to a different college to help her with her commute; selecting a different college would save her about a half hour of commute time a day, which she believed would help her to complete more out-of-class work.

Overall, Adriana enjoyed MATH 5. She recognized that there were things that she could have done better, such as studying more, reserving more time for homework, and also not taking the job halfway through the course. She felt the course met her needs as a student and that if given the chance again, she would succeed.

Layana

Layana is a 20-year-old woman, born in the United States to a Guatemalan father and Mexican mother. She is not a first-generation college student and at the time of the study, was starting her third year at CWC.

Home Life

Layana lived at home with her parents and younger brother. She had two older half-brothers from her dad's previous relationship. The oldest was in the Marines, which she said was his way of not having to continue going to school. Her second oldest brother dropped out of high school when he was a junior and has lead a difficult life selling drugs and drinking, which she felt has made his future work possibilities very limited. She had a little brother who was in sixth grade. Layana's dad was in the army and worked a part-time job to earn extra income, and her mom was a babysitter while going to school full-time.

Both of Layana's parents were citizens, though it took her dad a little longer to become a citizen. Layana's mom was born in Mexico and moved to the United States when she was seven. Her mom was able fix her immigration status right away because her maternal grandparents had arranged to start a business in the United States and they were able to support her naturalization. It was harder for Layana's dad to enter the United States. Layana's dad and his three younger brothers arrived to the United States when he was 13 years old by hiking from Guatemala through Mexico to the United States border. His parents did not come until much later. He was responsible for caring for his brothers while they lived with an uncle. He learned English by watching cartoons. Layana thought it was amazing that neither of her parents had a Spanish accent when they spoke English given that it was their second language. Layana's dad always joked with her mom saying that she had "cheated" to get to the United States because her process was streamlined while his was dangerous and scary. At times Layana could not imagine trying to become a United States citizen and recognized how lucky she was to never have experienced what her parents went through.

Layana's family spoke only English at home, but when she went to her grandparents' houses they spoke Spanish. Layana described her grandparents very differently. Her maternal grandparents could speak English and made an effort to be able to learn the language. She found that her maternal grandparents made huge efforts to learn American culture, worked hard, and bought a property. Her paternal grandparents, on the other hand, did not speak or understand English. Her uncle took care of them and paid for all of their expenses, so they did not have any need to work. They complained about the American culture and often spoke about wanting to return to the *pueblo* that they had left behind in Guatemala. She associated their differences to how they were raised. She felt that her Mexican grandparents showed her that hard work, focus, and determination paid off, and associated more with that side of the family. She did not always agree with the values of her Guatemalan grandparents.

Layana worked in order to help pay her personal bills such as her phone and gas for her car. Her parents helped her by allowing her to live at home with them. She was not expected to give any of her money directly to her parents to support the household, although every now and then she would take her parents out to eat or buy them a gift to show them her appreciation. Layana worked at the YMCA as an afterschool leader around 20 to 30 hours a week. She usually worked with elementary school children, helping them with their homework and providing activities for them to do. She loved kids and loved working with them. Layana also cared greatly about her fitness and health, so she was happy that her job allowed her to use their gym, where she worked out every day. In all, Layana had a very regimented schedule, accounting for every hour of her day in her busy schedule.

Previous School Experiences

Layana's mother always ensured that she would go to some of the best schools in the district. Layana's older brother went to the "wrong" high school, Maple High School, which is why they think his life turned out the way it did. In Layana's opinion, Maple high school had limited resources, the students were always fighting, there were police officers constantly on campus, and Layana pointed out that the campus had a predominantly Black culture, with far fewer White students in attendance. Her mom instead, enrolled Layana in the better high school in the district, Cherry high school. Layana described this space as being clean and organized, with newer buildings, and students who did not start fights with one another. She described the student enrollment at Cherry high school to be very diverse. Because Layana was able to go to the "better" schools in the district, she was in classes that had high percentages of White students. She described that her high school had different internal programs that you select into at the start of freshmen year and follow until graduation. The programs had themes, such as one that focused on marine biology or another focused on business. These programs would dictate the classes that students took. Layana did notice that these programs had certain groups dominate them. The marine biology program had mostly White students whereas the business program had a mix of everyone. Once you were in a program, you never mixed with any students in the other programs, so you would never see anyone from outside your program in your classes. Layana wished that she had been part of the marine biology program because she loved the ocean. Because her mom had to fill out a lot of paperwork to get her into the better high school, which took time, Layana was not able to select the program she wanted to be in. Instead, they placed her in a business program, which she said was a mix of a lot of different people.

Layana spent a lot of time with her teachers. Towards the end of high school, she would spend her lunch hour with her history teacher because she preferred to be around others who were more mature than her peers. She had built good relationships with her previous teachers and felt that they contributed a lot to her progression through high school because she felt she could always talk to them about her struggles.

Layana could not recall the math courses that she took in high school. She was certain that she took pre-algebra during her junior year, and some other math courses prior to that. Layana's goal was to complete the required three years of mathematics to graduate high school, and then worry about taking more math when she got to the community college. Layana was in her third year at CWC, and was placed into one of the lowest developmental mathematics courses (she was also placed into the lowest developmental English course). *Table 7* shows the progression of the courses she took at CWC. In order to transfer on time, Layana would need to complete one more college-level mathematics course after MATH 5. She had to repeat two math courses because the instruction did not fit her needs. Once she finished the developmental mathematics courses, she would need to take Statistics in order to transfer.

Table 7: Layana's College Mathematics Timeline by Semester

Semester	Mathematics Course	Important Instances as Described by Layana
Fall 2014	Pre-Algebra	Passed the course. No comments on the instructor.
Spring 2015	Introductory Algebra	Dropped the course because the instructor's accent was too heavy and the instruction was unorganized.
Fall 2015	Introductory Algebra	Passed the course. This instructor had a slight accent, but he was patient and understanding of his students and very well organized.
Spring 2016	Intermediate Algebra	Dropped the course due to work obligations and other classes. Also did not like the instructor because she moved too quickly and did not show empathy to students' obligations.

Layana had a particular method for choosing her professors and classes at CWC. First, her dad helped her to make decisions because he went to CWC previously. He pointed out to Layana the professors to stay away from, and recommended to her professors he felt helped him to succeed. Second, Layana had two criteria when choosing a professor. First, she wanted a professor that was organized and worked at a slower pace. To find this out, she used the website www.ratemyprofessor.com to find out whether students felt various professors met those criteria. Next, she avoided choosing professors who had foreign last names. She had struggled in the past with instructors who had such heavy accents that she could not understand the mathematics. "Math is such a hard subject for me. I need to understand what's going on and if at one point I get lost, I need to be able to jump back on and understand what just happened" (Interview 1). Layana described taking her first math class at CWC with an Asian professor who she could not understand. She said that he jumped around the board and wrote the problems in a strange order, so that if she zoned out at all, she struggled to know where he was in his demonstration. She also could not understand many of the words he said, which did not help her with her learning the mathematical vocabulary. She ultimately dropped that course because the instructor was not a good fit.

Relationship with Math

Layana said that she did not have a very good relationship with math. She found that as a subject, it took more time and effort to study for and review than it did for her other classes, which made it very difficult to stay focused and interested in the subject. Her mom was very good at math, and did not have to take as many developmental classes as Layana was required to. However, Layana did not want to bother her mom by asking her for help on her work; her mom already had a lot on her plate. Layana felt that she should be self-sufficient and deal with the challenges that came her way, mirroring the lessons that her maternal grandparents demonstrated to her.

When working with math, Layana described needing to work at a very slow pace. She felt that she always needed to practice multiple examples (four to five) before she felt comfortable moving on to another topic. Throughout high school and even into the start of college Layana was a quiet student and felt that if she missed something in class, she would figure it out later. However, she acknowledged that she would never return to a topic or problem once the class was over. She started to realize that her success in a course depended on her level of intervention. Within the last two semesters she felt she had started to ask for more clarification in her mathematics classes by asking her instructors to repeat explanations or to clarify various steps in the problems.

Layana felt that all mathematics and English classes were the same: the classrooms were very individualistic and there was never a community built within. She believed that people always either loved or hated either subject. She felt that mathematics and English were two subjects that were forced on students throughout their entire K-12 experience, which made the courses less fun and contributed to her dislike of math. In comparison, she described a physical geography course she took at CWC, which was something new and exciting. Students worked with maps and learned about the world. She described the joy she felt when she was able to have the ability to choose a course that suited her. For example, she was required to take a life science course in order to transfer, and was given five courses to choose from. She never had the opportunity to choose the math she was taking, which contributed to her dread to show up to class. She even noticed that many of her teachers were not excited to teach mathematics.

> Even in elementary school, I remember when it was time for music it was like, 'Alright! It's music time!' But it was never anything that was like, 'Let's do some math!' I don't

> know if it was just *my* classes… but it was just never something I saw that my teachers were passionate or excited to talk about.

Layana – Interview 3

Layana never experienced a classroom where math did not appear to be a required subject in the curriculum. Because Layana worked with elementary students after school, she recognized that they looked up to her as a role model. Even though she did not appreciate mathematics, she realized that she needed to speak positively about mathematics so that her students did not feel the same way that she did.

> I try to keep them up about math. They'll complain about their multiplications, you know. They're, right now I think they're on like, their sevens and eights. Like, "We hate math." And I'm like, "Well, you're gonna need this in life." I go, "What are you gonna do when you're grocery shopping? What are you gonna do when you're shopping?" So um, yeah. That's kind of how I keep them going.

Layana – Interview 3

Layana realized that mathematics was important, and recognized the value of being a role model to younger students who may be feeling how she used to feel in school. She admitted that she still needed someone to be this person for her, as she was still a student of mathematics.

Educational Goals

Education was always an important conversation in the household when Layana was growing up. Her parents expected that she and her brothers would excel in school. Layana's dad and mom both achieved higher education after having their children. Recently, her dad graduated with his bachelor's degree in sociology and her mom also attended CWC with the goal to finish her associate's degree and transfer. Layana commented that at first it was weird having her mom in some of her classes, but then she just got used to it. Her mom was a little ahead of Layana, so she was going through the transfer process about a semester earlier than Layana, guiding Layana through the process.

She found that most traditional Latinx families expected her to become a young mother and focus on raising a family before going to school or instead of going to school at all. Layana was able to convince her fiancé to attend college, and they both came to realize the value of an education. His family in particular gave them a lot of grief for going to school and made fun of them for spending so much energy on school rather than just living a "relaxed" life and raising a family. Members of her fiancé's family had their children at a young age. She had come to realize that having a family right away was not important to her, and for that reason she instead focused on making sure she had the education she needed to be able to support her future goals.

When Layana started at CWC, she intended to go into nursing. When she went to the nursing orientation, she was overwhelmed with the messages that the college sent to her. "It changed when I went to the orientation… they were like, 'Oh we suggest like if you have kids like you start looking for a babysitter because you're going to dedicate like 80 percent of the time to this and if you're in a relationship we would suggest you watch that relationship'" (Interview 1). She knew that with her busy lifestyle outside of class that she was not going to be able to finish a nursing degree in a reasonable amount of time. While Layana knew that she did not want a family yet, she wanted to make sure she had a career where she could spend time with her family while also balancing work. She changed her degree plan to be psychology, and wanted to become a marriage and family counselor. Her goals at the start of the term were to finish her associate's degree by the end of the academic year, transfer to a four-year institution, and finish her bachelor's degree. Her long-term goal was to get her Ph.D. so that she could be a psychologist.

Experiences in the MATH 5 Classroom

By the end of the semester, Layana described the class as “interesting.” She used that word because she could not think of another word to describe this math class:

> It was interesting because I didn’t expect this class to be somewhat enjoyable. I thought I was gonna be in complete misery the entire semester taking it. Um, it was interesting because I mean, I’d be a liar if I said I didn’t enjoy the class. I enjoyed the struggles that came with the class, which I never thought I’d say about a math class. But it was definitely interesting. It was interesting on the bad side where again, why do I need this? But definitely more of the good interesting.
>
> Layana – Interview 3

Layana described a few of the struggles she faced. She had to learn new ways to get around challenges in the class, such as using YouTube whenever she did not understand her notes. “If I didn’t get it looking back at my notes, well, what are you gonna do? Find another way to understand it, you know? So it wasn’t just being trapped inside of the box. You know, the norm,” (Interview 3). Layana felt that certain aspects of the course did not fit her learning needs, yet at the same time she enjoyed the class because of the ways she needed to adjust to make the class work for her. She found it difficult to see the purpose of the mathematics they were learning which took away from her in-class experiences. In this section, I will describe Layana’s perceptions on the instruction in MATH 5, the classroom community, and interactions with others. I will also synthesize the ways that she made changes to the course structure as well as describe her performance in the class.

Layana’s Perception of the Instruction in MATH 5

Layana described the class structure as routine: warm-up, announcements, lecture, and some time to check with your partner/work on a problem. Layana described the majority of the time as spent in lecture. Layana pointed out that at the start of the semester, Beatrice slowly opened up to having students come to the board to present their work, which she appreciated because it broke up the monotony of copying down what Beatrice did in the notes. She described another tactic that Beatrice used during lecture, which was to ask questions to one side of the room versus the other side. Layana said that Beatrice started to engage them a little bit more (though not by much) after she had talked to the class about how poorly the students performed on the first exam.

In all, Layana wanted to see more engagement in the classroom instruction.

> I feel like I would like a little more engagement, like, just not so much lecturing. Yeah, you know. Like working with your partner or going up to the board and doing it more. Just not so much lecturing and copying down what she's writing, because sometimes when that's happening I kind of feel like I'm not really putting into practice what she's saying. And then when she's like, "Okay, go ahead and work on a problem," I'm like, 'What the heck do I do?' You know? But I've been copying her the entire time as she's going. But I'm not necessarily learning it.
>
> Layana – Interview 2

Layana described that most students would sit around during the individual student work time and have a look on their face that suggested they did not know what to do. Because the classroom environment was so quiet, she noted that no one would raise their hand for help and instead would wait until Beatrice presented the work at the board. Layana recognized around Week 8 that she needed to do more. "I've kind of gotten over being stuck not knowing, being clueless. Because that's not going to help me," (Interview 2). Layana felt that prior to that epiphany that she behaved like other students normally did, "It was more like, 'Oh I don't need to know it now. I can go back to it later [at home]'" (Interview 2). But Layana admitted that she would never go back to the problems she did not understand in class, and therefore would not learn the material. Layana had previously believed that watching her instructors demonstrate the mathematics was the best way to learn it. However, during MATH 5, she realized that she was *not* in fact learning the mathematics, and realized she needed more than just the lectures to succeed in the class. In all, Layana wanted to see changes to the lessons that incorporated more student input and student thinking. Because individual student work time was limited, she was frustrated that she felt unable to work through the problems she was given and blamed that on the amount of notes that students were expected to copy. She felt that by letting students work on the mathematics more, they would have ownership of the work and could better understand what they were learning.

Another feature of the classroom instruction that Layana was disappointed with was understanding *why* they were learning the topics they were presented. Throughout the semester, Layana repeatedly described not understanding the value of the mathematics that Beatrice was teaching, which caused her to get extremely frustrated with how much time they spent on topics that were not useful (e.g., logarithms, radical equations). During instruction, Layana was always presented a new problem type or a new topic area, yet she was left to determine how that math skill applied to her, something she felt that the instructor should fully describe. As a psychology major, she did not see any of the material as valuable. She felt that maybe if she was going into biology or another science field, then maybe she would need to know this because "crazy numbers and crazy letters are gonna pop up [in that field]," (Interview 3). She felt that both MATH 5 and the course just before it should not be required for students to take. She felt it extended her time at CWC and that she could have transferred the year before had she not needed to take so many math courses.

Even though Layana wanted more student engagement and would have preferred to know why the mathematics was important for them to learn, she felt that it would be good if all classes at CWC were similar to this.

> I think it would just help people be less scared of math because, I mean, from my experiences like math professors tend to go kind of fast… they just kind of treat it like it's a topic that people are supposed to know, and not something that people are still learning. So I feel like she's, you know, she actually shows that she cares. She'll bring up

> her situations when she was in school, so it makes her more of a human being, not so much as just someone up there teaching us something. And she knows most of us by our first names. So that definitely helps, versus a few of my previous professors did not know our names. So it just makes it a little more personal, I guess, when it's like that… If [students] knew that someone was willing, not necessarily to hold their hand, but to stand with them through the whole way. I think that would definitely be like a, 'Oh, okay. They're not just going to speed through everything.'
>
> Layana – Interview 3

Layana appreciated that Beatrice was different than her other professors in that she demonstrated a care that none of her other instructors had shown. Layana was a friendly and outgoing once she warmed up to someone, and she felt that Beatrice tried to connect with the class, which made Layana feel she could talk to Beatrice if she needed to.

Classroom Community

Layana did not feel like a valued member of the MATH 5 community. In fact, she felt that there was not much of a community to describe. "Yeah, because it's not, at least to me, it was never a community like, 'Hey, work together.' Or, I don't know. I think it's just the way the whole math and English system are set up from the beginning" (Interview 2). Layana did not feel that a math class could possibly become a community because she had never seen it structured as one, like she had seen in her other classes such as psychology or biology. When I asked Layana who was a leader in the MATH 5 community she immediately said Beatrice. She did not feel that any students were given leadership roles in the class, which meant that they were not leaders in the community. When I asked Layana what she felt her role in the community was she replied,

> I'm just there… I just always kind of wished that math courses and English courses wouldn't be like that. Not just like you just go there to sit, listen, you lecture, and then leave. Yeah…I don't really feel like there is a community… I don't feel like there's anything to fit into.
>
> Layana – Interview 2

Because Layana felt that her role was just to come and sit in the class, she also did not feel like a valued member of the community. At first she described that being a valued member only mattered from the perspective of Beatrice, not of anyone else. When considering it from the perspective of Beatrice, she felt that Beatrice demonstrated to everyone that they were valued, because "she definitely makes everyone feel like she cares about their grade and she's helping them work through this." When she thought of her peers, she did not feel valued because no one interacted or asked for help from one another, "people are just not looking for communication with others in there" (Interview 2).

Interacting with Others

Layana interacted mostly with Beatrice during the class sessions. Layana would either stay after class to ask for help or would send Beatrice questions via email. She felt that Beatrice tried to make herself available to students during those times.

> The fact that she even responds to my emails are [*sic*] something that's important. Because some professors I've had I've emailed them different concerns and I don't hear from them. So just her taking that time to actually email me back is kind of like, 'Okay, you're not all talk but you do care about where I stand in this class.
>
> Layana – Interview 2

Layana said that she had stayed after class a few times to clarify problems in the notes and that Beatrice had never turned her away, which is important to her that an instructor do. In all, she felt very comfortable talking to Beatrice.

Layana described herself as a quiet person and preferred to work alone or with one person, avoiding group work whenever possible because usually there were too many people discussing one idea. She did not initiate interactions with her peers, but was always grateful when someone else would reach out to her. At the start of the semester she and Marisa would compare answers to their problems every now and then. However, towards the second half of the semester they started sharing less and less. Instead, Larry had started to regularly sit next to Layana. Layana felt that Larry was a little stronger at math than she was; he was patient and always would reach out to Layana when they had finished working on a problem. At the start, if he asked her how she did something in her work, she would push her notebook towards him and let him read it. By the end of the semester, the two would ask each other to explain their work instead of just reading their work. She said she really appreciated Larry because he was not afraid to speak up in class, asking for clarification on a procedure or correcting Beatrice if she had made a mistake. Although Layana talked about her relationship with Larry as beneficial to her, she did not think that there needed to be any additional kind of peer-to-peer work in the class, just more opportunities to do other types of mathematics activities to break up the boredom of the lecture.

Performance in MATH 5

At the beginning of the course, Layana's performance was weaker than her peers; she received an F on the first two quizzes and received one of the lowest grades in the class on the first exam. On the first exam, she answered problems that required solving linear equations or graphing a line in slope-intercept form but skipped the majority of the word problems. After looking at the work she presented on the first exam, it appeared that she struggled with most of the content, and did not attempt many of the problems. Figure 11 shows Layana's understanding of the x- and y-intercepts of a linear function and graphing a linear function in standard form. In this problem, she demonstrated that she knew she needed to substitute 0 for x and y, to find the y-intercept and x-intercept accordingly. However, this would result in two points, $(0, 6)$ and $(9, 0)$. Instead, she created a new point, $(9, 6)$, by combining the results. Had she checked if the point $(9, 6)$ was in fact a solution to $2x + 3y = 18$, she would have found that this work was incorrect. She used the point $(9, 6)$ to graph, and also incorrectly selected the point $(0, 0)$ as a point on the line. Had Layana rewritten the equation of the line from standard form, $2x + 3y = 18$, to slope-intercept form, $y = -\frac{2}{3}x + 6$, she may have been able to correctly graph the equation, as she had done in earlier problems on the exam. This demonstrated to me that Layana was able to correctly answer specific problems (e.g., graphing a linear function when written in slope-intercept form) and that she had some understanding of the steps needed to find intercepts algebraically, however, she was not able to show flexibility with the same content when it was demonstrated in an alternate form.

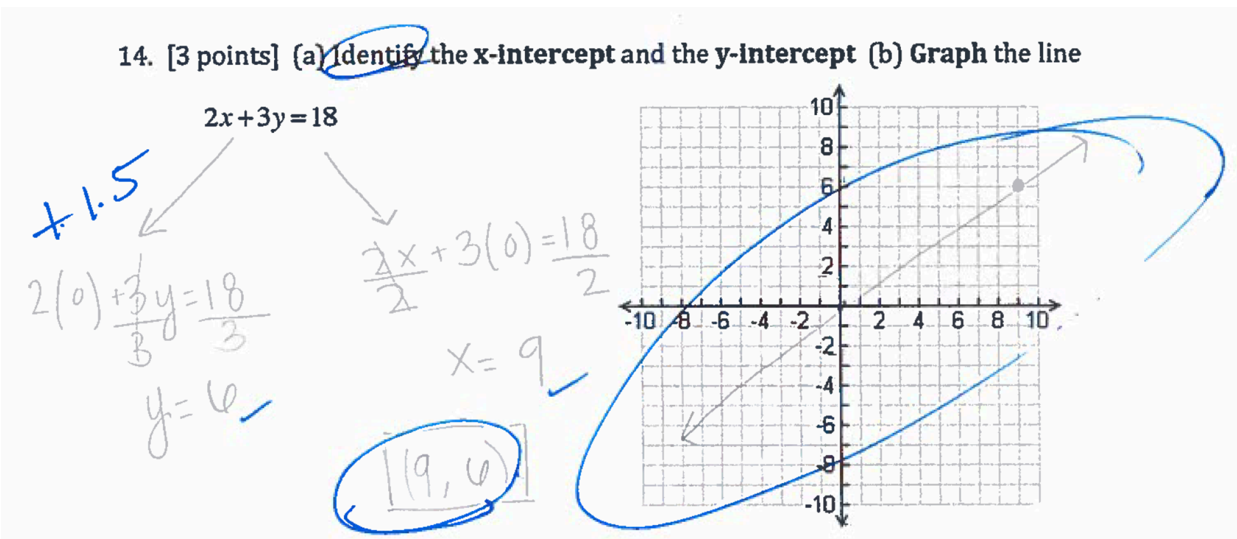

Figure 11. Layana's Work on Problem 14, Exam 1

By Week 8, and after receiving the scores for her two quizzes and first exam, Layana estimated her grade to be a D because she thought that the homework counted for 50% of the grade. Because she thought the homework counted so high towards the grade, she had a moment of realization that she could control her overall grade by the amount of time she spent on ALEKS. During Week 4 or 5 of the semester she had a change of perspective on her education. She realized that she just needed to push through and complete her math classes because that was the only thing in her way to transferring. She had already spent five semesters to complete three developmental mathematics courses and could not afford to spend another semester at the college taking MATH 5. She decided to reorganize her time to put her math homework as her priority. She devoted one hour a day at home to work on ten topics from ALEKS. Two days a week, she gave up an hour of her workout schedule to spend time between classes working on ALEKS.

Once Layana got into the routine of doing homework daily, she realized that she could better estimate how many topics she needed to do each day by dividing the number of topics by the number of days she had to work on it. She shared this tactic with Beatrice after class one day, telling Beatrice that by making her homework assignments smaller, it was more manageable to finish, rather than waiting until the last minute and facing 100 topics the night before it was due. Beatrice was impressed by her planning and shared her story with the class the next day. She did not point out Layana specifically, but it was clear she was talking about Layana because she kept looking at her and smiling. Beatrice used Layana's plan as a suggestion for other students to follow.

After the first midterm, Beatrice had asked the class to provide her with suggestions about how to make the class better for them, and in particular, to help them be more prepared for the second midterm. Layana was the only student to provide concrete suggestions for ways to make the class better, sharing some ideas of things she had seen her previous instructors do in other math classes at CWC. In the last class that she had dropped, her instructor allowed the students to use a note card to write down formulas and various procedures to use on the midterms. She explained to Beatrice that when she took the exams she forgot what to do on many of the problems and felt that with a little cheat sheet she would be able to do more. Beatrice was grateful for the idea and told Layana that she would allow the students to use an entire page for a cheat sheet for all future midterms, and two pages for the final exam. Layana also shared with Beatrice that her previous instructor utilized group quizzes. Beatrice said that she would be willing to give the group quizzes to the students. Layana also described that her previous instructors would allow for test corrections for one poor test score, and that they were more flexible with homework extensions and due dates. Layana said she wanted to be discrete when giving suggestions to Beatrice because she did not want to appear to her classmates that she was telling Beatrice what to do.

By week 10 of the semester, Layana felt that Beatrice was seeing improvement in her efforts in the class.

> I feel like she sees someone that's trying, that actually caring about their grade. Because I do email her. I email her my concerns, or something that I'm having trouble with. And I think – I'm not a professor – but I feel like if I were a professor that would kind of make me feel good seeing a student caring about their grade, even though they might not like the subject… I've come to the—I have to face the facts you know. I need to pass this math class. So I am making the best out of it. You know, emailing her if I'm struggling with something.
>
> Layana – Interview 3

Layana changed her schedule at home to make time for her math class. Because this was her second time taking MATH 5, she did not want to fail this semester and take it for a third time; she recognized that by putting in a lot of hard work now, she would be able to succeed. "I'm just keeping more of a positive mindset. You know, 'This is the now. You may not need math later, but for right now you need it because of this class.'" (Interview 2). This perspective helped Layana feel in control.

Layana felt proud because her quiz and test scores began to improve. She also attempted to work on problems that she would have previously left blank. Beatrice allowed the students to work in pairs for Quizzes 4 and 5, of which she also gave full credit to students regardless of incorrect work or responses, without telling the students that their work may have been incorrect. Layana solved most problems on both quizzes incorrectly but believed she did well because she received 100% on each quiz. On her final exam, Layana received a D-, again struggling with word problems, graphing non-linear equations, radical equations, and complex numbers. However, in spite of her low test scores, she finished with a B in the course. Beatrice offered the students an opportunity to write up test corrections for one of their midterms to receive half of the missed points back. Layana worked hard to make sure she submitted this on time. Beatrice also curved all of the exams which greatly boosted Layana's test scores to be at least 20% higher or more for each test. Layana made sure that she did everything she could to help boost her grade up, even if only by a little.

Overall, Layana enjoyed Beatrice as her instructor and tolerated being in MATH 5. She recognized that had she not changed her mind to a positive mindset, she would have failed the course, needing to retake the course again. She was happy to know that now she might possibly be able to take statistics the next semester, a math course she felt would finally apply to her career and life.

Comparing Stories

Adriana and Layana had very different stories that led up to their first day of MATH 5. Adriana overcame a lot of adversity. She lived in a neighborhood that required her to be tough, and experienced very adult challenges while she was quite young. The schools that she went to categorized her as a problematic student, and did not provide the support that she needed to flourish. Yet she overcame this adversity and walked in her graduation. She found a way to learn about the beginning steps towards applying for and enrolling in college. She demonstrated strength, tenacity, and endurance. Layana would have faced some similar challenges had her parents not stepped in to ensure that she went to one of the top schools in her district. Both of Layana's parents provided guidance to Layana as she transitioned from high school to college, helped her to make good decisions with her enrollment, and encouraged her when she struggled. Layana demonstrated perseverance as she struggled to find instructors that were a good match for her learning needs. She made time to balance her work life, personal relationships, personal health, and school. Both of these students knew what it meant to put in hard work pushing against the stereotypes that they experienced in the world.

Both of these students started the semesters at very different levels as revealed by their initial assessments: Adriana used her knowledge to attempt a wide range of problems that required some transfer, suggesting a strong understanding of the connections of mathematics; she also attempted every problem. Layana, on the other hand seemed to have a disjointed knowledge of mathematics; she was able to answer specific types of problems and could not transfer that knowledge to other problem types; she left several problems unanswered. There were similarities in their classroom behavior. Adriana and Layana both took course notes, they both listened to what Beatrice told students, they both observed the student presentations, and they both worked on the class problems when assigned. Both students regularly compared answers to the student that sat next to them, and neither was eager to initiate that communication. Both students described mathematics as receiving clear instructions from the instructor and doing mathematics as being able to replicate the same procedures or skills individually on their own. Neither student used the classroom tutor.

Half way in the semester one student started a job that took up more of her time; the other student, upon realizing that if she did not make major changes in her orientation she would fail it again, took specific steps that changed the possible negative outcome. These events had a visible impact in their classroom behavior. Adriana started to fall asleep in class and struggled to keep motivated to work on problems assigned to her. She also stopped interacting with her peer, Kio and because she worked less during the individual work time, Beatrice's interactions were shorter. She missed a few classes too. Layana stayed on campus to do her work, and by cutting her workout routines in half she was able to complete the heavy ALEKS homework. In addition, by supplementing her notes with YouTube and Google, she was less stressed out about writing everything Beatrice wrote as she lectured. She also shared her personal outlook towards the work needed for MATH 5 with Beatrice. Both students had different outcomes in the course: Adriana failed it; Layana raised her grades and passed with a B.

These two students perceived their instructional experiences differently. Adriana felt that all of the interactions that she had with Beatrice and her peers were at the right level. Yet she never initiated these interactions and they happened only if other people engaged with her. She also felt that she had enough opportunities to work on problems in class, though as time went by, she described moments where she would not work on the problems, and would wait for Beatrice to demonstrate the solutions. She said that the way that Beatrice presented the material worked well for her learning needs, and that watching Beatrice during the lecture was enough. In contrast, Layana felt that because there was so much lecturing there was not enough time for students to engage directly with the content or to interact with peers. Though she did not to tend initiate these interactions, she did want more interaction with Beatrice, but not during class. She found other ways to reach her.

The two students appeared to demonstrate that they knew how to work through the school system in different ways. Adriana appeared timid and unsure yet compliant, while Layana knew exactly what she needed in order to succeed beyond the classroom expectations. The students brought with them different types of *capital* that affected their instructional experiences. Yosso (2005) outlined six forms of capital that many students bring to the classroom, which may affect their educational experiences, but in particular, I will discuss three: aspirational capital, social capital, and navigational capital. *Aspirational capital* refers to "the ability to maintain hopes and dreams for the future, even in the face of real and perceived barriers" (p. 77). *Social capital* refers to the networks of people and community resources that may help them to navigate through the various institutions that students face (e.g., school, work, relationships). *Navigational capital* refers to the skills needed in order to maneuver through social institutions, such as college. Navigational capital "acknowledges individual agency within institutional constraints" (p. 80), and acknowledges that due to structural injustices in schooling, an underrepresented minority student may need strategies to sustain success in such a system.

Throughout the study, Adriana and Layana demonstrated through their instructional experiences the various forms of community cultural wealth that they had developed from all of their previous life and school experiences. Adriana demonstrated a broader level of aspirational capital than Layana due to the multiple experiences, which she overcame, continuing her journey to higher education. The educational path for Layana was set out from an early age to attend college and get a job. While she had similar aspirations to Adriana, she did not face the same challenges; Layana did not face the same challenges as Adriana because of where she lived, her home life, and having two parents who knew how to navigate the United States schooling system advocating for her school choices. Layana did not face the same obstacles and closed doors that Adriana did. Adriana faced many moments during her high school career where she was judged by her teachers, was let down by a school system that worked against her, and was told to quit school and work part-time instead of pursuing her education. She also faced struggles at home such as lack of financial security as well as gang violence. All of these experiences were obstacles that she needed to rise above, in order to make it to her graduation day. Throughout all of these experiences, Adriana continued to keep positive insight about her future, maintaining high goals for graduating from a university and working on a career. For this reason, Adriana demonstrated broader aspirational capital, which she carried with her to the end of the study. Even when she learned that she did not pass the course, Adriana had already started a new plan to either change colleges so that she could save commute time, or stay at CWC but to quit her job and focus on courses that she knew she could manage. Layana faced different obstacles, specifically at CWC when she was placed in one of the lowest developmental mathematics courses. However, she demonstrated a determination to arrive at taking a college level math course and achieving her goals of transferring. This level of aspirational capital presented itself in the classroom in various ways. Adriana struggled to get to campus due to the commute time and also due to her work schedule; these obstacles were challenging and Adriana tried her best to balance them. Layana was able to rearrange her obstacles by changing her schedule to ensure that she had given herself enough time to

The two students demonstrated different applications of social capital. For example, Adriana's mother did not attend schools in the United States, which led Adriana to make decisions on her own about her schooling. On the other hand, Layana's parents, who had assimilated quickly into the United States at a young age, appeared to understand the schooling system and made decisions that greatly affected all of Layana's schooling experiences. This extended to college, in which Layana's parents *both* attended CWC and were able to provide specific advice and guidance for Layana, and in particular related to Layana the importance of having a good relationship with instructors. Layana also referred often to two different couples that she and her husband spent time with, describing how she aspired to be like them and constantly asked them for guidance in her schooling and career preparation. Adriana, for example, did not refer to anyone beyond her mom and stepdad, and did not know anyone who had previously attended college. The social capital appeared in the classroom via the actions that both Adriana and Layana took in their instructional experiences. For example, because Layana's parents shared with her the value of having a good relationship with the instructor, she purposefully reached out to Beatrice and wanted to show Beatrice that she cared about her grades and learning. Adriana, on the other hand, thought that sitting in the front and being present every day was enough to pass any course at the college, which appeared to be an extension of her experiences in high school.

These levels of social capital appeared to directly relate to the levels of navigational capital that both students described while at CWC. Adriana described a lack of support for how to apply for college admittance. Only in her final semester of high school was she given guidance for how to select a college as well as briefly learned how to enroll and apply for financial aid. However, she did not receive any further guidance once she actually *started* college, relating to the lack of structural supports provided by the college. Adriana was unaware of how to interact with faculty, how to look up grades, and how to find specific supports on campus. Layana, on the other hand, knew from a young age that she would attend CWC, like her parents had, and would transfer to another university. Her parents helped her within high school to understand the math requirements needed to graduate, and similarly helped her navigate the placement process and course requirements at CWC. They even guided her to specific instructors that she should look for to take classes with. Layana had even broader navigational capital than Adriana had because she had been a student at CWC for two years already. Adriana, as a new student, did not know as much about the structures of the college, whereas Layana knew about the resources available (e.g., the math tutoring center, the online grade portal) and had an understanding of the expectations for college math from her prior experience. This level of capital became apparent through their instructional experiences. Layana came to understand through her previous experiences that if something did not work for her learning needs, that she could voice an opinion and influence change. Adriana did not recognize until the end that the course outcomes did not match what she had expected, and only then began to reflect back on how her instructional experiences could have been different. Similarly, she was unaware of resources available outside of the classroom that could have provided her to understand more efficient ways to study or to prepare for class.

Adriana and Layana's instructional experiences were different because of their previous experiences and in particular because of the types of capital they had at the time of instruction. While both students had high aspirations, Adriana's past definitely had more obstacles and boundaries than Layana did, and Adriana showed strength and determination to rise above. Layana had connections to and knew more people who had attended college and university and had successfully graduated, which showed the high social capital that she had. She referred to multiple people who she saw as role models and constantly referred to them as her "dream board," the type of people she aspired to be. Adriana knew what she did *not* want to be, but did not have anyone in her life who had achieved the dreams she set out to achieve. Both the variety of role models she had and the lack of a close role model inhibited her: she did not know specifically what to major in in order to achieve her dreams nor how to get to her ultimate end goals. Layana also had more navigational capital, which was directly affected from the high level of social capital, but also was built from her previous experience at the college. It appeared that Layana understood how to navigate the school systems throughout high school and continued to understand how to support herself and her needs in college. Adriana, on the other hand, did not have the same level of navigational capital and specifically did not know how to advocate for what she needed to successfully support her college experience. Because of this, the two women had very different instructional experiences in the same MATH 5 classroom.

Chapter 9

Discussion

In this study, I sought out to understand how instruction was enacted in a developmental mathematics class and how Latinx students perceived their instructional experiences. To this effect, I investigated the following research questions:

1. How is instruction enacted in a developmental mathematics classroom taught by an adjunct faculty at a Hispanic-serving institution?
    a. What are the interactions between the students and between student and instructor?
    b. What are the interactions between the instructor and content?
    c. What are the interactions between the student and content?
2. How do Latinx learners perceive their instructional experiences in this developmental mathematics classroom at this Hispanic-serving institution with an adjunct faculty?

This is a case study of one intermediate algebra class that documents classroom instruction and the instructional experiences of nine Latinx students enrolled in the course. Using the definition of instruction as a conceptual framework, I described what this classroom offered in terms of student-instructor, student-student, instructor-content, and student-content interactions, and student perceptions of those interactions. I described the instructional experiences of two students in the classroom, Adriana and Layana, to illustrate the way in which environments and community cultural wealth may have shaped the instructional experiences that those two students had. This discussion is organized by the two research questions of the study.

How is Instruction Enacted in Beatrice's MATH 5?

Personal Interactions

The personal interactions in this class were greatly shaped by the ways in which the class time was structured. The prominence of lecturing over student presentation or individual student work throughout the semester defined patterns of interaction that privileged the instructor's voice over the students' thinking, and an expectation that the only knowledgeable person in the class was the instructor.

Beatrice might have structured class time in ways that emphasized lecturing because of her prior experiences as a student in an engineering program. Lortie (1975) has called this the "apprenticeship of observation." In Beatrice's case this possibility is strong given that she had very limited teaching experience; her images of instruction are likely have been built through her K-16 student experiences. Mewborn and Tyminski (2006) have noted that what may have worked for novice teachers when they were students, such as Beatrice, might not work for the students they teach (in this case, community college developmental math students; see also The Carnegie Foundation for the Advancement of Teaching, 2008).

Likewise, Beatrice may have found that as an instructor, lecture was the most reliable way to ensure that the content was covered during the lessons, allowing her to have control of the interactions in the classroom. Having a structured set of notes allowed her to control the flow of the class so she could feel competent handling the possible questions that could emerge. Opening up to exploration, leaving aside the script, could diminish her confidence to handle the material.

The literature has documented that the amount of content that is included in these courses together with the time available in the semester may press teachers into lecturing (Yoshinobu & Jones, 2012). Fostering exchanges during lecture that involve students' discussion of the content does take significant amount of instructional time that may result in the impression that significant content needs to be sacrificed. Community college students have noted that too much emphasis on student-instructor interactions could reduce the opportunities to learn more content (Cox, 2009a, 2009b). To students, a non-lecture based way of interacting may not look like what college math should be and they may, unwittingly, press for instructors to lecture or sabotage their attempts to engage in group work.

The emphasis on lecturing reduced students' opportunities to interact with each other; but even when they were asked to work together if they wanted to, students did not take up those opportunities. Students noticed the lack of peer-to-peer interactions and suggested the lack of interaction was a consequence of Beatrice not requiring or suggesting the benefits of doing so. This is a reasonable explanation; Beatrice's lack of personal experience in facilitating collaborative work, which is in itself a complex teaching practice (Finelli, Bergom, & Mesa, 2011), may have played a role in the lack of scaffolding seen around collaboration in the class. It could also be that Beatrice wanted to give students the choice for how they wanted to spend their time solving problems, rather than imposing on them awkward collaborations.

Instructor-Content Interactions

The analysis of the instructor-content interactions indicates that Beatrice demonstrated mathematics as a list of separate mathematical topics, which were illustrated through a series of procedures. Beatrice may have presented the mathematics in this way for two reasons. First, the curriculum requirements for intermediate algebra require instructors to cover a wide range of topics including linear and non-linear functions (e.g., rational, absolute value, exponential, logarithmic), inverses, graphing and solving inequalities, and complex numbers. The topics are broad and include many different particular techniques. In the state of California, most community colleges call developmental mathematics courses basic skills courses because they are seen as providing students with the “basic skills” that they need to succeed in college level mathematics. Because there are so many techniques that students need to learn and demonstrate they have mastered, it is possible that college instructors find it efficient to show in class those procedures that will be assessed on departmental exams or the Student Learning Outcomes that departments create that demonstrates that students in each course have learned what they need to move on. Therefore, many faculty may want to give students the opportunity to practice those techniques often. This choice is likely to result in instructors sacrificing the conceptual underpinnings behind these techniques. Because it is easier to assess students on their proficiency in performing procedures than in their competence handling mathematical concepts, the choice to emphasize procedures seems obvious and more beneficial for the students.

Second, as noted before, at the time of data collection, Beatrice was a novice instructor, so she may not have had the experience to develop conceptual explanations for the topics to a group of students who may be seeing the content for the first time or third time. Also known as *horizon knowledge* (Ball, Thames, Phelps, 2008), Beatrice may also not have a full sense of scope of the content that students would be exposed to in subsequent courses that would allow her to make more informed choices about what to emphasize and what to omit. Without such knowledge or the support from someone more knowledgeable in the department it seems reasonable that Beatrice chose to emphasize proficiency with techniques rather than discuss in detail underlying mathematical concepts.

Beatrice could be seen as a very competent instructor because of her strong mathematics background. However, having a strong knowledge of mathematics is different than having the knowledge of how to teach mathematics effectively (Ball, Lubienski, & Mewborn, 2001). *Pedagogical content knowledge*, which connects the knowing of content and being able to effectively teach such content to students through effective pedagogy, is what separates someone who knows content versus someone who can effectively teach the content (Ball, Thames, & Phelps, 2008; Shulman, 1986). Many college faculty (both full-time and part-time) do not receive any training before teaching (Ellis, 2015; Pruitt-Logan, Gaff, & Jentoft, 2002).

This conundrum has always confused me—the students who need the most support with mathematics start at community colleges, yet the faculty who are assigned to teach this courses, are usually the least pedagogically experienced even though they are required to have demonstrated high academic mathematical training. Even though colleges may have professional development programs to support instructors, the reality is that part-time faculty are seldom invited or when invited, they are rarely available to attend the programs. This state of affairs is particularly alarming, especially because nation-wide most developmental mathematics courses are taught by part-time faculty (Blair, Kirkman, & Maxwell, 2018).

Student-Content Interactions

When student interactions with the content are made visible, an instructor can learn about students' ways of thinking, blind spots, or misunderstandings, and incorporate those into instruction. There were few opportunities to openly witness students interacting with the content in Beatrice's MATH 5. These interactions were manifested in how students solved the problems: by mirroring what Beatrice had demonstrated which required an application of known procedures. Student presenters demonstrated that they were able to reproduce what Beatrice did, and showed their understanding by walking through the various steps they followed to arrive at their answer. Thus, students were able to comply with the expectations set by the classroom organization, but more than that in some cases, they were also able to engage in assessing the quality of their own work, a skill that is important in solving mathematics problems as it provides opportunities for students to develop the ability to critique and justify their own work (Speer & Wagner, 2009). From Beatrice's perspective, her questioning was a way to engage students with the content, and she used these questions during lecture, during individual work time, and during presentations; the intention was to draw mathematical knowledge needed to solve the problems, usually in the form of steps needed.

Several features of the environment of MATH 5 help explain why these interactions occurred. Beatrice was pressed for time; thus her choice of presenting problems herself rather than letting students present their work might have been guided by her concern that she would not be able to manage the daily agenda and at the same time address all of students' questions and needs. Because of the time constraints, she may have sacrificed student opportunities for working together in favor of lecturing which would ensure that she did cover all topics.

Beatrice might have recognized that the student presentations were not benefiting everyone and thus her favoring of increasing individual student work combined with her concern that students were not doing well, resulted in her increased interaction with all students. Beatrice used those opportunities to ask mathematical questions related to the work students were doing, which provided tailored attention to each student.

The design of the study limited the ways in which it was possible to document the interactions students had with content in Beatrice's MATH 5. The students were exposed to mathematics all the time; they were listening, taking notes, attempting problems; yet many of those interactions were not documented because of my role as a non-participant observer. A different set-up or design would have allowed more access to students' engagement with the mathematics in the classroom.

How do Latinx Learners Perceive their Instructional Experiences in Beatrice's MATH 5?

An important contribution of this study is to recognize that students play a significant role in instruction—it is not simply a matter of investigating the instructor or the content. Moreover, while the literature is full with accounts of how instructors experience and enact instruction, very little is known about how students experience it. In this study I found that students were able to clearly articulate their perspectives of mathematics instruction in their developmental class; I referred to these as their instructional experiences. The students' instructional experiences were influenced by their previous experiences in math courses as well as their perspectives on mathematics. However, all students' instructional experiences were also affected by the structures of the institution. In this chapter, I describe different types of students, based on their instructional experiences, and how the various systems in which they exist may have had an impact on their overall success in MATH 5.

Bronfenbrenner (1977; 1994) proposed a framework to understand how children develop within specific ecological spaces, and how these structured spaces interact with one another to explain differences in children's development. The first structured space, the microsystem, describes any space where a person spends a great deal of time. One person can experience many various microsystems, such as home-life, school, and work. The next structured level, called the mesosystem considers how various microsystems may interact for that person. For example, a student may not be able to study as much (related to the microsystem of schooling) because of his or her obligations to work extra shifts to cover a co-worker who recently quit at his or her work site (related to the microsystem of work). There are also other important structures that indirectly affect the student, of which the person may be unaware of how they are affecting his or her development. This system is called the exosystem. The exosystem may have influences on a students' mesosystem, affecting in turn the individual microsystems or their interactions. For example, say a college cannot provide an instructor with professional development, and while students be aware of the importance of a professional development program for their instructors, whether their instructor has attended a program or not indirectly influences what the students experience in the classroom. Finally, all of these systems are influenced by the macrosystem, representing cultural and social structures influencing all of the structures and systems in which a person lives. For example, in the United States, individuals are expected to work, pay bills and taxes, and contribute as members of society. Because our society favors capitalism, in order to have a good paying job and to succeed, having an education is important.

Building from the perspectives of the students, I found three different types of students, considering the types of capital that students demonstrated and leveraged throughout the course. The first type of student described experiences in the course that presented narrow aspirational capital, but high social and navigational capital. These students appeared unafraid to push Beatrice for changes to their instructional experiences by asking questions, reaching out to her, or explicitly requesting changes to the classroom expectations. This type of student appeared to move back and forth between microsystems, resulting in a mesosystem that worked well for them. For example, these students were able to balance the requirements from the MATH 5 classroom while also maintaining work- and home-life in a way that was harmonious for them. The second type of student demonstrated broader aspirational capital, but narrow social and navigational capital. These students overcame many obstacles to arrive at the college and pursue higher education and continued to set high goals for themselves. However, these students did not have the same supports and knowledge of the system as those students in the first group. These students' instructional experiences projected an alignment with the in-class structures that Beatrice established, and felt that they had sufficiently participated in instruction to support their learning, presenting as a narrow application of navigational capital. These students' struggled to maintain the various demands from each microsystem, resulting in a mesosystem in which the students could not find the same stability as the students in the previous group. For example, work and home obligations took up much of their time, which affected how much they were able to engage in the classroom. For this group of students, it may be that having less social and navigational capital may have affected their experience within the schooling microsystem, which made the home and work microsystems easier to navigate. For example, when a student that has been working at their job for a longer period of time than attending CWC faces challenges in understanding how to navigate their schooling, the student may prefer to spend their energy and time on their work because it is something that is more familiar to them and makes them feel more competent; the student may be less willing to be vulnerable in the less familiar space. Finally, the students in the last group demonstrated variance among the three capitals and did not align, which resulted in different overall experiences in schooling. While demonstrating variations in aspirational capital, these students appeared to have broad navigational capital with low to medium social capital. However, this group demonstrated variance in their overall course outcomes, with the students with high aspirational capital passing the course and students with low aspirational capital failing it. The students in this group, who were able to create a balance within their mesosystem and across their microsystems, were able to pass the course while others did not.

The students' instructional experiences took place in a course at CWC. There were specific structures of the college (exosystem) that indirectly affected the students' mesosystems. Students with high navigational and social capital were able to navigate these implicit structures. I will describe two exosystems that influenced students' instructional experiences. The first structure relates to the supports and opportunities available for Beatrice at CWC as an adjunct faculty member. The second structure includes features of the developmental course MATH 5 at CWC.

Being a community college adjunct faculty had indirect effects on the students in Beatrice's MATH 5. First, though Beatrice was provided a shared office that was available for over 50 other adjunct faculty, she did not have a separated space that she could call her own. Because this shared office offered desk space for around seven instructors, there might not have always been available space for an adjunct faculty member so the department did not require adjunct faculty to hold office hours. Thus, she was not obligated to spend additional, unpaid, time in the mathematics department, to meet with students privately or to meet with other MATH 5 instructors, or to get to know other faculty in the department. Second, as an adjunct faculty, Beatrice could not select her schedule because only full-time faculty are given first priority to select their schedules. Being an adjunct, Beatrice had to accept the only class the college offered her because she needed the job, which as an early hour class. This was her least preferred time because she said she was not as focused early in the morning, which resulted in mistakes, which in turn, affected the students.

Third, Beatrice was unable to attend as many professional development offerings as the full-time faculty in the department. Teaching developmental mathematics requires sensitivity towards students including various teaching strategies to help teach students content that they may have seen before. CWC offered professional development that provided strategies and teaching practices that were efficient for teaching such courses, however, not always at times that all adjunct faculty were available. Therefore, the students in Beatrice's math class were indirectly affected because she was unable to receive the professional development she needed as a new instructor and that could have supported her in making instructional decisions appropriate for the students she was teaching at CWC.

Fourth, her schedule was so packed, teaching at three different colleges, that she had limited time to sufficiently grade all of the assignments from the four courses she was teaching. The students in the more advanced courses demanded more of her attention and expected to receive their exam results quickly. Because the students in her MATH 5 did not push her for their results, she tended to grade the exams from her other courses first. To help ease the burden of grading, she also began to grade students' quizzes for completion, rather than accuracy. Many students did not notice that they may have had incorrect work on their quizzes, and genuinely thought that the increase in quiz scores indicated that they had improved in their math skills. Therefore, the lack of time Beatrice had to spend providing adequate feedback to the students in her class indirectly affected the students' perceptions of their learning.

The department had specific structures in place that affected the MATH 5 course, and indirectly the students within any given section. First, the course outline contained many topics to teach within the 16-week semester. Beatrice said that because of all the material she was required to teach she had to move through the topics at a fast pace, covering multiple sections a day and without going deeply into any one topic. The fast pace affected the students' instructional experiences because Beatrice was felt obligated to teach in more of a procedural way in order to cover all of the topics rather than spending more time developing students' conceptual understanding on a fewer set of topics.

Second, MATH 5 was the final course in the developmental mathematics series. Many of the students in the course were being held back from pursuing degrees that did not require a lot of mathematics (e.g., psychology, nursing) due to the requirement to complete remediation. Most of the students in this study struggled to understand the relevance of the content they learned in the second half of the course and their future career and educational goals. Students were required to take intermediate algebra in order to be "prepared" for college level mathematics. The content in intermediate algebra was useful for students who took college algebra as their subsequent course. However, many students' degree plans were not STEM-intending, and instead many students needed to take statistics, not college algebra. Given their goals, they did not need to be exposed to these topics.

Third, even though the course had multiple sections, it was not coordinated. When courses are coordinated there is some consistency across the sections, in terms of schedule, activities, or exams. While coordinated courses sometimes remove certain decisions from the instructors, it may assist the instructor with many of the stresses of teaching, one of which can be creating quizzes or exams. Coordination can also support instructors by providing opportunities to engage with other faculty who are teaching that specific course. Because MATH 5 was not a coordinated course at CWC, Beatrice, as a new instructor, was left to plan and teach the course on her own.

Fourth, full-time faculty can select their schedules, and because limited numbers of sections of higher-level courses are offered, many full-time faculty choose to teach those courses, leaving many of the developmental classes for adjunct instructors to teach. While

Beatrice was offered intermediate algebra at CWC, she was offered two Calculus 2 courses at other campuses. Teaching these courses had greater value to Beatrice. First, she did not have previous opportunities to teach Calculus 2, and therefore spent more time preparing for those classes and less time preparing for MATH 5 because she felt more confident with teaching intermediate algebra. Similarly, Beatrice wanted to be recognized for teaching higher level mathematics courses because this would help her to secure a full-time position in the future, as many colleges expect adjunct faculty who apply for full-time positions to demonstrate a diverse teaching record, including the ability to teach the high-level courses. Given this, Beatrice did not spend as much time preparing for her intermediate algebra course, which may have affected the daily teaching, and in turn the students' instructional experiences.

The students' mesosystems existed within these exosystems and had silent effects on the students in the course. Some students struggled to understand material that appeared new to them, feeling more confident with the content presented towards the start of the semester. This was an indirect impact of the exosystem regarding the content requirements for MATH 5, which indirectly affected some of the students' instructional experiences related to the content. Other students felt that the course moved too quickly for their learning, affecting their instructional experiences in the classroom. Again, this was an indirect effect of the required material that Beatrice needed to teach. Some students felt that the amount of lecture in the course took away from their opportunities to learn. Other students wanted more time spent working on structured group activities, which would give them more interaction with peers.

The students who demonstrated broader navigational and social capital appeared to be able to address their needs while also balancing their other obligations at home, work, church, and in other places. The students who did not describe the same level of navigational and social capital knew that they needed more than was available during instruction, however, given the structures from the exosystems in which they were situated, appeared to need to have some sort of navigational or social capital in order to succeed. The students who demonstrated applications of their navigational capital knew ways to advocate for themselves describing different instructional experiences than their peers. For example, some students knew how to interact with Beatrice to maximize the short amounts of time they had with her. They were able to recognize when they needed more support or help with specific content, and would work on additional problems during the lecture or would reach out to peers for help. All of the students who demonstrated having broader navigational capital had taken math courses previously at CWC or had social capital that directly influenced their navigational capital (e.g., a student had a mentor who attended CWC, and therefore helped them to understand how to navigate the system). Students with narrower navigational capital did not as often advocate for their needs, and this is perhaps because they were unaware that they needed to do *more* than what was expected to succeed or because they did not know specifically what their needs were and thus did not know how to get support.

The students with narrower navigational capital oftentimes demonstrated broader aspirational capital than their peers. An example of this is that for those students who did not have the navigational capital needed to succeed within the unjust structures of the schooling system, they were not defeated and demonstrated a determination to try again until they found success (e.g., take the course again). However, aspirational capital alone is not enough to guarantee students' success. It appears that students who *know* how to navigate the complicated system of schooling are those who appear to succeed. All of the students who did well in the course had spent at least one semester at the college previously. This implies that a student must spend time to adjust to being a college student in order to begin to show progress. Students should not have to spend time or money to learn how to play the game of school. If having broader social and navigational capital is the key to student success in this course, then the institution needs to supply this knowledge to students as they start, rather than forcing them to learn through their experiences at the college alone. Currently, for students who come from environments where social and navigational capital is not as accessible, the only way to gain such capital is by repeating the course.

Chapter 10

Conclusion and Implications

Given the high numbers of Latinx students that do not successfully complete a college level mathematics course in community colleges, something needs to be done to understand how to make changes that effectively address student success. This study demonstrated that while students may be in the same classroom, they describe different instructional experiences, even when lecture is the predominant mode of instruction. In particular, the Latinx students in this study described their understanding of what it meant to be a student in Beatrice's MATH 5 class through their instructional experiences. In the Chapter 9, I described how specific structures from the department, which directly influenced the instructor and the content in MATH 5, might have also had an indirect influence on students' instructional experiences. I conclude this dissertation with suggestions for the students, Beatrice, and the mathematics department at CWC.

The students in this study demonstrated varying understandings of what it meant to be a student at CWC and what agency they had to make the experience their own. I offer suggestions to the entire group of students in Beatrice's MATH 5 course. First, their success in the course is not purely the students' responsibility; that is, success is not only about how hard a student "tries" or not. All students in this study came into the classroom with high hopes of success and future aspirations. All students in this study came into the classroom and did what was expected of them during instruction. The structural constraints placed on both the students and instructor from the exosystems in place made it so that only the students who knew how to handle those constraints were able to succeed and earn a passing grade in the course. Second, mathematics learning is a social endeavor and should be engaging. Many of the students in this study recognized that watching someone else work through the mathematics was not enabling them to learn and be competent executing the taught skills and procedures. Students recognized that working with peers on problems and discussing ideas about how to approach the work would help. This has been advocated in the current instructional and curricular guide for mathematics teaching at two-year colleges: the learner needs to become more engaged with the mathematics (AMATYC, 2018). Third, it appears that having social and navigational capital provided students with the ability to succeed in such courses. For those students who did not have the opportunities to develop such capital, being a student simply was not enough. Students could support one another by sharing information that they have brought with them to help guide their college experience, though the college could do more to provide such information for students by interweaving such information into the classroom. However, having broader social and navigational capital was only helpful to get those students through the course, and in the end, not many students had a solid knowledge of the mathematical material presented. That is, for those students who passed the course, their mathematical proficiency was not much more sophisticated than those students who did not pass the course, as in the case of Adriana.

The students' instructional experiences of also provided important information for faculty. First, students were able to point out instructional experiences that were positive and supported their learning and also those that did not. Some students may want to see changes made in the classroom, but may not be aware of how to go about making a change. Faculty should be more explicit about notions of schooling that have become second nature due to the amount time they have spent in the field. All students benefit from the attention of a faculty member (Wood, Harris, & White, 2015), but some students may not know how to initiate that engagement. This study showed that having a caring and concerned instructor could make students' instructional experiences more meaningful.

Second, as has been noted in many studies (Cobb, Gresalfi, & Hodge, 2009; Cox, 2015; Cox & Dougherty, 2018), classroom instruction can easily fall into presenting mathematics as a series of unconnected mathematics topics given to the students that focus on procedural understanding. Students should have more opportunities to develop conceptual agency (Cobb, Gresalfi, & Hodge, 2009), in which they can use reasoning to determine when and where to apply specific procedures, be part of the creation of the mathematical dialogue, and have more agency overall in their mathematical learning. The findings from this dissertation show that most students viewed mathematics as disjointed and as a set of rules to apply to specific problem types and thus, it is important for instructors to recognize the opportunities that students have to engage with the content, which affects how students come to understand mathematics. Even in courses such as intermediate algebra, where often instructors are left with the pressure to get through a lot of content, it is important to let students have the opportunities to engage with the mathematics more meaningfully. In this study, Beatrice covered a lot of material, however there was no connection across the content. Students in the end knew a little about a lot of topics, rather than knowing really well a few key components. Faculty should consider varying the modes of instruction to engage students in the creation and discussion of the mathematics. While lecture is many times inevitable, keeping in mind that alternate modes of instruction may keep students more focused and engaged is useful. Students in this study wanted more opportunities for individual student work as well as student presentations as it put them in the position to lead the discussion. Further, many students may ask faculty to correct their work (e.g. "Am I doing this right?"), however, correcting their work promotes a reliance on the instructor and does not build the students' reasoning and sense-making within their own work. Students should begin to see themselves and their peers as intellectual resources (Forman, 1996). Third, students want interaction with their peers, but due to social norms or being a new student in a new institution, it may be difficult to reach out to others. Creating activities that require students to work together in the first few weeks of the class may help students to feel more comfortable working with their peers. Students in this study felt that had Beatrice structured more group activities, they would have felt more connected to their peers.

This study has made clear that there were many environmental factors that trickled down from the department level that affected the way that instruction was enacted in the classroom. First, as an instructor, it is important to be aware of what resources are available and how to implement them efficiently. Students learn to use resources through modeling and opportunity (Moyer, 2001), which means that faculty may need to model this for students. Therefore, it is important to provide support for instructors teaching community college mathematics to learn how to utilize and capitalize on resources, as there are resources that are not always used yet are readily available.

This study demonstrated that faculty might need guidance to develop three important aspects of teaching. First, faculty may need guidance with supporting more student involvement during instruction to increase mathematical learning (AMATYC, 2018). The main mode of instruction in Beatrice's MATH 5 was lecture, and when students had the opportunity to work directly with the mathematics, they mimicked what they saw in the lecture. It has been acknowledged that moving away from a lecture based approach is challenging for some instructors, and learning how to promote meaningful classroom discussions or allowing students to develop their thinking around mathematics can be difficult (Speer & Wagner, 2009).

However, it is not impossible. With focused support and guidance, faculty can begin to increase their understanding of how to best implement such practices. Second, mathematics faculty also may need support to develop meaningful connections both within content and across content within developmental mathematics as well as to develop an understanding of the importance of the mathematics in the curriculum for student learning. Students in this study often commented on not understanding the purpose or utility of the mathematics they were learning, and wanted to know how and why what they were learning was important for their future. Students did not see the mathematics they were learning as a connected field or a topic of importance, and instead described it as a set of disjointed topics, which may have been due to the way that Beatrice presented the topics. Perhaps by shortening the list of topics that students are exposed to in intermediate algebra, more space can be given to forge mathematical connections across topics. Alternatively, in 2017, the California Community College Chancellor's office stated that students enrolled in programs or degrees that did not heavily require mathematics would not longer be required to take intermediate algebra. This is an important shift in order to help students shorten the requirements to succeed and their time to degree completion for two reasons. First, many students who place into developmental mathematics struggle to successfully pass intermediate algebra specifically and often drop out before reaching college level mathematics. Second, students who do not pass intermediate algebra the first time may take the course up to three times, which adds time to degree completion (Melguizo et al., 2014). However, the remaining developmental courses that students may place into should be reviewed to consider whether or not the required content is absolutely necessary for the students' academic goals. Finally, this study pointed out that students valued having an instructor that showed concern and care for them. Students felt that Beatrice demonstrated this throughout the semester.

For some students, this was the first time they experienced an instructor like that. Building up positive relational practices within the classroom is extremely important to ensuring that students feel valued and that they are seen as important members of the mathematics community (Wood, Harris III, & White, 2015). Providing faculty with professional development to ensure that students not only feel but believe that they are welcome in the classroom, validating the students, empowering students to engage in their learning, as well as helping faculty understand their implicit biases and how microagressions affect their instructional practices would help both faculty and students to foster a positive and caring learning environment.

The mathematics department could also re-evaluate who is assigned to teach developmental mathematics. While the department may have intentions to give the best possible experience to their students, adjunct faculty cannot choose the hour of the day that they teach or the level of the course. Balancing the teaching of all the courses across full-time and part-time faculty may give part-time faculty more opportunities to teach higher level courses and likewise for full-time faculty to be expected to teach more developmental mathematics courses. Because full-time faculty can select their teaching schedules, some may choose to *not* teach developmental mathematics. Full-time faculty may have more experience than some of the novice adjunct faculty, and may therefore have more training with classroom instructional strategies. By adjusting the proportions of faculty who teach the various courses, it would ensure that faculty who have the most teaching experience and also possibly more professional development are in the courses where students have the most need.

The mathematics department may consider ways to build community within the teaching force. A shared office was insufficient for Beatrice to discuss teaching with other faculty. Though she did have a group of colleagues she met from across all campuses, ensuring that adjunct faculty have the opportunity to build relationships and make connections with their colleagues may be beneficial to help them support their teaching (Gerhard & Burn, 2014). Teaching is a social practice, and working in isolation can be disheartening. Beatrice demonstrated in this study that she did not have a "home" at any of her institutions because she was adjunct at all campuses. Therefore, finding ways to include adjunct faculty in the department community will not only boost morale of the adjunct instructors, but it can possibly support collaboration among faculty.

The mathematics department should also be aware of the complicated and complex lives that all students bring to the classroom. While Beatrice appeared to be aware of the obstacles students face in their other microsystems, she was not sure how to always handle these complicated situations. The math department could help to address the difficulties that many community college students face while a student. For example, the department could create spaces within the department so that students can come together and socialize outside of the classroom, which have been found to support community college students (Bressoud, Mesa, & Rasmussen, 2015). Alternatively, because students in the dissertation described not spending much time on campus outside of class sessions, the department could incorporate some sort of informational session within the course outline. This informational session could address and acknowledge the many realities and struggles that other students have faced and how they were able to navigate through their school experience. This could be one way to provide all students in the course access to the social and navigational capital needed for success.

Research within the mathematics classroom is under-studied, yet this study showed that the classroom held a plethora of valuable insight on the student experience at community college. While I had a good idea of how students discussed mathematics, one limitation to this study was that I was unable to gain a clear view of the way that students processed and considered the mathematical problems that they were required to demonstrate knowledge of. Future work could make stronger connections to the way that the mathematics is delivered during instruction to how students reason and work through similar problems as well as novel problems. Other work can compare sections of the same course at one institution to demonstrate how the in-class experiences of students vary, which contributes to the success of some students and not to others.

This study took place in a face-to-face classroom setting. Because many developmental mathematics courses have been offered in alternative delivery methods, it would be worthwhile to investigate how those delivery methods support student learning differently than face-to-face instruction. Similarly, new curricular models imply utilizing different resources (e.g., technology, updated curriculum) as a way to better support student learning. It would be worthwhile to understand whether and how the environmental factors identified in this study equally influence instruction in alternative delivery methods and whether and how students see the impact of those factors on their success.

I chose to follow a part-time instructor because adjunct faculty are normally set to teach developmental mathematics courses. Beatrice was able to demonstrate a care and nurturing that other faculty had not shown students. This is extremely important, especially for many students who have felt disenfranchised through their prior educational experiences. Teaching developmental mathematics courses is hard, and not enough credit is given to faculty who teach those classes. As a novice instructor, Beatrice did the best that she could given her circumstances. Considering ways to support part-time faculty (and all faculty) as they navigate teaching at a community college will directly impact the students that they work with every day.

As an instructor, Beatrice represents a good example of how to build up her strengths as an instructor. She had a high capacity to understand mathematics, a nurturing outlook, interest in seeing their students to succeed, and willingness and interest in improving her practice.

Appendix A: Student Recruitment Questionnaire

Full Name: ____Age: ______________________

Best form of contact:

Email: ____

Text: ____

Call: ____

1. Are you a first generation college student? Yes No
2. Gender (list all that apply): __________________________
3. Race: __________________________ Ethnicity: ___________________________
4. In what country were you born? ____
5. If you were born somewhere besides the United States, how old were you when you began living in the U.S.? ____
6. Nationality of your mother: ____
7. Nationality of your father: ____
8. What language(s), if any, do you speak besides English? _____________________________
   In what language(s) do you usually speak? ____
   In what language(s) do you usually speak about math? ______________________________
9. Are you a primary caregiver for any children or other family members? Yes No

   If yes, how many? _____________
10. Circle all of the courses that you took in high school:
    a. Algebra
    b. Geometry
    c. Algebra II
    d. Trigonometry
    e. Calculus
    f. Statistics
    g. Other _________

11. What average grade did you earn in math? A B C D F

12. What is your current GPA at CWC? ____________________________

13. Student Status: Part-time Full-time

14. During the semester, how many hours do you typically work at a job per week? (circle one)

0 hours/Not employed 1-10 11-20 21-30 31-40 Over 40 hours

15. What are your educational goals? (check all that apply)
    - ☐ Obtain a GED.
    - ☐ Obtain an Associate's/two-year degree.
    - ☐ Transfer to a four-year college/university.
    - ☐ Technical certificate.
    - ☐ Career change.
    - ☐ Personal enrichment.

16. How would you describe your relationship with mathematics?

Appendix B: Student Observation Survey Questions

If the student was present:

1. My experience in class today was (rate out of five stars)
2. Why did you give this rating above?
3. What would have made today's class better?
4. From what you remember, what was the math topic of today's class?
5. Do you think the math you learned in today's class is useful for your future? Please explain why or why not.
6. What was one topic or problem that you felt you understood well?
   You may write an explicit problem, if you remember it. Feel free to use your notes.
7. What was one topic or problem that you felt uncomfortable with, or did not understand? Why did you feel uncomfortable with it?

   You may write an explicit problem, if you remember it. Feel free to use your notes.
8. Please select ALL of the different ways you participated in class today.
   a. I raised my hand to ask a question
   b. I was called on by the instructor to give a response
   c. I voluntarily presented material at the board
   d. I was forced to present material at the board
   e. I worked with the person next to me on an example
   f. I provided a response in the lecture when the instructor asked the large group
   g. I corrected the instructor
   h. I helped a classmate
   i. I asked a classmate for help
   j. I asked the instructor for help
   k. I asked the class tutor for help
   l. I took notes of what the instructor wrote for the notes
   m. I took notes of what I heard the instructor saying in class
   n. Other
   o. I did not do any of these today

9. Please elaborate on the ways you participated in class today:
10. Describe all of the people you interacted with in class today.
11. Personally, what did you do for most of the class today?
12. Did you feel like a valued member of the Math 130 mathematics classroom community today?

    Why or why not?
13. Describe a moment in class that went really well. Describe why it went well.

    Note: If you reference a problem in this box, please be detailed with the problem. E.g., Please don't say "When I did that problem". Say instead, "When I did example 2 in the notes, because I was able to complete the problem on my own without help and got the correct answer."
14. Describe a moment in class that did not go well. Describe why it did not go well.

    Note: If you reference a problem in this box, please be detailed with the problem. E.g., Please don't say "When I did that problem". Say instead, "When I did example 2 in the notes, because I had no idea what I was supposed to do and I did not receive any help from my partner."
15. Describe a moment in class that was challenging. Describe why it was challenging.

    Note: If you reference a problem in this box, please be detailed with the problem. E.g., Please don't say "When I did that problem". Say instead, "When I did example 3 in the notes, because I had no idea what I was supposed to do but in the end I asked the in class tutor for help and he and I worked through it."
16. What else stuck out to you from today's class? Explain.

If the student was not present:

1. Describe the circumstances that did not allow you to attend class today.
2. What are your plans to catch up on the content of today's missed class?
3. Who are the people you may contact to know more about today's missed class?
4. Is there anything else you would like to share with me?

Appendix C: Student Interview 1 Questions

Section 1: Personal History

Tell me a little bit about your past…

1. Where did you grow up?
   What was it like growing up in your neighborhood and in your community?
   Where else have you lived?
   What is your current living situation?
2. Do you work while you go to school?
   What is your primary source of income?
   Would you consider yourself upper class, middle class, or lower class?
3. Describe your family. Where were your parents born?
   What are your parents' educational levels?
   What are your parents' occupations?
   How many siblings do you have?
   What are the education levels and occupations of your siblings?
4. How would you describe yourself as a person? Why?
   How do other people describe you?
5. Do you have any strong political views that you would like to share?
6. Can you describe what your ethnicity/race/gender means to you?
   Are there any cultural practices that were important to you growing up or are important to you now that you would like to share?
7. How have you been treated in society up to this point in your life?
   Has life been fair or tough so far? Why?
   What is your outlook for the future?
   What are your personal and family goals?
   What are you doing to achieve these goals?

Section 2: Academic History in Mathematics

8. Where have you previously gone to school?
   What types of schools were they?
   Would you describe them as good schools?
9. What positive or negative experiences stand out to you from high school?
10. Describe yourself as a student in high school?
    What pushed you to do well academically? Who, if anyone, encouraged you? Who was your favorite teacher?
    What discouraged you from doing well academically? Who, if anyone, discouraged you?

11. Please describe your mathematical experiences during high school (or previous to starting at the CC):
    a. Describe yourself as a math student in high school.
    b. Describe how others (peers, teachers, family, etc.) viewed you as a math student.
    c. What pushed you to do well in mathematics? Who, if anyone, encouraged you?
    d. What discouraged you from doing well in mathematics? Who, if anyone, discouraged you?
    e. What was your favorite mathematics course? Why?
    f. What was the most challenging mathematics course? Why?
    g. How did students separate into math courses into high school? Who was in the higher level math courses?
    h. What were your relationships like with your mathematics teachers in high school?
    i. What sorts of things did your teachers tell you about your performance in math?
    j. Describe a typical mathematics class that you encountered during high school.
    k. Do you feel that you were treated fairly in your math classes?
    l. Tell me about the grades you typically made in mathematics in school. What are your opinions about those grades?
    m. How did you feel if you didn't understand a concept in your high school mathematics class?
12. Tell me more about how you are as a mathematics student.
    a. What sort of work habits do you have in math?
    b. What were the best ways for you to learn mathematical concepts?

Section 3: Attitudes towards Mathematics

13. What are your feelings towards mathematics?
14. Think of someone who is very successful at math. Describe this person who is very successful at math.
    a. Do you feel you are successful at mathematics? Explain.
15. How would you define someone who has high ability in mathematics? What does it mean to have a low ability in mathematics?
16. If you were asked to rate your ability in math on a scale of 1 (lowest) and 10 (highest), where would you be? Why?

Section 4: Educational Values and Goals

17. How was the topic of school discussed in your household growing up?
    a. Probe: What goals did your family have for you and your siblings?
18. How important is an education to you?

19. How important is mathematics for your life/career goals?
20. What type of degree do aim to achieve?
    a. Probe: What is the highest level degree you wish to achieve? In what area?
21. Where do you see yourself in three years?
    a. What type of work do you envision doing?

Appendix D: Student Interview 2 Questions

<u>Perception of MATH 5 Instruction</u>

1. Describe what a typical MATH 5 class is like.
   a. Do you use the printed notes the teacher offers? Why/why not?
2. How would you describe the teaching that takes place in MATH 5?
   a. Probe: If you could change how mathematics is taught in MATH 5 what would you change and why?
3. You indicated previously that the best way for you to learn math is by ________. In which ways is this class is meeting your learning needs?
4. I notice in your class that your instructor asks students to present solutions at the board. At this point in the semester, have you presented your work at the board? Why do you choose to present/not present solutions on the board?
5. In your surveys you mentioned ________ as a time that went well in one of your class meetings. Can you recount that experience for me?
6. In your surveys you mentioned _________ as a time that did not go very well in one of your class meetings. Can you recount that experience for me?
7. How would you feel if all math courses at CWC were like this MATH 5 class?
8. How are you doing so far in the class?
   a. Probe: How do you know? How do you feel about that?

<u>ALEKS Homework and Tutoring Center:</u>

9. How has meeting in the computer lab changed the classroom learning environment?
   a. Probe: What are your thoughts on the ALEKS system?

<u>Mathematics Learning Community</u>

10. Some people would say that the classroom is its own little community. How would you describe the MATH 5 classroom community to another person?
11. How would you describe your role in the MATH 5 classroom community?
    a. Do you feel like you fit into this community? Why/why not?
    b. In the surveys I use the term “valued member”. What does “valued member” mean to you?
12. How has your participation in MATH 5 changed since the beginning of the term?

   a. At this point in the semester, do you feel more comfortable, less comfortable, or the same about participating in the MATH 5 classroom than you did in the beginning of the semester? Why?
   b. Probe with methods of participating that they mentioned in their journals.

13. You mentioned from your survey last week that you normally work with ________ in class. Describe how your interactions with your peers in MATH 5 affect your mathematics learning.
    a. Probe: How would you compare your math ability to the person you tend to work with?
14. What do you think your instructor thinks of you as a math student?
15. Describe how your interactions with your instructor in MATH 5 affects your mathematics learning
16. Describe how your interactions with your peers affect your mathematics learning

Appendix E: Student Interview 3 Questions

Section 1: Overall Course Experience

1. How do you feel now that the semester is over?
2. What was your attendance like overall throughout the semester?
    a. What were reasons as to why you could not attend class?

Section 2: The MATH 5 class

3. Since the last interview, did you change any of your habits in the classroom?
    a. Probe: In the last interview, you mentioned that some things that you were going to do to increase your success in the class were to: *list items*
4. During the middle of the term, the teacher talked a bit about changing some of the ways she would grade items or that she would provide other opportunities. Can you talk a bit about what she did to make changes, and what you did in response to that?
5. In your surveys you mentioned ________ as a time that went well in one of your class meetings. Can you recount that experience for me?
6. In your surveys you mentioned _________ as a time that did not go very well in one of your class meetings. Can you recount that experience for me?
7. On your final survey, you described this class in one word as ________. Why did you choose that word?
8. You rated the class ____ out of five stars for your overall class experience. You described _____ as the reason why. Can you elaborate more on that?

Section 3: Classroom Community

9. In the surveys, when I asked you if you felt like a valued member, you said YES/NO and discussed the community as _____________. Can you talk a little bit more about that? What suggestions do you have to make the math classroom more of a community?

Section 4: Mathematics

10. How would you describe mathematics?
    a. How do you describe doing mathematics?
11. How do you know if you understand a mathematical topic?
12. Do you feel the tests/quizzes you have taken in this class accurately demonstrate your mathematical understanding?

13. If you were asked to rate your ability in math on a scale of 1 (lowest) and 10 (highest), where would you be? Why?
14. Last time we interviewed, you had estimated your grade to be _____ when at the time it was ______. Why do you think your thoughts on your grade differed from the actual course grade?

Section 5: View of yourself as a math student

15. Has your overall view of yourself as a math student changed or been affected by your participation in MATH 5?
16. Have your feelings about the importance of math changed or been affected as a result of your experiences in MATH 5?
17. Can you talk more about how your motivation to learn math has changed or been affected by your participation in MATH 5?
18. How have your experiences in MATH 5 affected your academic goals?
    a. Probe: change of major, class decisions?

Section 6: Co-construction of Mathematics Identities and Other Identities including Racial, Cultural, Ethnic, and Gender Identities

19. In one of the surveys I asked you to narrate for me the typical storyline about Latinx student success in math. You said:
    a. *Insert what they say about Latinxs*
    b. Was there anything you'd like to add to this?
20. Do you see everyone as being equal in the class? How would you define equal in this case?
21. Did you ever feel like you were a minority student in MATH 5?
22. Do you think there are factors that prevent or discourage Latinos from going in to mathematics, doing well, and sticking to it? What are those factors?
23. Do you think society sends a different message to certain ethnic groups vs. others about their ability to participate in math? If so, how is this message different for other groups?

Overall, what did you get out of the MATH 5 experience? How and in what ways does it benefit you?

Appendix F: List of Problems Beatrice Demonstrated to Students During Focal Observations

Observation & Topics	Total Problems in Notes/# of Problems Demonstrated	Demonstrated Problems
Observation 2 • Defining the Absolute Value • Solving Absolute Value Equations • Solving Absolute Value Inequalities	16/6	Solve the absolute value equations. $\|y\| = 8$ $\|w\| + 7 = 10$ $\|x\| = -1$ Solve the equations $\|4x + 1\| = 9$ $\|3 - 2x\| = \|3x - 1\|$ Solve and write the solution in interval notation $\|2t + 5\| + 2 \leq 11$
Observation 5 • Factoring Polynomials o Grouping Method o AC Method o Trial and Error Method o Difference of Squares o Perfect Square Trinomial o Identifying conjugates o Factoring by Substitution o Difference & Sum of Cubes	58/16	Factor using AC Method $10x^2 + x - 3$ Factor using Trial and Error Method $2x^2 + 7x + 6$ $4t^2 + 5t - 6$ Factor Completely $n^2 + 4n - 12$ No directions $x^2 + 1$ No directions $9x^2 - 25$ No directions $(2x + 7)^2$ No directions $x^2 + 14x + 49$ Factor by Substitution $(3x + 1)^2 + 2(3x + 1) - 15$

Observation & Topics	Total Problems in Notes/# of Problems Demonstrated	Demonstrated Problems
		Identify the conjugate of each binomial $(w+8)$ $(3t-9)$ $(7y+6m)$ Multiply $(2x-y)(2x+y)$ Factor b^4-16 $125p^3-8$ h^6-k^6
Observation 8 • Solving Radical Equations • Defining Imaginary and Complex Numbers • Adding, Subtracting, and Multiplying Complex Numbers	26/13	Solve $\sqrt{a}=8$ $\sqrt{x-6}-3=0$ $\sqrt[3]{x}+11=8$ $\sqrt{4x^2+5}=2\sqrt{x^2+x-3}$ $\sqrt{3x+1}-\sqrt{2x-1}=1$ $\sqrt{x}+1=\sqrt{x+1}$ Write each complex number in the form $(a+bi)$ $2-\sqrt{-49}$ $7+\sqrt{-24}$ Add or Subtract $(-4+5i)+(2-4i)$ $(7-\sqrt{-4})-(-1-\sqrt{-16})$ $(8-\sqrt{2})-(5+\sqrt{-15})$ Multiply $(6-2i)(3+i)$ $\frac{1}{2}\left(\frac{1}{3}-18i\right)$ $\sqrt{-25}(-\sqrt{7}+2i)$

Observation & Topics	Total Problems in Notes/# of Problems Demonstrated	Demonstrated Problems
Observation 10 • Composition of a function and its inverse • Exponential Functions • Logarithmic Functions • Properties of Logarithms	37/7	For the pair of inverse functions, show that (a) $(f \circ f^{-1})(x) = x$ and (b) $(f^{-1} \circ f)(x) = x$ $f(x) = 3x \text{ and } f^{-1}(x) = \frac{x}{3}$ $f(x) = \sqrt[3]{x+9} \text{ and } f^{-1}(x) = x^3 - 9$ Approximate the expressions. Round answers to four decimal places. $8^{\sqrt{3}}$ Rewrite each equation in exponential form $\log_3 81 = 4$ Write each equation in exponential form; then find the unknown value $4 = \log_{1/2} x$ Evaluate each expression. $\log_4 16$ Graph $y = \log_3 x$. State the domain and range.

Appendix G: Problems Assigned During Individual Student Work Time

Observation #	% of time spent on Individual Student Work	Problem	Who Presented the Problem
2	22	Solve the compound inequality: $-10t - 8 \geq 12 \text{ } or \text{ } 3t - 6 > 3$	Instructor
		Solve the equations: $3\left\|\frac{3}{2}a + 1\right\| + 2 = 14$	Instructor
		Solve: $\|y\| + 4 = -8$	Student
		Solve: $1 = -4 + \left\|2 - \frac{1}{4}w\right\|$	Student
		Solve: $\left\|\frac{4w - 1}{6}\right\| = \left\|\frac{2w}{3} + \frac{1}{4}\right\|$	Student (Chris)
5	14	Factor: $-16p^3q^2 + 24p^2q^3 - 32\square^4q$	Instructor
		Factor: $105xuv + 60xv - 70xu - 90xv^2$	Instructor
		Factor: $10x^2 + x - 3$	Instructor
		Factor Completely: $2n^2 + 6n - 108$	Student
8	36	No Directions: $(\sqrt[3]{9} + \sqrt[3]{2})(\sqrt[3]{3} + \sqrt[3]{4})$	Instructor

Observation #	% of time spent on Individual Student Work	Problem	Who Presented the Problem
		FOIL: $$\left(1+\sqrt{2x-1}\right)^2$$	Instructor
		No Directions: $$\sqrt{x}+1=\sqrt{x+1}$$	Instructor
10	26	Given $f(x)=x+2$ and $g(x)=x-8$, find: $(f\circ g)(x)$	Instructor
		Given $f(x)=x+2$ and $g(x)=x-8$, find: $(g\circ f)(x)$	Instructor
		Graph the functions *f* and *g* on the same graph. $$f(x)=3^x$$ $$g(x)=\left(\frac{1}{3}\right)^x$$	Instructor
		Rewrite each equation in exponential form $$\log_{14}\frac{1}{196}=-2$$	Instructor
		Rewrite each equation in logarithmic form $$12^2=144$$	Instructor
		Rewrite each equation in logarithmic form $$9^{-2}=\frac{1}{81}$$	Instructor
		Rewrite each equation in exponential form $$\log_u\frac{15}{16}=v$$	Instructor
		Rewrite each equation in logarithmic form $$\left(\frac{1}{5}\right)^x=y$$	Instructor
		Evaluate each expression $$\log_3\frac{1}{243}$$	Instructor

Appendix H: Student Observation Survey Responses: Moments that went Well

Student	Observation 2	Observation 5	Observation 8	Observation 10
Adriana	A moment in class that went well was when she explained why we have to move the sign when is divided by a negative. Or when x<-6 that's a no solution.	A moment that went well in class was when she put the two examples on how to get the two different answers.	The exit problem was good because I was winging it until she came and I asked her if I was doing it right and she said ya and then she explained how I had to move the one so it'll be 0 on other side and then square it to get the radical out.	The moments that went well was the whole class because everyone was understanding the material and if some didn't understand she made it clear for them and told them why was that answer or # there.
Chris	Doing the math problem on the board because I understood everything.	When we went over factoring perfect squares because I was familiar with the topic.	I was able to help out a student on a problem.	The function of functions. I didn't understand it at first but then I looked back at my notes and I was able to do the problem.
Guillermo	During the time in class	In all the problems that were given to us, I completed it and got the correct answer.	The moment that went well in class was when the warm up problems that were giving to us, I knew how to do it.	The entire time in class went really well because I understood all the topics that were given to us.
Layana	Following along with the professor	When I was able to solve problems on my own before the instructor wrote them on the projector	Once she clarified what I was stuck on, everything went smoothly. I was able to complete the problem without further assistance.	The whole section in which we went over logs because I understood all of the sections

Student	Observation 2	Observation 5	Observation 8	Observation 10
			It was the last problem, which I got a 0 and I thought it was wrong but it turns out it was the right answer	
Marisa	When our prof. put the examples on the projector I tried to complete them before the class or she did. I got the answers right.	I felt good when our professor told me I didn't have to do the problem on the board. It let me know she had confidence that I was going to do the problem correctly.	I'd say all the examples went fairly well for me today! I've been working on aleks a lot and its been really building up my confidence with these radicals and complex numbers problems.	When I attempted problem 6 and 7 in 8.4 I got both of them by myself and I got them correct
Nancy	While doing the practice problems is when it went well because I fully understood how to the problems and I felt confident.	What went really for me today was when we were doing problems with the AC method because I really understand it and I feel really comfortable with it.	when we were doing the practice problems it went well because once the instructor got me started I knew what to do with the problems on my own.	When we started to learn about the log formulas because it was very simple and straight forward.
Raquel	When I understood the problem	When I did all the examples provided well such as squared and cubed polynomial.	*Absent*	When we kept simplifying the logs and investing them, and the professor passed by to check my work and she said it was correct.
Santiago	When she made the class laugh.	When I did example 1 because I understood the topic well.	The whole class was significantly great.	*Absent*
Teresa	I was doing a	When I did	A moment that	*Absent*

Student	Observation 2	Observation 5	Observation 8	Observation 10
	problem and when we were going over it I actually got it right and all my steps were the same as the instructors	problem number 4 from sum/diff. of cubes I solved the problem before my instructor and went she went over it my answer was correct	went well for me was when I realized my mistake in number 8 which was the practice problem she gave us	

Appendix I: Student Observation Survey Responses: Moments that did not go Well

Student	Observation 2	Observation 5	Observation 8	Observation 10
Adriana	I don't have nothing in mind.	When we did the last two problems before we left.	Today there wasn't a bad experience just the very long problem I mentioned.	None .
Chris	Doing some of the problems as practice because I was not 100% on them.	Going over trial and error because I was taught a different way and foolishly payed [sic] more attention to my work rather then what the instructor was saying.	Radicals being added because it required a lot of steps and I messed up on some.	Graphing logarithms because I just got confused.
Guillermo	Nothing went bad everything went well	Nothing went bad, everything went well.	The moment that didn't go well was when the problems I knew how to do, did not go well. I tried them but I did not get the correct answer on one of the problems. I won't be able to show the problem because my found does not have the functions to do so.	Everything went really well.
Layana	Adding fractions with out thoroughly explaining	At the end, where she got confused. She confused me	Most of the class I felt didn’t feel was very productive for me. Also I kind of feel like learning about "i: is completely	When it gets a bit frustrating that this won't be showing up in my future

Student	Observation 2	Observation 5	Observation 8	Observation 10
			pointless.	
Marisa	There was not a moment of class that did not go well for me.	I messed up on one of the problems because I wrote down the wrong number. After asking our professor she pointed out my mistake without giving me the answer.	Example 5 in 6.7 really threw me for a loop for a little while there. I was getting frustrated because I wanted to figure out without any help from anyone but I soon realized outside help is always a good thing.	Class wasn't going well in general for me once I realized we were talking about logs.
Nancy	When we had to work with fractions is when I had a hard time because it was a little difficult but I got the hang of it close to the end of class.	What did not go well was the last two problems we did in class because I became lost very quickly and I was really confused.	Starting the problems on my own is when I had trouble I know what to do in the problems but they all seem the same to me I don't know how to start it.	What didn't go well was the warm up problem because it was something I never seen because I wasn't in class Tuesday.
Raquel	When I totally bombed the quiz yesterday	When I didn't get the final answer today for the last problem.	*Absent*	When my partner didn't show up.
Santiago	As soon as class started because I was still sleepy.	At the beginning because I came late to class, but then I caught on with the topic.	There really wasn't a moment like that today.	*Absent*
Teresa	when we began to deal with fractions I started to get confused and compared my notes with my partner but turns out we were both confused	a moment that didn't go so well was when I did examples 5 from the notes and forgot to factor the terms by 2 and my answer was incorrect	Going back to problem number 5 I had difficulties with that problem since I was unsure if we had to foil or distribute	*Absent*

Appendix J: Student Observation Survey Responses: Moments that were Challenging

Student	Observation 2	Observation 5	Observation 8	Observation 10
Adriana	When she let us do the problem with fractions.	I felt the challenging moment in class was when the students went to up there and do all the work by himself but then she turn out helping him.	I think it was the exit example because I was going through my notes and seeing if I was doing right and I was in a way winging it to the pattern I saw on the first problem we did as a class.	I feel the change of log because since the calculator is only to the power of 10 or something like that so you have to change and by changing meaning dividing log.
Chris	Some of the problems because it expanded on what we talked about.	I was a little confused on a certain problem in the beginning because it didn't factor out completely and I wasn't sure if I did something wrong or not.	The warm up because it was something I didn't practice on.	Graphing logarithms. I don't know exactly how to find the points.
Guillermo	The challenging part in class was trying to get the correct answer to a problem.	Nothing was challenging everything was just a refresh of memory.	The challenging part was when there were long problems to solve and I was just feeling lazy.	The challenging part was learning how to show our answers in interval notation or set builder notation and also how to figure out how to graph log problems. I do not have one specific.
Layana	Adding fractions with out thoroughly explaining	Same as above, when the instructor got confused	Focusing for me was hard because I was stuck pretty often on the	None

Student	Observation 2	Observation 5	Observation 8	Observation 10
			problems, so it was hard to move forward if I didn't know what to do	
Marisa	While I think I did well with the fractions today they were still the most challenging bit for me.	Nothing was challenging today.	At the end of class I asked our professor about the properties of I because on aleks they really didn't explain it well and she gave me a post it note with some of the pattern for I. It was not necessarily challenging for me today but I believe ill have some trouble remembering it in the future.	It was challenging in the beginning for me to try to understand what was going on and it didn't help that I was really tired.
Nancy	The fraction problems were challenging because getting rid of fractions is hard for me to understand.	What was challenging was trying to stay focus after I had gotten lost.	Trying to remember what to distribute and what not to was challenging because I would get easily confused.	What was challenging was trying to get notes from Tuesday to catch up and look at what we were learning about today.
Raquel	Hearing out the teacher	All the problems weren't challenging today.	*Absent*	Trying to memorize the domain rules.
Santiago	When I was working on some new problems.	There wasn't really a time where I was challenged.	Nothing wasn't really challenging today.	*Absent*
Teresa	solving the fraction problems were hard but once I saw how one of my peers solved it I knew what I had done wrong and	When I did the instructor was teaching the last topic of the class there were so many steps and I was getting lost with	A moment that was challenging was mostly trying to solve a new problem with the knowledge I had from the previous	*Absent*

Student	Observation 2	Observation 5	Observation 8	Observation 10
	corrected it.	the problem	problems and kind of failing just because of the set up of the problems and how they had to be solved differently	

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